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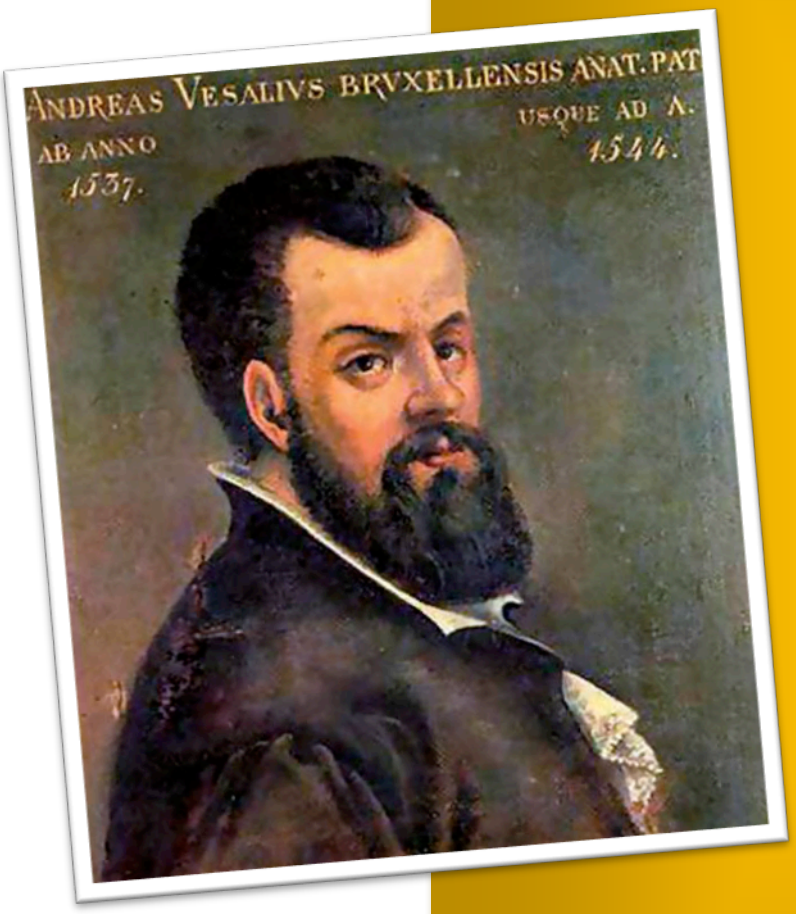
Vesalius

SOCIETAS INTERNATIONALIS HISTORIAE MEDICINAE



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Special issue,
Proceedings of *A Tribute to Andreas Vesalius*
Padua, Italy - December 2015
Guest Editors: Giorgio Zanchin & Robrecht Van Hee

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Cover Page: Portrait of Vesalius by Anonymous, oil on canvas. Courtesy of Padua University

Guest Editorial

Giorgio Zanchin

The international scientific community celebrated the birth (Brussels, 1514) and remembered the death (Zante, 1564) of Andreas Vesalius in 2014 with a series of commemorations.
Vesalius composed his main work, *De Humani Corporis Fabrica* while at the University of Padua establishing a new paradigm of anatomical investigation and setting a milestone in modern medicine. An annotated translation of Andreas Vesalius' *Fabrica*, of both its 1543 and 1555 editions, by Daniel H. Garrison and Malcolm H. Hast, also appeared in 2014 making the difficult Latin texts available in English.
The Executive Committee of the International Society for the History of Medicine, whose official journal bears the evocative headline *Vesalius*, wished to promote these tributes, which were celebrated in such locations as Antwerp, Louvain, Zakynthos, Paris and Tbilisi, where our ISHM Congress took place in 2014, as well as in Padua. Thus, this key figure in the History of Medicine and Science was commemorated in the very same university that witnessed, thanks to his genius, the revolutionary "reform" of human anatomy. A Brabanter, Vesalius graduated under the wings of San Marco's Lion in Padua, the State University of the Serenissima, which he expressly chose for his studies, as can be seen by his own words: ".. *Padua, the world's most famous university… Venetian Senate, whose generosity to the world of scholarship is without equal"*. And it was as professor of the same institution that he established the fundaments of modern anatomy, paving an innovative way to all of the medical knowledge with his *Fabrica,* illustrated by the School of Titian.

Therefore, as ISHM President and Professor in Padua, I was particularly excited and involved organizing in my own University this *Tribute to Andreas Vesalius* as a fitting finale to the commemorations honoring the character who revised the study of anatomy, opening the way for the modern approach to medical investigation. Indeed, we also owe to the Vesalian research and methodology that Padua is internationally recognized as *"the cradle of modern medicine"*.
This event, which took place in the historical Aula Magna on December 3th, 2015, aimed to highlight the international dimension of Vesalius' life and research. It emphasized how his work influenced the future of medicine and involved important international scholars, some of whom had recently published a monography on the subject.

Under the chairmanship of Carlos Viesca and Adrian M. Kynaston Thomas, the first session was opened, with *'A Short Biographical Profile'* by myself, followed by Robrecht Van Hee on *'Vesalius as a Surgeon'*. *'An updated census of the 1st edition (1543) and the 2nd edition (1555) of Vesalius' Fabrica in the United States of America'* was then presented by Stephen N. Joffe. The session was concluded by Carlos Viesca's report on the *'Impact of the De Humani Corporis Fabrica in the New World'*.
Chaired by Robrecht Van Hee and Giorgio Zanchin, the second morning session put a bridge between Vesalius' heritage in the past and in the present, investigating some possible future perspectives of modern neuroimaging, with the presentations *'Vesalius' legacy*. *The "Tabulae pictae" of Fabrici d' Acquapendente (ca 1533–1619)'* by Giorgio Zanchin; '*Vesalius, Röntgen and the Origins of Modern Anatomy'* by Adrian M. Kynaston Thomas. A paper on '*Neuroimaging Five Hundred Years Later'* was presented by Giuseppe Rolma. The afternoon session, chaired by Stephen N. Joffe and Alfredo Musajo Somma, dealt with the romantic, yet scientifically documented, '*Searching for Vesalius'* by Theo Dirix on the lost grave of the Flemish anatomist. There followed a stimulating interpretative hypothesis on his portrait, *Visualizing Vesalius*, by Alfredo Musajo Somma. Finally, Pascale Pollier presented '*Fabrica*, *the art of Vesalius'* displaying the feeling of an artist in front of the anatomical wood engravings of the *Fabrica.*
In my *Closing remarks*, I stressed how the event, thanks to the specific expertise and personal research of the speakers on their topics, gave new, original insight on different aspects of Vesalius's life and legacy. This was a result which could not be obtained easily when talking about such a pivotal character, who had been already studied under many different aspects.

Thus, once more, Andreas Vesalius' own words about his work *"Vivitur ingenio, cetera mortis erunt" (Genius lives on, everything else is mortal)* have been confirmed in honor of its author.

The following day, I enjoyed demonstrating to the guests, through an onsite visit, the most relevant landmarks of medico-historical interest in Padua: the Medical School of the University, the Anatomical Theatre by Fabrici d' Acquapendente; the ancient *Hortus Simplicium* and the modern *Orto Botanico*; the new Museum of History of Medicine, located in the premises of the former *San Francesco Grande*, the oldest hospital in Padua.

The event was well attended by an interested audience, who followed with great interest the presentations, posing many stimulating questions. The convivial part, including the Gala Dinner, took place in the historical, beautiful *Caffè Pedrocchi*.

I thank Robrecht Van Hee, former ISHM Treasurer, for kindly co-editing the papers of this *Tribute*, carefully monitoring the advancement of the project, and Kenneth Collins, Editor of *Vesalius*, for kindly hosting these *Proceedings* and preparing them for publication.

Giorgio Zanchin, MD
President
International Society for the History of Medicine
Professor of Neurology
Padua University Medical School

Foreword

Robrecht Van Hee

This issue of our journal *Vesalius, Acta Internationalia Historiae Medicinae* is for a second time devoted to the name giver of our journal. After the 2014 issue (Vol.XX, no.1), in which life and works of the Flemish anatomist Andries van Wesel were thoroughly discussed, based on the communications of the Zakynthos meeting of September 2014, this 2016 issue is devoted to the influence in medical and artistic thinking, generated by Vesalius up till now. The articles follow the communications made at the December meeting in Padua in 2015. The president of the ISHM Giorgio Zanchin is to be congratulated for the outstanding selection of the themes and for the organization of this meeting.

In this issue the topics will cover different aspects of Vesalius's legacy. In a first part Vesalius' own work and contemporary influence on medical thinking is presented: after a Guest Editorial by Giorgio Zanchin, Vesalius' influence on contemporary surgery is discussed by Bob Van Hee. A study of the *Tabulae pictae* of Fabrici d'Acquapendente is presented by Giorgio Zanchin. The copies of the Fabrica still existing in the USA copies are described by Stephen Joffe and the impact of the Fabrica on medical practice in the New World is treated by Carlos Viesca. In a second part the legacy of Vesalius' anatomic iconography up into the 21st century is covered with Vesalius' visualisation in the Fabrica which is thoroughly analyzed by Alfredo Musajo-Somma, while the evolution of imaging is discussed by Adrian Thomas and Giuseppe Rolma with the radiological advances of the 20th century and the newest techniques of neuroimaging in the 21st century.

Finally, in a third part the search for Vesalius' remains and his artistic representations in past and future form the more existential approach of Vesalius' legacy made by Theo Dirix and Pascale Pollier. On the whole, this issue again testifies to the inexhaustible interest scholars still have for the 'Father of Anatomy'.

Robrecht Van Hee, MD
Professor emeritus of Surgery and Medical History
University of Antwerp

Editor's Note

As Editor of *Vesalius, Journal of the International Society for the History of Medicine*, it gives me great pleasure to welcome this special edition, dedicated to Andreas Vesalius, following a meeting devoted to his works and legacy, held in Padua in December 2015. My work as Editor, has been greatly assisted by Prof. (em.) Robrecht Van Hee who collected all the material, including the many illustrations which add so much to visual appearance of this issue. Finally, my thanks, as always, to Giorgio Zanchin and Alfredo Musajo-Somma, whose continuing support and encouragement, make the work of editor both rewarding and easier.

Dr. Kenneth Collins, Editor

The Influence of Vesalius' *Fabrica* on Surgery in the 16th & 17th century*

Robrecht Van Hee

Abstract

The innovation in anatomy, brought about by Andreas Vesalius[1], particularly by means of his *Fabrica*, has had an important influence on the practice of surgery[2]. Various surgeons of the 16th and the 17th century have implemented different approaches in operative techniques, based on the anatomical knowledge drawn upon the *Fabrica*.

Examples are given in this paper concerning Pierre Franco, Ambroise Paré, Giovanni Andrea della Croce, Girolamo Fabrici d'Acquapendente, Wilhelm Fabry von Hilden and Paul Barbette, who all, in one way or another, have proposed surgical techniques that required precise anatomical understanding, which was provided by the new Vesalian anatomy of the human body.

The concept, adopted by many medico-historical scholars, that the anatomy of Vesalius had only limited repercussions on Modern Surgery, therefore needs reconsideration.

Résumé

La modernisation de l'anatomie, réalisée par André Vésale, en particulier par le biais de sa publication de la '*Fabrica*', a eu une influence importante sur la pratique de la chirurgie. Plusieurs chirurgiens du 16e et 17e siècle ont proposé des approches nouvelles dans leurs techniques opératoires, basées sur une connaissance d'anatomie, puisée dans la '*Fabrica*'.

Dans cet article quelques exemples sont donnés, appartenant à Pierre Franco, Ambroise Paré, Giovanni Andrea della Croce, Girolamo Fabrici d'Acquapendente, Wilhelm Fabry von Hilden et Paul Barbette. Tous ces chirurgiens ont d'une façon ou d'une autre, introduit des techniques chirurgicales, qui exigent une connaissance et compréhension anatomique précise, que leurs avait apporté la nouvelle anatomie Vésalienne du corps humain.

Le concept, présenté par certains historiens de la médecine, comme quoi l'anatomie de Vésale n'aurait eu que peu d'influence sur la chirurgie pendant l'Ancien Régime, devra dès lors être reconsidéré.

Introduction

'*Surgeons who do not know anatomy very often make mistakes, and cut through nerves and ligaments. When one is dealing with a wound, it will be easy to determine*

*Based on communications at the International Vesalius Conference '*Vesalii Continuum*' in Zakynthos on 5-7 September 2014 and the International Symposium '*Vivitur Ingenio*' in Padua on 3- 4 December 2015.

[1]For recent overviews concerning Vesalius, see amongst many others Van Hee 2007 pp.1264-1267, and Van Hee 2014. For a recent English translation of the *Fabrica*, see Garrison & Hast, for a recent French translation of the *Epitome*, see Vons. For a complete bibliography on Vesalius, see Biesbrouck 2016.

[2]For overviews on surgical practice in the 16th century, see Van Hee 2000 and 2002.

through one's knowledge of anatomy, whether a nerve has been cut, or a tendon or even a ligament'.

This Middle Ages citation by Guy de Chauliac (1298-1368) in his '*Chirurgia Magna*' of 1363 highlights the importance of anatomy for surgery which already been recognized from ancient times[3]. Guy's warning was specifically meant in relation to the most important surgical act, namely bloodletting.

In Hippocratic-Galenic humoral philosophy, bloodletting was indeed one of the corner stones of treatment for a great variety of diseases. Two centuries after Guy, Andreas Vesalius still cited regularly the dangers of such bloodletting procedures by inexperienced barber-surgeons. He told the students in Bologna in 1540 that he had seen three such patients, treated by one and the same surgeon, with a total cut of the biceps tendon at the site of bloodletting, preventing the victims from bending their arm[4]. The accidental cutting of the biceps tendon, the median nerve or perforation of the brachial artery was, according to Vesalius, the result of insufficient knowledge of the structures of the human body[5]. The importance of Vesalius' publication of the *Fabrica* for anatomy and medical thinking has extensively been studied in the last decades[6]. However, his influence on surgical 'thinking' and particularly on surgical practice has hitherto been underestimated.

Until the 19th century surgery was confined to external pathology. Only in case of accidental or war conditions did surgeons dare perform intestinal sutures, trephination or other risky operations.

[3]The first printed French edition of Guy's '*Grande Chirurgie'* dates from 1478 and was published in Lyon, together with the original Latin text, by Nicolas Panis. For the translated citation of Guy, see de Moulin p.71.

[4]This is reported in the Bologna notes by the German student Badasar Heseler: '*In interior musculo brachii circa iuncturam internam cubiti ostendebat nobis illum tendinem prope ipsam venam medianam, quam imperiti chirurgi pro ipsa vena sepe scalpello secarent, maxime quando phlebothomen intenderent, sicut germane solent, tuncistos non posse extendere brachium, sicut ego inquit tres ita vidi lesos ab uno chirurgo*.' (Heseler fol.57 vo). 'In the inner muscle of the arm at the inner joint of the elbow he (Vesalius) showed us near the vena mediana the sinew which unskilled surgeons often cut with the scalpel instead of the vein, especially when they do venesection after the German method. These people cannot stretch the arm. I have seen, he said, three persons so damaged by one surgeon' (Translation Eriksson p. 147). See Eriksson pp.146-147.

[5] *'Nam isti tonsores sunt valde imperiti in his, nesciunt situm venarum, neque sciunt ubi eas inscindere debeant: sepe igitur sicut vobis antea dixi inscindunt cordam illam in curvature cubiti, et faciunt quod illi homines non possunt amplius contrahere illum brachium sicut ego vidi.*' (Heseler fol.114 vo -115 ro). 'For these barbers are very unskilled in these matters: they do not know the position of the veins nor do they know where to cut them. As I have told you before, they often therefore cut the tendon of the elbow joint, and then the persons cut no longer bend the arm, as I have seen.' (Translation Eriksson p.253). See Eriksson, pp.252-253.

See also Vesalius in the introduction of the Fabrica*: Dum enim medici solam interiorum affectuum curationem ad se pertinere aut umabant, etiam viscerum cognitionem sibi abunde suffice rearbitrabantur, & ossium, musculorum, nervorum, venarum, arteriarum quae ossa musculosque perreptant fabricam, vel uti adipsos non spectantem, neglexerunt. Ad haecquum universa administratione tonsoribus commitebatur, non solum vera viscerum cognitio medicis periit, verum etiam dissecandi industria intercidit prorsus, eo quod scilicet hi confectionem non aggrederentur, illi vero quibus manus artificium commiteretur, indoctiores essent…'* (Fabrica 1543, p.II vo). 'For as long as physicians maintained that only the treatment of interior diseases was their concern, they believed that knowledge of the viscera was all they needed, and they neglected the fabric of the bones and muscles, and of the nerves, veins and arteries that run throughout the bones and muscles, as if these were irrelevant to them. Moreover, when all operations were entrusted to barbers, not only did true knowledge of the viscera perish in the medical profession, but the work of dissection completely died out.' (Translation Garrison & Hast pp.3-4). See Garrison & Hast, Vol.1, pp.3-4.

[6] See for instance the different chapters in Van Hee 2014. For recent bibliography, see Biesbrouck 2016.

The *Fabrica* for the first time gave adequate insight in the internal structures of the human body, and presented an opportunity for reckless surgeons, who dared to perform lithotomy, inguinal hernia repair, limb amputation or trephination[7].

It therefore is comprehensible that Vesalius' *Fabrica* and particularly its abridged counterpart, the *Epitome*, got translated into vernacular languages in most European countries[8], and was used as a basic science, which would be indispensable for surgeons. The influence that this availability of anatomic texts had on surgical practice is impressive, but it varies according to each particular field of pathology.
It has been argued that the new Vesalian anatomy was only slowly accepted by the surgical community[9]. Notwithstanding the fact that citations of Vesalius in Renaissance surgical texts are limited[10], and his influence therefore proves difficult to evaluate, the 'historical' view of his anatomy being of little direct effect to surgeons should be reconsidered, even challenged.

Pierre Franco

The French surgeon Pierre Franco (1500/05-1578) not only reiterates Guy's and Vesalius's advice to study the anatomy of the human body, but in his '*Traité des Hernies …'* [Fig.1] for the first time thoroughly explains the anatomical details of a particular region of the body, namely the groin[11]:

> '*Before demonstrating the treatment procedures of the different hernia types, we will describe and write about the anatomy of these body parts …*
> *We thus will first treat about anatomy of the Peritoneum, then of the Epiploon or Zirbus, and then of the intestines, since it are the Omentum and the Intestines which cause those hernias, named Enterocele & Epiplocele & Bubonocele: these originate from a dilatation or rupture of the Peritoneum, mainly in the inferior or lower part near the scrotal base, in which location the peritoneum is more tender'* [12].

[7] See de Moulin p.91.
[8] See for instance for Dutch translated editions: Houtzager 2012, pp. 307-311.
[9] See de Moulin p.75.
[10] This holds true as well for his anatomical text books as for his activities as a surgeon. See Van Hee 1996.
[11] See Franco, chapter 2, pp. 3-20. For a history of hernia treatment in the 16th century,see Van Hee 2011.
[12] '*Avant que venir à monstrer la procedure comme fault curer toutes especes d'hernies, nous monstrerons et escrirons l'anatomie des parties… Nous monstrerons donques premierement l'anatomie du Peritoine, & puis de l'Epiploon ou Zirbus, après des Intestins, pource que le Omentum & les Intestins causent ces hernies, assavoir Enterocele & Epiplocebe (sic), & Bubonocele : les quelles adviennent par la dilatation ou ruption dudit Peritoine, principalement en la partie inferieure ou basse aupres du Penil: en la quelle partie il est plus tendre*'. See Franco pp. 3-4.

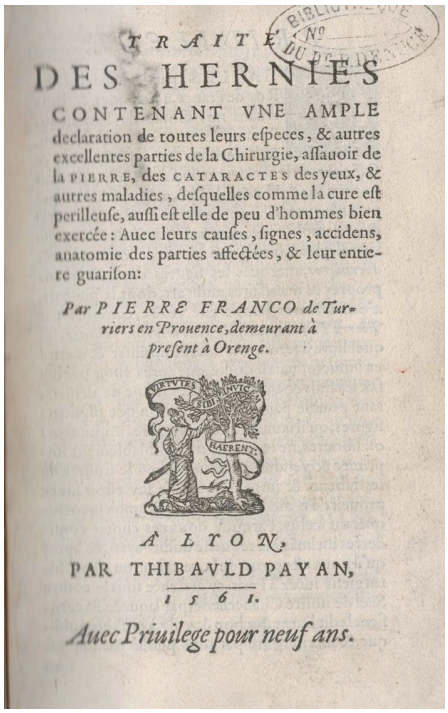
TRAITÉ
DES HERNIES
CONTENANT VNE AMPLE
declaration de toutes leurs eſpeces, & autres
excellentes parties de la Chirurgie, aſſauoir de
la PIERRE, des CATARACTES des yeux, &
autres maladies, deſquelles comme la cure eſt
perilleuſe, auſſi eſt elle de peu d'hommes bien
exercée: Auec leurs cauſes, ſignes, accidens,
anatomie des parties affectées, & leur entiere guariſon:
Par PIERRE FRANCO de Turriers en Prouence, demeurant à preſent à Orenge.
A LYON,
PAR THIBAVLD PAYAN,
1561.
Auec Priuilege pour neuf ans.

Fig.1: Title page of the 1561 edition of the '*Traité des Hernies'* by Pierre Franco.

The author highlighted the correct manner of peritoneal sagging:

> '*Moreover the Peritoneum descends towards the testicles to cover them, and with it also the sperma producing vessels descend; via the same route the spermatic duct ascends to the groin. Some say that the peritoneum is pierced at this location. But one is unable to find such an opening; on the contrary the peritoneum makes a process or canal like the cavity in the finger of a glove; in this process the intestines or omentum descend, and form the swellings of an enterocele, epiplocele and bubonocele …*'[13].

It is clear that in this text passage, in explaining the cause of herniation, Franco follows almost literally the text of Vesalius[14].
It may be supposed that Franco had been aware of Vesalius' 1543 publication of the *Fabrica*[15], since in discussing the different hernia treatments, he stated that he

[13]'*Aussi que le dit Peritoine descend aux testicules pour les couvrir: & avec luy descendent les vaisseaux espermatiques preparans: & par mesme voye remontent les diaculatoires ou expellans. Aucuns ne disent que ledit Peritoine est percé en ce lieu. Or il n'y a nulle apparence : mais fait un processus ou voye, comme la cavité d'un doigt de gan, & par là descendent les intestins ou Zirbus, qui font les relaxations comme enterocele, epiplocele, bubonocele…*'. See Franco pp. 6-7.
[14]'*The tunics wrapping each testicle separately vary greatly in size, construction and thinness. One of them* (i.e. the tunica vaginalis testis*), which is also the outer, clothes the testicle and its vessels as far as the place where they are joined to the great space of the peritoneum; it is strong but thin, and full of veins. The peritoneum produces this wrapping, which is rightly considered a part and process of the peritoneum, at the point where you will hear that the seminal vein and artery and the vessel* (i.e.the ductus deferens*) taking semen up out of the testicle pass out of the great space of the peritoneum into the region of the loins and the scrotum itself...*'. See Vesalius' *Fabrica*, 1543, Book V, Chapter 13, p.522 with the corresponding figures 20 & 22. For the used English translation, see Garrison &Hast, Vol. II, p.1051.
[15] It may have been the German version, edited by Alban Thorer in Basel and printed at Oporinus's office in the same year 1543.

undertook these operations in the 12 to 15 years before his second publication (in 1561), corresponding to the post-*Fabrica* period between 1546 and 1549[16].

Franco does not cite Vesalius. However, he may have known his works. Indeed, born in Turriers in the Haute-Provence between 1500 and 1505, he started as a surgeon in his home region. Possibly as a result of the religious troubles in France, he moved to Lausanne sometime between 1541 and 1545[17], in the period that Vesalius worked in nearby Basel, supervising the printing of his *Fabrica*.

Franco's first edition of the '*Petit Traité de Chirurgie'* dates from 1556, one year after the second *Fabrica* edition, when he still lived in Switzerland. By the time Franco's second and revised edition came out in 1561 he had however already returned to France for two years, '*demeurant à present à Orange'*.

The absence of his citation of Vesalius should not be a surprise. Several copies of Vesalius' *Fabrica* or *Epitome* were also often plagiated without any reference to its original author. Even more, Ambroise Paré (1510-1590) who extensively took over the techniques of Pierre Franco and sometimes cites him literally, does only once mention the name of Franco!

The anatomical description of the various hernia types, including the femoral form[18], and particularly the subsequent topographical indications of their surgical treatment, may well be the result of Franco's knowledge of the new Vesalian anatomy. Moreover, Vesalius had also prepared the way for later bladder stone surgery in correctly depicting the urachus and obliterated umbilical arteries[19] [Fig.2], thus easing Franco's first description of the supra-vesical bladder stone incision[20].

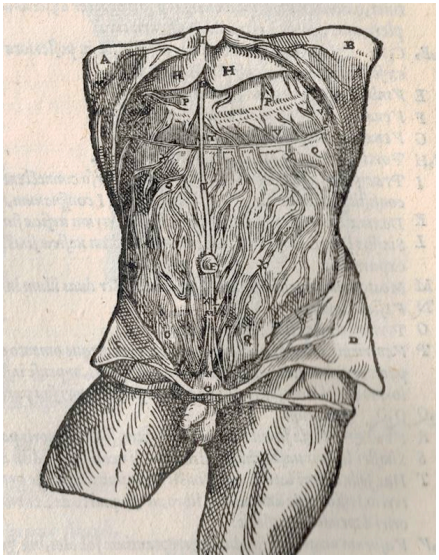

Fig.2: Picture of the abdominal wall with visualization of the urachus and the umbilical vessels. Vesalius' *Fabrica,* 1543, Book 5, Plate 2.

[16] See Franco p. 30.
[17] See Houdard & Kuss p.19.
[18] Which he calls '*bubonocele*' because it clinically resembles a plague *bubo* of the groin.
[19] See Vesalius *Fabrica* 1543, Book V, Plate 2.
[20] See Franco pp. 139-140.

A third proof of Franco's insight in the *Fabrica* is his description of how to mount a skeleton, greatly based on Vesalius' technique.

Indeed, Franco devotes the last chapters of his '*Traité des hernies'* to osteology. He describes the number and type of bones, hereby mainly following Galen, and adds three rudimentary figures of a skeleton, seen from the front, the back and the side, according to the drawings of Jean Tagault[21] [Fig.3].

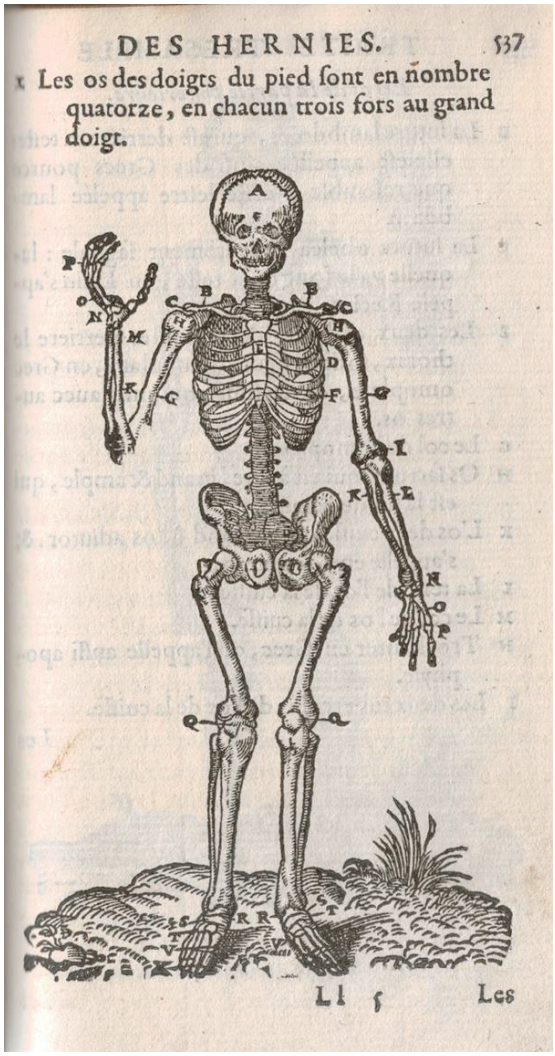

Fig.3: Drawing of a human skeleton, printed in the '*Traité des Hernies'* of Franco, and taken from the *Chirurgie* by Jean Tagault.

Interesting, however, is his chapter 156, discussing '*La manière de conioindre les os'*[22]. In six pages the technique of mounting a skeleton is described, again without referring to Vesalius or to his *Fabrica*[23].

[21] '*...ay mis les figures comme sont en la Chirurgie de monsieur Tagaut.*' See Franco p. 543.
[22] '*The method to reassemble the bones'.*
[23] Fabry von Hilden later followed completely the technique of Vesalius. See Biesbrouck & Steeno. 2014. p.119.

In the 1561 edition of his treatise, Franco mentioned:

> '*I mounted three to four [such skeletons] while I was serving and being paid by the Masters of Bern and Lausanne, and these [skeletons] were well received there by the physicians, even by those of Montpellier and other towns, which is quite understandable'* [24].

He even made a special cabinet to view the skeleton from four different angles:

> *'I offered one [skeleton] to the Masters of Bern; I mounted it in a small cabinet, which could be opened through four doors to make it visible from all sides …'* [25].

The description of the mandible bone is another example of Franco's knowledge of Vesalius' anatomy.
In the early chapters of his book, he still follows Galen when he states that '… *each mandible contains sixteen [teeth]*' [26]. However, in describing the setting of mandibular luxation, he counts only '*…one mandible'* [27].

Luxation treatment therefore is adapted to the situation of one lower jaw bone:

> *'The lower jaw or mandible cannot dislodge since it has processes or apophyses, which are firmly embedded in the upper jaw, like a hinged joint, from which start firm tendons connected to very strong muscles.*
> *In this way it never can luxate unless one yawns and widely opens his mouth'* [28] [Fig.4].

[24] *'Je en ay dressé trois ou quatre pendant que I'estoye au service & gages de messieurs de Berne, & de Lausane de cette sorte, qui sont esté bien estimées des medecins, voire de ceux de Montpellier, &autres : comme aussi on peut comprendre'.* See Franco p. 551. The skeletons of Franco did however not stand long, since the assembling ropes disintegrated. Wilhelm Fabry von Hilden assessed this when visiting Lausanne in 1586, approximately 30 years after Franco set up his skeletons: '*So hatte er [Franco] der Stadt Lausanna auch eines verlassen; alsich [Fabry] aber Anno 1586 erstlich bin dahin kommen, war erschon zerfallen'.* See for Fabry's citation: Roth p. 472. According to the Helmstadt doctor Ph.C. Fabricius, Vesalius' method of mounting a skeleton was still used in the late 18th century. See Roth p. 472.
[25] '*Je fis present d'une a messieurs de Berne : à laquelle j'avois fait comme un petit cabinet, qui se ouvroit à quatre portes pour le voir de tous costez… '.* See Franco p. 552.
[26] '*… chaque mandibule contient seize [dents].* See Franco p. 144.
[27] Ibidem p. 554.
[28] '*La machoire inférieure ou mandibule ne peut tomber du tout, pour ce qu'elle a des process ou apophyses, qui sont fermement inserees en la machoire superieure, en maniere d'un gon d'huis, desquelles naissent de forts tendons liez à certains muscles bien fort. Par ce il n'advient iamais qu'elle soit luxée, sinon quand on baille & ouvre bien fort la bouche'.* See Franco p. 530.

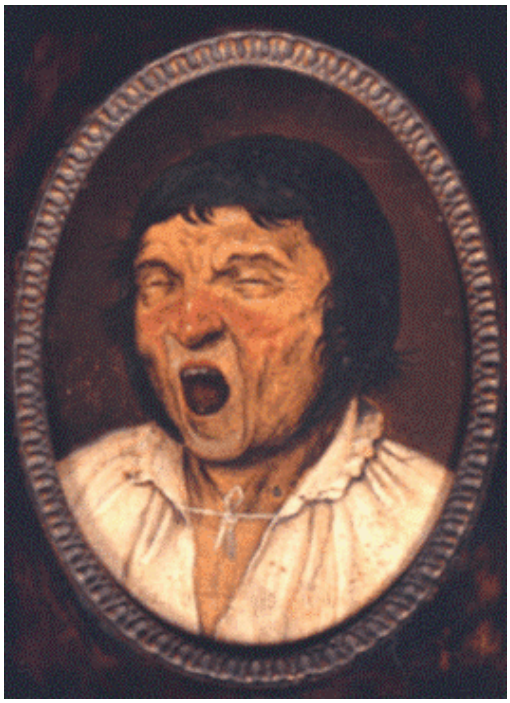

Fig. 4: '*The Gaper'*, painting by Pieter Breughel the Elder in 1558. Brussels: Royal Museum of Fine Arts.

It is to say that even without any reference to Vesalius in Franco's work, it seems very probable that this author used a number of Vesalius's new anatomical findings in his different surgical treatments.

Ambroise Paré

Vesalius' influence on surgery is still more evident in Paré's publications[29]. Ambroise Paré (1510-1590) published his book on anatomy in 1550[30]; it was reissued in 1561[31], and later formed part of his collected surgical works of 1585, where the third, fourth and fifth book contain extensive chapters on anatomy.

They are produced together with most of the prints of Vesalius' *Fabrica* in reduced size[32], stressing the importance Paré awarded to the knowledge of the new Vesalian type of anatomy.

As he states in his preface of '*Les Oeuvres'*:

> *'So I have used illustrations of anatomy: most of them I have borrowed from Andreas Vesalius, an exceptional man, & the very first in our century in this field of Medicine'* [33].

[29] For an overview on Paré's life and work, see Michelet 1930; Dumaître 1990.
[30] See Paré 1550.
[31] See Paré 1561.
[32] See Paré 1575. For this study the 13th edition of 1685 has been used: the anatomy of the human body is treated in Books 3 to 6, pp. 52-152.
[33] '*Ainsi que I'en ay usé aux figures de l'Anatomie: la plus part des quelles I'ay empruntez d'André Vesal, homme rare, & le premier de son siècle en cette partie de Medecine*.' See Paré 1685, '*Au Lecteur'*, folio 3 v°.

As the title of chapter 41 states:

> '*Brief repetition of all bones of the human body: it is necessary that surgeons know their structure, size, number, situation and assembly'* [34].

For treatment Paré used this new anatomical knowledge particularly in traumatology. In elbow dislocation for instance he draws his surgical setting technique directly on Vesalius' anatomy:

> *'The elbow bone turns around the upper arm like around half a pulley, in order to bend and to stretch the arm; I say half a pulley because if Nature would have allowed a greater degree of bending, the arm would not function adequately. Indeed, then the arm could also have bended as well outwards as inwards, something we obviously would apprehend from anatomy. Therefore, we will say that an elbow is able to luxate as a result of its two apophyses not encircling the entire bone of the forearm, which it receives'* [35] [Fig.5].

Fig.5: Picture of the reposition of an elbow luxation in '*Les Oeuvres'* by Ambroise Paré (13th edition, 1685).

[34] '*Briefve recapitulation de tous les os du corps humain : il faut que le Chirurgien sache leur substance, grandeur, nombre, situation et assemblage'.* See Paré 1685, p.147.

[35] '*L'os du coude tourne autour du haut du bras, comme autour d'une demie poulie, pour fléchir & estendre le bras, je dis demie poulie, parce que si Nature l'eust fait tourner advantage, l'action du bras n'eust pû se faire commodément : parce que le bras fût plié au dehors comme au dedans ce que l'on peut connoistre par l'anatomie. Nous dirons donc que le coude se luxe, à cause que ses deux apophyses ne traversent pas tout autour de l'os de l'avant-bras, qui le reçoit'.* See Paré 1685, chap. XXX, p. 352. See also the 2 figures p.353.

Giovanni Andrea della Croce

Vesalius's and Paré's contemporary Giovanni Andrea della Croce (1509/15-1575) also elaborated on Vesalius' anatomy. Della Croce, born and living most of the time in Venice, started to write his book '*Chirurgiae libri septem'* in 1545, two years after the first *Fabrica* edition, but it got published only in 1573, two years before he died. In this book[36], della Croce widely discusses the treatment of skull fractures. In Book I of the Second Tract, dealing with '*Wounds of the Head'*, he follows Hippocrates and the Medieval surgeons in their classification of traumas to the skull: bone fissure, bone crack, bone elevation and bone depression, as well as lesions to the opposite side[37].
This last type of trauma, also called *contre-coup* lesion, is particularly interesting to della Croce, just as is differentiation between a fracture line and a skull suture. Della Croce depicts the various forms of skulls with its sutures: in these pictures the drawings of Vesalius and Calcar are very well recognizable [Fig.6].

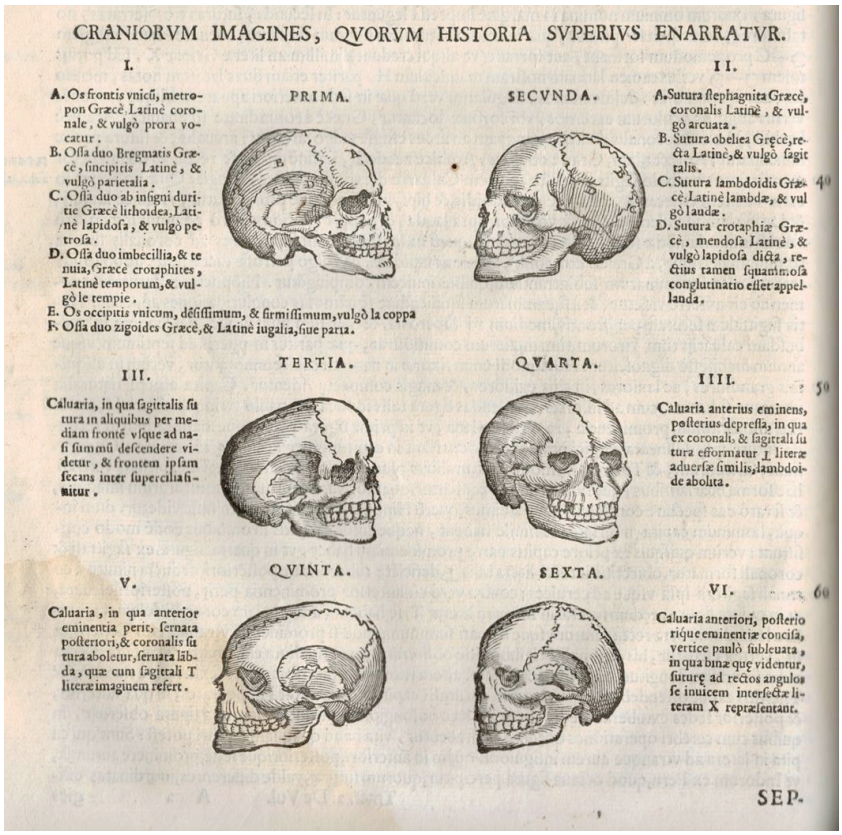

Fig. 6: Depiction of skulls with their sutures by Giovanni Andrea della Croce in his '*Chirurgia'* (edition 1596).

The *contre-coup* lesions were an important point of debate in the late medieval and Renaissance surgical community: Guy de Chauliac, Guido Guidi and even Gabriel Falloppia had written about it.

[36]Here the third edition is used, edited in Venice in 1596. See della Croce 1596.
[37] '*Fissuram, rimam, elevationem, collisionem et oppositionem'*. See della Croce, Tractatus II, Liber I, Capitulum II, p.6.

Della Croce confirms the statements of the Old Masters Hippocrates, Soranus, Celsus, Galen and Avicenna, that a blow or weapon impact on the skull may induce a fracture or internal lesion at the other side:

> *'It is true that after accidental concussion of the head, swelling may occur. When no fracture is visible at the site of the impact, it is wise to thoroughlyinspect the other parts and look for underlying swelling or weakening, and if present, to make an incision there. Then it will be easy to see if a fracture has occurred there. It does not matter that no fracture is found at that place, since the incision will heal rapidly'*[38].

Moreover, della Croce reflects on the presence and function of the skull sutures or '*commissurae*', referring to the anatomical findings of his contemporaries, not least those of Vesalius. He confirms that in older people these sutures may be absent or invisible:

> '*This [absence of sutures] is particularly seen in elderly, whose skull sutures, except for the temporal region, are so fused, that one may think the skull is just one bone. This is also the case in skulls found at cemeteries, and still more during anatomical dissections. This has very well been documented by our contemporary anatomists, like the wonderful Andreas Vesalius, the handsome Realdus Columbus and the diligent Gabriel Falopius, who examined multiple skulls, whose sutures were either absent or so fused that they could resist any force of people who would want to disrupt them*'[39].

This had of course therapeutic implications, since disclosure of fractures would direct the use and the place of trephination.

[38] Ibidem p.8, referring to Aulus Cornelius Celsus : '*Solet etiam evenire, ut altera parte fuerit ictus, & os altera fissum sit ; itaque si graviter aliquis percussus est, si mala indicia subsecuta sunt, neque ea parte, qua cutis secta est, rima reperitur, non incommodum est partem alteram considerare, nunquis locus mollior sit, et tumeat, eumque aperire, si quidem ibi os fissum reperietur, nec tamen magno negotio cutis sanatur, etiam si frustra dissecta est'.*

[39] Ibidem p.8 : '*In quibusdam vero craniis suturae substantia contigua est, contiguitate adeo compacta, ut omnino continua appareat, ac difficillime separabilis, ut in quorundam senum capitibus videre est, in quibus ossa calvariae, preterquam in temporibus, ita in superficie inseruntur & propemodum uniuntur, ut unum tantum esse credantur, quemadmodum in cimeteriis, rectiusque in anatomicis administrationibus, cum ossa admodum exsiccata non sint, inspici potest ; nostrates etiam attestantur anatomici (Mirabilis Andreas Vesalius, Diligens Realdus Columbus, Studiosus Gabriel Falopius) multoties calvarias suturis sensum effigientibus, arctissimisque, ut vix agnosci, ac divelli possint, munitas, se inspexisse.'.*

Moreover, in his *Officina chirurgica* della Croce shows the many instruments he used for trephination, as well as some beautiful pictures of the surgical room where this operation took place [Fig.7].
It is worth repeating, that even when these interventions existed before Vesalius, surgeons now adapted their operation to the anatomical knowledge of the time.

Fig.7: Surgical treatment room, drawn by G.A. della Croce with depiction of a trephination, in his '*Chirurgia'* (1596).

Girolamo Fabrici d'Acquapendente

The various successors of Vesalius in the Padua school of surgery also followed the same path in their surgical practice.

In the second part of Fabrici's 'Collected Surgical Works', published in Latin 27 years after the first part, in the year of his death, and devoted to the '*Operationes chirurgicae*'[40], Girolamo Fabrici d'Acquapendente (1533-1619) [Fig.8] regularly cited Vesalius and his successors Colombo and Falloppia, when discussing treatment of surgical diseases with special anatomical particularities.

In treating thoracic empyema[41], he did not follow the ancient technique of Hippocratic drainage using instead the new anatomical insights. According to Fabrizzi, the incision

[40] See for the first volume, the so-called '*Pentateuchus chirurgicus'*: Fabrici 1592. It reappeared in 1619 together with the second volume, the '*Operationes chirurgicae'* , and was often republished and translated in many languages. Here the French edition of 1674 was used for study and translation into English.
[41] See Fabrici, 1674, Ch. XLVI, pp.634-651.

should be performed at the lower side of the thorax, near the pleural supra-diaphragmatic recess, for treating thoracic effusion[42], in order to prevent lung perforation. Furthermore, the rib should not be cut, as recommended by Hippocrates, but the intercostal space should be used for drainage:

Fig.8: Anonymous painting, representing Girolamo Fabrici d' Acquapendente. Padua: Palazzo del Bo, Academy Room.

'Moreover, one wonders why Hippocrates in case of hydrothorax isperforating the rib and not the intercostal space, like he does when incising a from peri-pneumonia resulting empyema? [43] *…There are a number of reasons that may challenge the type of operation as proposed by Hippocrates, since by perforating the rib with an auger one may easily injure the internal organs; indeed, the rib extends far more inwards [in the thorax] than the intercostal space…'* [44] .

[42] or 'Hydrothorax'.

[43] '*En second lieu on demande, pourquoy Hippocrate en l'hydropisie du thorax perce la coste, & non l'espace d'entre deux, comme en l'autre incision, à sçavoir en l'empyème succedant à la peripneumonie ?*' See Fabrici 1674, p.639.

[44] '*… il y a quelques raisons qui semblent enerver la susdite operation d'Hippocrate, d'autant qu'en perçant la coste avec la tariere, on peut offenser tres-facilement les parties internes, veu que la coste s'advance bien plus en dedans que l'espace intercostal …*'. Ibidem, p. 640.

Fabrici therefore opposed the cutting and removal of a rib segment:

> *'This is why one should prefer the incision of an intercostal space, and theninsert a silver cannula that just fits [the size of] the incision …'* [45] [Fig.9].

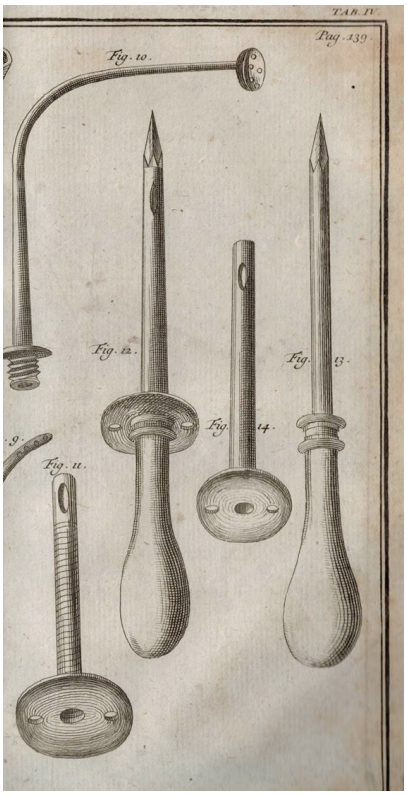

Fig.9: Depiction of trocar instruments, as shown in the treatise of Lorenz Heister (edition Hendrik Ulhoorn: *Heelkundige Onderwijzingen*…, Amsterdam: Janssoons van Waesberge, 1741, Table IV).

Moreover, the incision, according to Fabrici, should be done at the least dangerous place:

> *'In the first place one can damage the internal parts, namely the pericardium, the lungs and the diaphragm, as well as the external parts, i.e. the vein, the artery, the nerve and finally the muscles. Therefore … we choose the proper place to safeguard the pericardium by not perforating the anterior nor the posterior side, but the lateral side'* [46].

[45] '*Voilà pourquoy il vaut mieux faire l'incision en l'espace intercostal, & puis y metre une canule d'argent, qui s'adjuste exactement à l'incision …*'. Ibidem, p.640.

[46] '*On peut premierement offenser les parties internes, à sçavoir le pericarde, les poumons, & le diaphragme, comme aussi les externs, à sçavoir la veine, l'artère, le nerf & finalement les muscles. C'est pourquoy … nous choisissons l'endroit propre pour garantir le pericarde perçans point au-devant, ny au derriere du thorax, mais à costé …*'. Ibidem, p.642.

Furthermore, in describing the patient's position, Fabrici is perfectly aware of the supra-diaphragmatic *recessus*, changing slightly in height during expiration:

> '*From this one may conclude in which posture and respiration state the patient should be, while making the incision, since he has to be in a state of expiration so far as his respiratory condition allows this; therefore, we must make sure that the patient has totally blown out his breath at the moment of incision: indeed, then the lungs, formerly full of air, now are totally deflated, creating a cavity in the chest, where one cannot induce an injury what so ever'* [47].

This is really a magnificent 16th century surgical procedure by Fabrici using Vesalius' description of the pleural cavity in thoracic anatomy and physiology[48].

Anatomical knowledge was still more used in the 17th century. Looking at surgical textbooks of that period, some examples will illustrate this statement.

Wilhelm Fabry von Hilden

One example is given by the German surgeon Wilhelm Fabry (1560-1634) [Fig.10]. This surgeon, originating from Hilden near Düsseldorf, and therefore called Fabricius Hildanus[49], had been a pupil of Cosmas Slot (?-1585) or Slotanus who had studied medicine in Padua, and there had attended lessons of the great master Vesalius.

Fabry faithfully followed Vesalian anatomy, even so that in 1624 he published a monograph, entitled '*Anatomia Praestantia et Utilitas'* [50], stressing, as he says that '*Anatomy is the key and rudder to the whole of Medicine'*.

Fabry wrote a great number of case studies, so called '*Centuriae*', which were published in five different editions, from 1598 to 1641.

[47] '*D'ou l'on peut receullir, en quel estat & situation se doit tenir le patient, lorsqu'on fait l'incision, quant à ce qui regarde sa respiration, car il doit estre en l'estat de l'expiration, pourveu que la difficulté de respirer le puisse permettre: de sorte que nous devons obliger le malade, à descharger tout son soufflé, quand nous faisons l'incision: car par ce moyen les poumons, auparavant enflez de souffle, s'affaissent, & ainsi se prepare la cavité du thorax, & ne les peut-on offenser en aucune façon.*'. Ibidem, p.643.

[48] See Vesalius, *Fabrica*, 1543, Book 6, chapter 2, p. 571 : '*Ad haec ipsa quoque, ut & peritonaeum ijs omnibus quae amplectitur organis tunicas exporrigit, eademque fermata colligat. Quod autem cum thorace distendatur, arcteturque, neminem ambigere arbitror;thoraci enim undique adnate, tali constat substantia, qualis & involucri loco habetur, ac simul levis sequaxque est'.*

[49] To differentiate him from Fabricius of Acquapendente. For an overview on life and works of Fabry von Hilden, see Schaefer 1904 and Jones 1960.

[50] Published In Bern in 1624 under the title: '*Anatomiae praestantia et utilitas, das ist Kurze Beschreibung der Fürtrefflichkeit, Nutz und Notwendigkeit der Anatomie'.*

Fig. 10: Painting representing Wilhelm Fabry von Hilden (1560-1634) called the 'Father of German Surgery'.

Fabricius was one of the first in 1614 to perform lower leg amputation at the level of the thigh[51].

His technique was published in his treatise '*De gangraena et sphacelo liber*'[52]. To obtain minimal blood loss, Fabry was in favour of cauterisation, but just as his contemporary Ambroise Paré he preferred ligation of the femoral vessels for faint-hearted or juvenile patients. Both were perfectly aware of the precise anatomy of the femoral vessels and ischial nerve.

Fabry reported an amputation on a 12-year-old boy with only 3 to 4 ounces of blood loss[53]. Wilhelm Fabry also was the first in 1618 to remove a gall-stone in a patient[54] [Fig.11], again based on a better knowledge of the anatomical position of gallbladder and liver[55]. Thus, once again Vesalian anatomy helped surgeons in performing their operative interventions.

[51]Shortly after his British colleague William Clowes (1544-1604)!
[52] Namely in Chapter 17. See Fabry 1682, pp. 799-805, particularly p.802. It is also mentioned in the sixth volume of his *Centuriae*, observation 19. See also Fabry 1682 pp. 513-515 and p.299.
[53] See Fabry 1682 pp.799-805, in particular p.802.
[54] See Fabry 1682 pp.320-321. See also Leonardo p.156.
[55] Vesalius had correctly described the two-lobed liver with the gallbladder in an inferior bed of the right lobe!

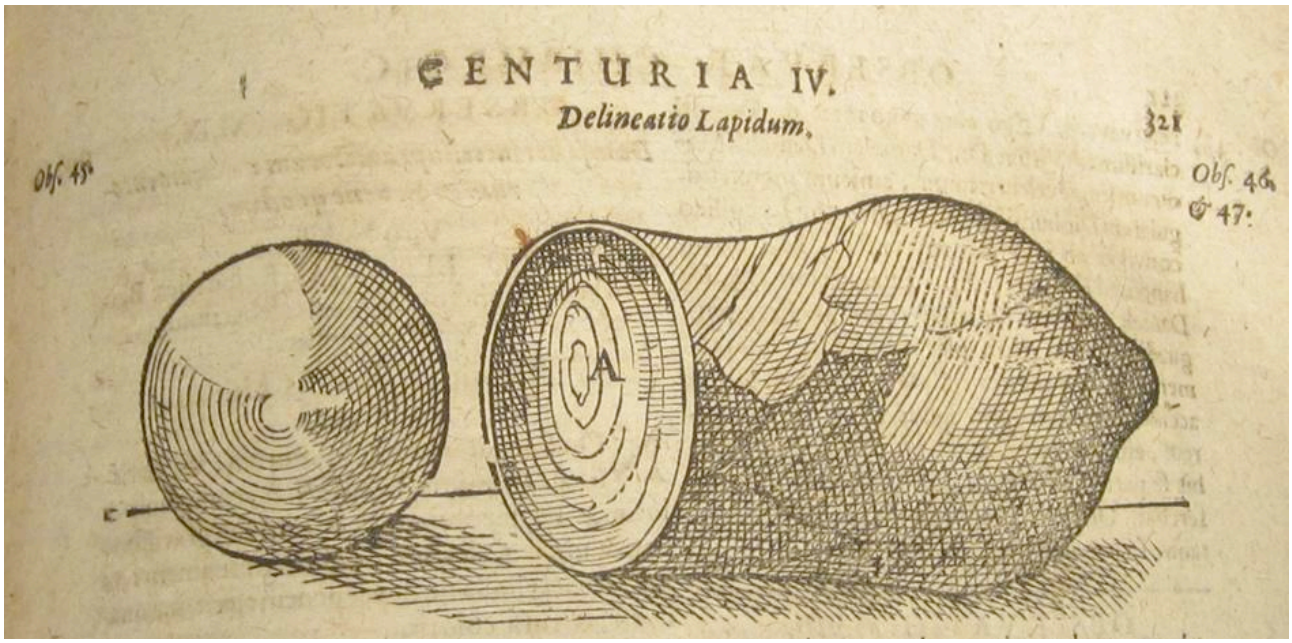

Fig. 11: Drawing of the gallstone as shown for the first time by Fabry von Hilden (Fabry: *Opera quae extant omnia…*Frankfurt: J.-L. Dufour, 1682, pp.320-321).

Paul Barbette

A rather trivial example will end this small overview. The Dutch surgeon Paul Barbette (1620-1666?) in his treatise on surgery [Fig.12] proposed a new and specific treatment for rectal prolapse. Besides an unguent based on camomile, which was introduced digitally in the anus, the following manual therapy proved efficacious according to Barbette:

> *'There is another apparently ridiculous, but indeed excellent treatment to reduce the anal gut into its proper position. With a stiff hand, one beats five, six or more times the buttocks of the patient, inducing the muscles, which we now call 'the anal pull up muscles' ('anilevatores'), to immediately pull the rectum in its right place. However, before I flog such patient, I brush the anus with rose or blueberry oil [56].'*

[56] *'Daer is noch een ander in den schijn belachelijke, maer in der daet goede manier om den aersdarm in te brengen. Men slaet met een styve handt vijf, ses, of meermaelen op de billen des patients, waer door de spieren die wij aers-optreckers (ani levatores) noemen, den endeldarm terstont in sijn behoorlycke plaetse trecken. Dan eer ick de lijder aldus doe geeselen, laet ick den endeldarm met olie van rosen of myrtillen strijcken'.* See Barbette p.38.

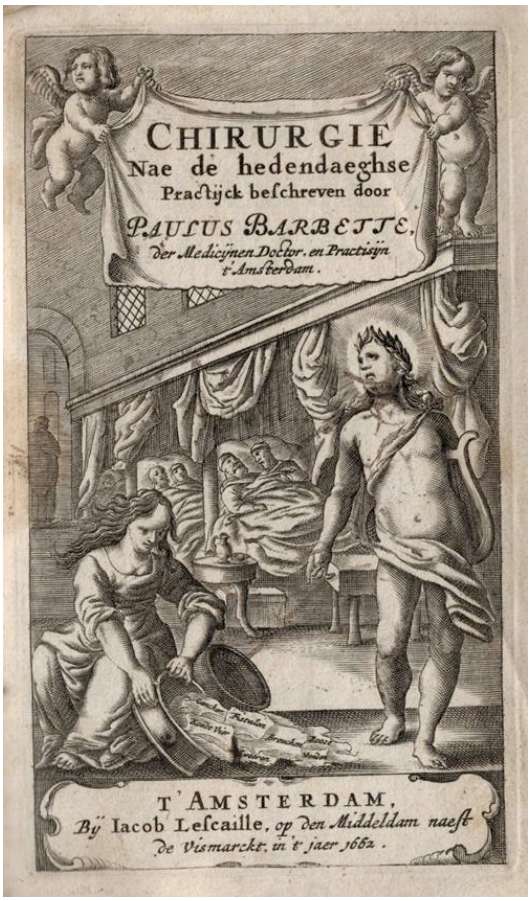

Fig. 12: Title page of the Surgical Treatise by Paul Barbette in 1662. Amsterdam: Jacob Lescaille.

That Vesalius lay at the basis of the knowledge of this critical function of the anal muscles has marvellously been pictured by Jan Stevens of Calcar in one of the initial letter drawings of the *Fabrica*[57] [Fig.13].

Again this treatment, despite its unpleasant appearance, is obviously related to the anatomical and physiological knowledge Vesalius proposed in his *Fabrica*[58].

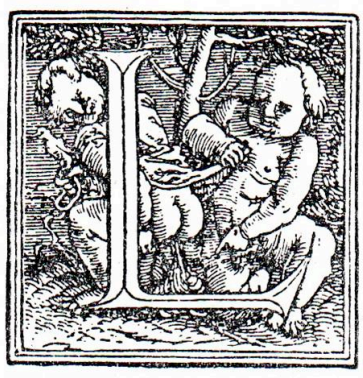

Fig. 13: Letter drawing (versal) in the *Fabrica* of Vesalius, representing the function of the anal sphincter in defecation (*Fabrica*, 1543, Book II, Chapter 51).

[57] See *Fabrica* 1543, p. 228.

[58] See for the text, *Fabrica* 1543, Book 2, Chapter 51, p.229 : '*Musculus iste circulatim intestinum ambiens, illius orificium stringit, ne praeter voluntatem intestina naturali suo motu recrementa continuo egerant, sed ut tempestive dum aut mole, aut vitiate quapiam qualitate hominem excrementa molestant, musculus hic laxatus instar fidi ianitoris ea transmittat'.*

Apart from these surgical techniques, brought about by Vesalius[59], probably the most important result of Vesalius' contributions lies in his emphasis of anatomical knowledge as the fundamental science in surgical education[60].

Both in universities and surgical guilds, anatomy became the first and most essential course for medical students and apprentice surgeons[61] [Fig.14].

And yet, 16th-17th century surgical innovations represented only the dawn of what surgery would gain from Vesalius' anatomy.

Fig. 14: Painting by van Mierevelt sr. & jr. *The anatomical lesson by Dr.Willem van der Meer*, 1617. Delft: Museum Het Prinsenhof.

As anaesthesia and infection prevention developed during the 19th century, surgeons could fully profit from the basic science it needed: the correct Vesalian description and depiction of the structure of the human body.

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[59] Vesalius also introduced his own novelties in surgical techniques. See Van Hee 1996.
[60] See Van Hee 2016, p. 67.
[61] See Van Hee 2002, p. 127.

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Copies of Vesalius' *De Humani Corporis Fabrica* in the USA

Stephen N. Joffe, Veronica Buchanan

Abstract

The purpose of this study was to confirm the locations in the United States of America (USA) of the first (1543) and second edition (1555) of the *De humani Corporis Fabrica* authored by Andreas Vesalius.

Contacts were made at institutions of higher learning, museums, libraries and an update of locations of previous studies in 1943 and 1984. A total of 64 copies of the 1543 *Fabrica* and 58 copies of the 1555 *Fabrica* were recorded in University and Institutional Libraries in the USA. Twenty-Six (54%) out of 48 locations having both editions.

The majority of locations recorded by Cushing in 1943 and subsequently by Horowitz and Collins in 1984 are still in their original collections. Location and dual ownership in private collections were more difficult to locate.

Résumé

Le but de cette étude consiste à confirmer ou retrouver les lieux, où dans les Etats Unis d'Amérique se trouvent les premières (1543) et secondes (1555) éditions de la *De humani corporis Fabrica* d'André Vésale.

Pour y parvenir, des contacts ont été réalisés avec des Instituts de Hautes Etudes, des Musées et de Bibliothèques, et ensuite des comparaisons ont été effectuées avec les études antérieures de 1943 et 1984. Un total de 64 exemplaires de l'édition 1543 et de 58 exemplaires de l'édition 1555 de la *Fabrica* a été répertorié dans les universités, institutions et bibliothèques dans les USA. Vingt-six (54%) des 48 localités possèdent les deux éditions.

La plupart des localités, répertoriées par Cushing en 1543 et par après par Horowitz et Collins en 1984 possède toujours ses collections originales. La localisation et la possession d'exemplaires en collection privée sont plus difficiles à déterminer.

Introduction

Andreas Vesalius's treatise*, De Humani Corporis Fabrica*, is considered the greatest work on anatomy ever produced. First published in Basel by Johannes Oporinus in 1543, the text of the Belgian anatomist Vesalius changed the science of anatomy, the manner taught and standardized the anatomical representation for the next two hundred years. Vesalius critically reexamined Galen's old anatomical text, which had been derived largely from nonhuman anatomical sources, and established the dissected body as the reference point for anatomy. Vesalius's anatomy was based on

firsthand observation and he conducted the demonstrations rather than using an assistant.

Presented in an elegant style with classical references, Vesalius's illustrations used the wood-block technique of printing. The *Fabrica* of 1543 contains some 660 pages and over 200 illustrations, many of which Vesalius personally chose, whilst supervising the artist's work from his own dissections. The result was a detailed and easily recognizable representation of the body showing the structure of bones and muscles.

Folio sheets were laid out in a sequence following an actual dissection. A series of animated skeletons posing in outdoor landscapes, were often juxtaposed with commonly recognized symbols of death, such as a tomb or shrouds. One of Vesalius's skeletal figures is shown in a melancholic position contemplating a skull placed upon a tomb and reprises a common *vanitas* motif, "*What I am now, you soon will be*."

Following a successful publication and sale of the first (1543) edition a second (1555) edition was produced. The 1555 edition was more sumptuous than the 1543 first edition. It was printed on thicker paper, set in larger type and had more widely spaced lines.
Vesalius made both stylistic and factual changes, and in some cases this required the design and production of a new initial letter woodblock. The new illustrations, with the exception of the title page, are generally considered to be even finer than those in the 1543 edition.

This second edition also had several textual alterations, including a revised chapter on embryology, a description of the venous valves, and two new chapters. No documentary evidence remains for the decision behind the production of a second edition except possibly to answer specific criticisms of the content leveled at the first edition and for Vesalius to answer his detractors in the new edition.

The recently found 1555, second edition, with annotations presumed to be by Vesalius in preparation for a third edition has been loaned to the University of Toronto, Canada.

This report discusses the locations of the first edition (1543) and second edition (1555) of *De Humani Corporis Fabrica* written by Vesalius and the Public University and Institutional locations in the USA.

It lists those locations possessing both copies and compares them to previous publications.

Materials and Methods

The development of the internet has helped greatly in the searching several hundred institutions in a matter of several months. Internet connections such as WorldCat.org, American Library Associations, Universal Short Title Catalogue (USTC), and LISTSERVS such as CADUCEUS and MEDLIB-L were a help.

Letters of enquiry were sent to libraries not yet online, consultation with dealers and collectors, telephone calls, faxes, checking auction records, original catalogues and other books were vital to the collection and collation of the information.

The method of researching copies held in Institutions and Libraries was relatively straight forward. Once ascertained which institutions owned both the 1543 first edition and 1555 second edition, requests were sent to the relevant librarians for any additional bibliographical details which did not appear in the online catalogues.

This included asking for confirmation of the presence of the Edition, number of copies held, past ownership, type of binding, condition of book, completeness of pages, bookplates present, previous owners, location and bookshelf call numbers, photographs (if possible) and any other relevant information.

The completion of this catalogue is due to the help the librarians provided through their own investigations, comments and cross-referencing of the information. In addition, all of the listed locations by Cushing[1] and Horowitz and Collins[2] were contacted to confirm the presence of the book.

Discovering copies held in private collections was more difficult with current owners requesting anonymity.

Auction houses were also more discreet regarding the purchasing identity of the client.

Results

First Edition (1543) Vesalius

A total of 64 First Editions were located in 47 public locations and compares these findings to Cushing (1543) and Horowitz and Collins (1984) [Table 1].

	Number	Locations
Cushing, 1943	19	13
Horowitz & Collins, 1984	46	38
Joffe, 2015	64	48

Table 1. First edition of the *Fabrica* in public locations in USA.

The geographical location ranged from 40% on the East primarily New York, Boston and New Haven, 33% Midwest, 18% Central and only 7% in the West coast in Los Angeles, Palo Alto and San Francisco, California.

Lists of the private owners of first edition (1543) is shown in Table 2. We have identified seven privately held, the owners who wish to remain anonymous.

In Cushing's study 100% were physicians, 80% in Horowitz and Collins and, in this study, 5 of the seven (71%) were physicians [Table 2].

Three out of 4 of the copies in Cushing's series are now in Universities and three of the physicians in Horowitz and Collins' study are still alive.

Cushing 1943	**Horowitz and Collins 1984**	**Joffe 2015**
Otto O. Fisher,MD	Meyer Friedman, MD	Private
John F. Fulton,MD	Howard W. Higholt, MD	Private
Lewis S. Pilcher,MD	Harrison D. Horblit	Private
J.C. Trent, MD	Arthur E. Lyons, MD	Private
	Francis D. Moore, MD	Private
	Haskell Norman, MD	Private
	Irwin J. Pincus, MD	Private
	Myron Prinzmetal, MD	
	Private	
	Private	

Table 2. First edition of the *Fabriica* in private ownership in USA.

In comparing the 45 First Editions in 37 Locations that Horowitz and Collins[2] reported in 1984, we confirmed 32 of the 37 (86%) Public Locations still possessed their first editions (1543) [Table 3].

				Published in 1543		Published in 1555
	Location	**City**	**State**	**Horowitz & Collins 1984**	**Joffe 2015**	
1	University of California	Los Angeles	CA	1	1	1
2	Stanford University	Palo Alto	CA	1	1	1
3	University of California	San Francisco	CA	1	1	1
4	Yale University	New Haven	CT	2	3	1
5	Smithsonian	Washington	DC	1	1	1
6	The Newberry Library	Chicago	IL	1	1	0
7	University of Chicago	Chicago	IL	1	2	1
8	University of Indiana	Bloomington	IN	1	1	1
9	University of Iowa	Iowa City	IA	1	1	1
10	University of Kansas	Kansas City	KS	1	1	1
11	John Hopkins University	Baltimore	MD	2	2	1
12	Library of Medical and Chirurgical	Baltimore	MD	1	0	0
13	National Library of Medicine	Bethesda	MD	1	1	1
14	Boston Medical Library	Boston	MA	1	0	1
15	Harvard University	Cambridge	MA	1	6	4
16	University of Michigan	Ann Arbor	MI	1	2	1
17	University of Minnesota	Minneapolis	MN	1	1	1
18	Linda Hall Library	Kansas City	KS	1	1	1
19	St. Louis Medical Society Library	St. Louis	MO	1	2	0
20	Cornell University	Ithaca	NY	1	0	0
21	Columbia University	New York	NY	4	4	2
22	New York Academy of Medicine	New York	NY	2	3	1
23	Hospital for Special Surgery	New York	NY	1	0	0
24	Pierpont Morgan Library	New York	NY	1	1	0
25	University of Rochester Medical Center	Rochester	NY	1	1	1
26	Duke University Medical Center	Durham	NC	1	1	1
27	Case Western Reserve University	Cleveland	OH	1	1	1
28	College of Physicians of Philadelphia	Philadelphia	PA	2	1	1
29	Thomas Jefferson University	Philadelphia	PA	1	1	1
30	The Wistar Institute	Philadelphia	PA	1	0	
31	Carnegie-Mellon University	Pittsburgh	PA	1	1	0
32	University of Pittsburgh	Pittsburgh	PA	2	1	1
33	University of Texas	Austin	TX	1	1	1
34	University of Texas	Galveston	TX	1	1	1
35	University of Texas	San Antonia	TX	1	1	0
36	University of Utah	Salt Lake City	UT	1	1	1
37	University of Wisconsin	Madison	WI	1	1	1
				45	48	32

Table 3. Comparison to Horowitz and Collins' Census of First Edition (1543).

Second Edition (1555) Vesalius

A total of 58 Second Editions were located in 49 Public locations and compared to our previous findings we had "missed" 13 (22%) in 15 (26%) locations.

A comparison of this study with Cushing's (1943) showed that 22 volumes were still in 16 of the original 18 locations reported. The geographical locations ranged from 37% on the East coast, 28% in Midwest, 25% in Central and a low 10% on the West coast.

A number of changes had occurred since our previous publication. Osler and Cushing reported having six copies of the first edition under review but we know that a second edition was given to Dr. Calvert at the University of Missouri.

The auctioneers, Swanns, had sold books from the Medical and Chirurgical Faculty Library in 2004, Princeton University had purchased copies in 2011, Harvard now had six and not four copies and one copy was misplaced.

Ownership of both copies of First and Second Edition Vesalius

Harvard University was possibly the first in the USA to obtain a 1543 edition before the 1764 fire as the book was still packed in storage.

The National Library of Medicine (previously called the Army Medical Library) acquired its copy between 1872 and 1876. Sir William Osler (1849-1919) and Harvey Cushing (1819-1939) began the Vesalius collections at Harvard, Yale, and New York Academy of Medicine.

In the Cushing[1] census of 1943 we found 11 (55%) out of 20 locations with both editions [Table 4].

	Location	City	State	1543	1555
1	University of California	Los Angeles	CA	1	1
2	University of California	San Francisco	CA	1	1
3	Yale University	New Haven	CT	2	2
4	University of Chicago	Chicago	IL		2
5	University of Kansas	Kansas City	KS	1	1
6	John Hopkins University	Baltimore	MD	1	
7	Library of Medical and Chirurgical	Baltimore	MD		1
8	National Library of Medicine	Bethesda	MD	1	1
9	Harvard University	Cambridge	MA	2	2
10	University of Michigan	Ann Arbor	MI	1	1
11	Columbia University	New York	NY	1	2
12	New York Academy of Medicine	New York	NY	1	1
13	Duke University Medical Center	Durham	NC		1
14	Case Western Reserve University	Cleveland	OH		1
15	College of Physicians of Philadelphia	Philadelphia	PA	1	1
16	Thomas Jefferson University	Philadelphia	PA		1
17	Brooklyn Medical	Brooklyn	NY	1	1
18	Northwestern Univ Med School	Chicago	IL		1
19	Fisher	Detroit	MI	1	
20	Academy of Medicine	Richmond	VA	1	
		Total		16	21

Table 4. Cushing's Census of First (1543) and Second (1555) Editions

In this current study a total of 48 Public Institutions possess either a first (1543) and/or a second (1555) edition of Vesalius *Corporis Fabrica*. Twenty-six (54%) have both copies in their libraries.

Most Universities have only one copy of each first and second edition, but within the Harvard University complex there are six of each volume, Columbia University has four first and two second editions, the New York Academy of Medicine has three first and one second edition [Table 5].
Yale University has three first and one second edition and the University of Chicago, John Hopkins and Washington University have two first editions and one second edition.

All the remaining 18 Public Libraries, Institutions and Universities have one copy of each edition of 1543 and 1555 [Table 5]. The donors were often similar for both editions and usually physicians affiliated with the University.

			Joffe (2015)		
Location	**City**	**State**	**1543**	**1555**	**Both**
University of Alabama	Birmingham	AL		1	
University of California	Los Angeles	CA	1	1	1
Stanford University	Palo Alto	CA	1	1	1
University of California	San Francisco	CA	1	1	1
Huntington Library	San Marino	CA		1	
University of Colorado	Denver	CO		1	
Yale University	New Haven	CT	3	1	1
University of Iowa	Iowa City	IA	1	1	1
Illinois Univdersity Urbana/Champaign	Champaign	IL		1	
University of Illinois	Chicago	IL		1	
Northwestern University Med School	Chicago	IL		1	
University of Chicago	Chicago	IL	2	1	1
University of Indiana	Bloomington	IN	1	1	1
University of Kansas	Kansas City	KS	1	1	1
Boston Medical Library	Boston	MA	0	1	
Boston University	Boston	MA		1	
Harvard University	Cambridge	MA	6	6	1
Massachusetts Institute of Technology	Cambridge	MA		1	
John Hopkins University	Baltimore	MD	2	1	1
National Library of Medicine	Bethesda	MD	1	1	1
University of Michigan	Ann Arbor	MI	2	2	1
University of Minnesota	Minneapolis	MN	1	1	1
Washington University	St. Louis	MO	2	1	1
Duke University Medical Center	Durham	NC	1	1	1
University of Nebraska	Omaha	NE		1	
Dartmouth University	Hanover	NH		2	
Princeton University	Princeton	NJ		1	
New York State Library	Albany	NY		1	
Cornell University	Ithaca	NY	0	1	
Columbia University	New York	NY	4	2	1
New York Academy of Medicine	New York	NY	3	1	1
University of Rochester Medical Center	Rochester	NY	1	1	1
Case Western Reserve Univ.	Cleveland	OH	1	1	1
Ohio State University	Columbus	OH		1	
University of Oklahoma	Oklahoma City	OK		1	
Oregon Health Sciences	Portland	OR		1	
College of Physicians of Philadelphia	Philadelphia	PA	1	1	1
Thomas Jefferson University	Philadelphia	PA	1	1	1
University of Pennsylvania	Philadelphia	PA		1	
University of Pittsburgh	Pittsburgh	PA	1	1	1
Vanderbilt University	Nashville	TN		2	
University of Texas	Austin	TX	1	1	1
University of SW Medical Center	Dallas	TX		1	
University of Texas	Galveston	TX	1	1	1
University of Utah	Salt Lake City	UT	1	1	1
University of Virginia	Charlottesville	VA		2	
Virginia Historical Society	Richmond	VA		1	
University of Wisconsin	Madison	WI	1	1	1
	Total		42	58	26

Table 5. Locations with both a First (1543) and Second (1555) editions of the *Fabrica* in Institutions and Universities in the USA.

Valuation

The first edition sold for 5 Florins in 1543 in Germany, reaching £2.30 in 1754 in Britain. Encouraged by Cushing to purchase copies when available the valuation has risen from US $100 in 1914 to recently being purchased for nearly US $400,000 including buyer's premium at auction. Over the last 100 years the rate of return has been approximately 8% per annum [Table 6]. Second editions are appearing less at auction and more with dealers at approximately 25 to 50% less valuable depending on condition and provenance.

1543	5 Florins
1573	6 shillings
1754	UK £ 2.30
1914	US $100
1933	US $800
1997	US $69,000
1998	US $1,625,000
2007	US $450,000
2014	US $300,000
2015	US $384,295

Table 6. Value of First Edition (1543) of Vesalius' De Humani Corporis Fabrica

Discussion

The internet has been a great development for the 21st century researcher. There are over several thousand University, Institutional Public libraries, many of which have catalogues searchable online. These innovations have shortened the time for researchers to find and confirm the relevant information.

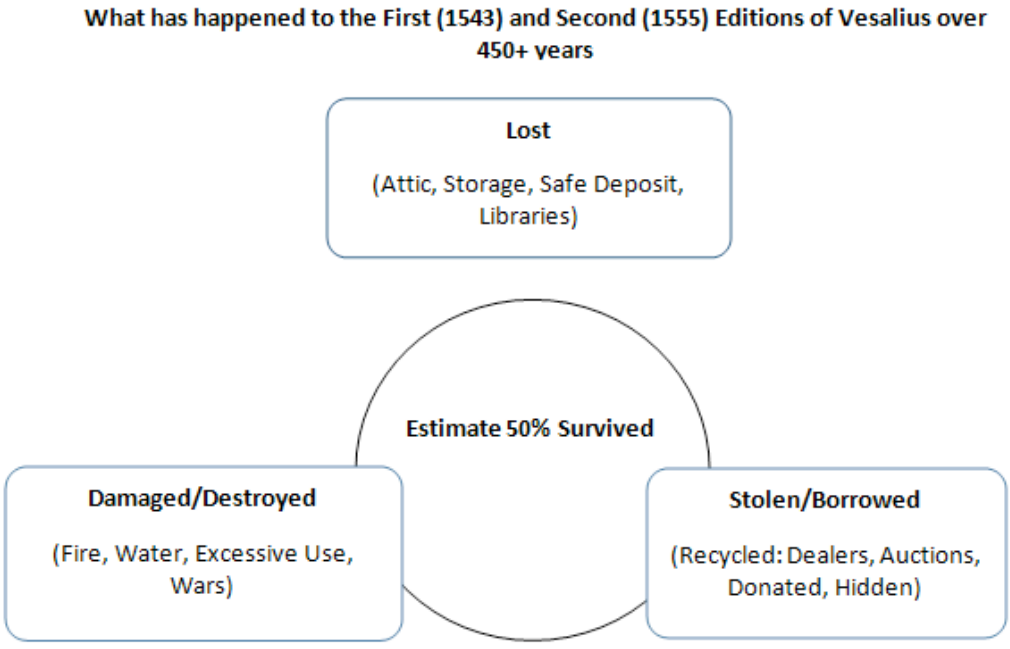
The *Fabrica* is as Osler[3] says in 1921, *"greatest book ever printed from which modern medicine dates"; "more admired and less read than any publication of equal significance in the history of science"* said Cushing in 1943 and Nutton stated recently the *"first modern book of anatomy".*[4]

Daniel H. Garrison and Malcolm H. Hast[5] in 2014 produced an annotated translation into English of both first and second edition texts published by Karger of Basel, Switzerland. Hopefully this will allow more people to read and understand the text.

Originally we reported that the 1555 print of the Fabrica, with its complexity and numerous illustrations, would have been produced in the order of 800-1000 copies[6] We now believe this number is too high as the *Fabrica* was a rarely used book. The majority of books printed would have survived. Loss of this type of book could be due to theft, fires, bombings, wares, and earthquakes, extensive water damage, stolen or simply misplaced. Thefts of precious and rare books from libraries and private collections do occur. Individuals have been known to borrow and not return a book [Figure 1].

Confiscation of books during wars such as by the Nazis in Second World War and destruction of libraries by bombings occurred during both First and Second World Wars[7]. Fires either spontaneous or during bombing have destroyed several copies of various editions of Vesalius. Extreme water damage occurs rarely. Most books we believe are misplaced during moving for security reasons, placed in safety deposit boxes or on shelves and forgotten or taken as a temporary loan and never returned. These books occasionally reappear in dealers or auction catalogues. If well documented in terms of binding, bookplates, or written annotations the book can be returned to prior owner(s).

Figure 1



In the Database of the International League of Antiquarian booksellers (ILAB), no antiquarian Vesalius books have been reported stolen or missing amongst the 1500 books listed on 168 pages since 15th June 2010.

The importance of rare books in public libraries is increasingly debated as funding pressures have continued. A number of institutions have decided to divest themselves of all or portions of their collections due to ongoing costs of protection, preservation and insurance.

Certain collections with time began to deteriorate and were removed from display. Later these books became unavailable to the public and were largely forgotten. Today, however, Libraries and Institutions are reinvigorating their rare book collections by cataloging and placing information on their websites.

Bookplate and listed ownership of many physicians, in particular surgeons, purchased rare books from dealers or at auction. During life or after death these books were donated to Libraries and Institutions where the majority of these rare books have remained.

The New York Academy of Medicine (NYAM) has three copies of the 1543 Edition. One from Sir William Osler, imperfect but passed through several other libraries and not in original binding; one from Samuel Lambert in limp vellum wrapper as if a temporary binding with slits cut into the wrapper and one from Edward Clark Streeter, bound with alum tawed pigskin over boards with clasps. The copy donated by Lambert is known as the "Fugger Copy" which was sold in 1933 by Karl and Faber from Munich,

Germany and then offered to Cushing by a New York dealer for $800. Cushing states it was the "finest untrimmed copy" he had ever seen. The NYAM also has a copy of the second edition of 1555.

It is interesting to speculate when *de Humani Corporis* of 1543 first arrived in the USA. We believe the earliest appearance of the 1543 Edition in the USA was just before 1764 at Harvard University (Founded 1636) in Cambridge, MA. The next recorded copy would be at the library, now known as the National Library of Medicine in Bethesda, MD, which had a copy between 1872 and 1876. Finally, in 1903, Cushing owned 2 to 3 copies and Osler had accumulated 3 to 6 copies from various sources which were then donated or given as presents.

Cushing (1869-1939) does not recall when his interest in Vesalius was 'first aroused'. Probably after reading Moritz Roth's biography in 1900 and at a presentation at the Johns Hopkins Historical Club at the time. In autumn of 1903, W.G. MacCallum bought an imperfect copy of the 1543 Fabrica at the back of a blacksmiths shop in

Rome which he gave to Cushing. Whilst abroad at this time, Osler (1849-1919) purchased three copies.

Ultimately, Cushing and Osler having "bought everything available" had six copies of the first edition which were distributed to libraries including McGill in 1907 which had received a copy from Osler a few years earlier, the Boston Library Association, Library of New York Academy of Medicine and University of Missouri.

The success of the *Fabrica* was predicted in March 1543 by Hieronoymus Gemusaeus (1505-1544), a Professor of Medicine before it was printed. Antonio Fumanelli on August 1, 1543 hailed Vesalius as a leading anatomist. The *Fabrica* was sent by Oporinus to his friend Vadianus in St. Galen at the end of July 1543. The messenger fell into a river and the book was swept away. A second copy was then sent. By the end of 1543, all copies had been sold to booksellers at the Leipzig Fair in Germany.

By 1546 there were at least three copies in circulation in Oxford, England. Philip Melanchthon (1497-1560), the Lutheran reformer and head of the University of Wittenberg, read and annotated his copy from cover to cover. He was so delighted that he wrote on the flyleaf of the book in Latin a poem praising Vesalius. This book is now in the National Library of Medicine, Bethesda, Maryland.

Despite being referenced in both Cushing's Bio-Bibliography and the Osler's Bibiliotheca Osleriana, as one of the six copies Osler laid out on his dining room table in the presence of Cushing in December 1903 was erroneously noted as a First Edition. According the both men's account, Osler gave his third-best copy to "W. J.

Calvert, a recent graduate who had just been appointed Professor of Pathology at Columbia, Missouri." After consulting with the librarian at the University of Missouri, we discovered that the Calvert copy is actually a Second Edition that had received a modern binding with "1543" inscribed on the spine. Once this mistake was un-covered, the Calvert copy was removed from the Cushing total in this Census. It is unlikely that Osler did not know the difference and probably grabbed the wrong book by mistake.

Osler states that "Copies are numerous and very often appear in sale catalogues at prices ranging from £10 to £20 varying with conditions." Osler also states that he and Dr. Cushing "bought everything of Vesalius that was offered" and goes on to say "we cannot have too many copies in America and no medical library is complete without one."

Gingerich in his annotated census of Copernicus's *De Revolutionibus* which was published in the same year as the Fabrica, lists 276 known copies of the first edition [8].

He assumes by utilizing various techniques – a survival rate of about 50 percent and estimates that about 500 copies of this book was printed by Petreius in Nuremberg.

Horowitz and Collins in their census listed 154 copies of the *Fabrica* and by extrapolation estimated 250 to 300 First Editions were still in existence[2] while Pozeg and Flamm in 2009 cautiously estimated that Oporinus printed 500 to 600 copies in 1543 of the first edition of *De Humani Corporis*[9].

Often a census is incomplete and misses locations or additional volumes are purchased. From a previous publication we estimated 40% of the 1555 editions were in the USA. If we use this simple mathematics it would indicate 175-200 volumes are located worldwide with an estimate of 350 to 500 of the first edition and second editions having been initially printed in 1543 and 1555 in Basel, Switzerland[10,11].
A census is never finished. Copies are missed and ownership change. With my colleagues Daniel Margocsy from Hunter College, City of University of New York and Mark Somos from Harvard University, Boston we are undertaking a Worldwide Census of the 1543 and 1555 *De Humani Corporis* including ownership and annotations (due for publication by Brill of the Netherlands in 2017).I f you know of copies present in Public or Private Capacity, please contact Daniel Margocsy at margocsy@gmail.com.

Conclusion

This article presents lists of dual ownerships of Andreas Vesalius' 1543 First edition and 1555 Second edition of *De Humani Corporis Fabrica* held in University and Institutional Libraries in the USA.

Most of the original editions recorded by Cushing in 1943 and Horowitz and Collins in 1984 are still present in the original collections. Private ownership appears to have decreased.

It is estimated that over the last 450 years since published nearly half of the 1543 and 1555 edition of the *De Humani Corporis* have survived, and of these, the majority are in University and Public Institutional Libraries with very few now remaining in private collections. The value of these books continue to appreciate due to their rarity [12].

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Competing Interest
The authors declare that there are no competing interests.

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Vesalius: His Presence in New Spain

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Abstract
In this paper we present a review of Mexican medical literature in the 16th and 17th centuries, analyzing the presence of Vesalius anatomical contributions and the conservation of Galen teachings in the official circles. We start with the anecdotal identification of don Carlos, son of Philip II, with Gregorio López, a hermit living in New Spain in the second half of the 16th century, as a legendary possibility of being a celebrated patient of Vesalius.

After a short review of the birth and early diffusion of Vesalius anatomy in Spain, we analyze the early anatomical and surgical books written and published in New Spain; those of Alonso López de Hinojosos (1578, 1595), Agustín Farfán (1592), Juan de Barrios (1607), Gerónimo Bezerra and Diego Osorio y Peralta (1685), identifying their acceptance or negation of the validity of Vesalius' discoveries and the tensions existing between those two intellectual positions. In the following pages we will present and discuss the nature, dimensions and impact of Vesalius' *Fabrica* knowledge in the medical thought of Colonial Mexico.

Résumé
Dans cet article, un aperçu de la littérature médicale Mexicaine du 16 e et 17 e siècle est présenté, analysant en particulier les contributions anatomiques de Vésale et la conservation scrupuleuse des doctrines de Galien dans les cercles officiels. En premier lieu l'identification anecdotique de don Carlos, fils de Philippe II, par Gregorio López, un ermite vivant en Nouvelle Espagne pendant la seconde moitié du 16 e siècle, est présentée comme une sorte de mythe Mexicain du patient célèbre de Vésale.

Après une brève récapitulation de la naissance et de la diffusion précoce de l'anatomie Vésalienne en Espagne, les premiers traités anatomiques et chirurgicaux, écrits et publiés en Nouvelle Espagne, sont analysés, en particulier les traités de Alonso López de Hinojosos (1578, 1595), Agustin Farfán (1592), Juan de Barrios (1607), Gérónimo Bezerra et Diego Osorio y Peralta (1685). Leur manière d'accepter ou de nier la validité des découvertes de Vésale est étudiée, ainsi que les tensions qui existaient entre ces deux attitudes intellectuelles. Dans cette communication la nature, l'étendue et l'impact des connaissances de la *Fabrica* de Vésale sur la pensée médicale au Mexique Colonial sont discutés.

Introduction

Vesalian anatomy was known in Mexico from early dates. Some copies of his *De Humani Corporis Fabrica* arrived there a few years after its publication and circulated between the members of the medical community, at least in the capital and some

important cities such as Puebla, for example. But the understanding of anatomy continued to be essentially galenic. When the Faculty of Medicine at the Royal and Pontifical University of Mexico began its courses in 1578, Galen's *De Usu Partium* was the text to be followed and in the university cloister the Vesalius *Fabrica* was never mentioned as a possible to be substitute text.

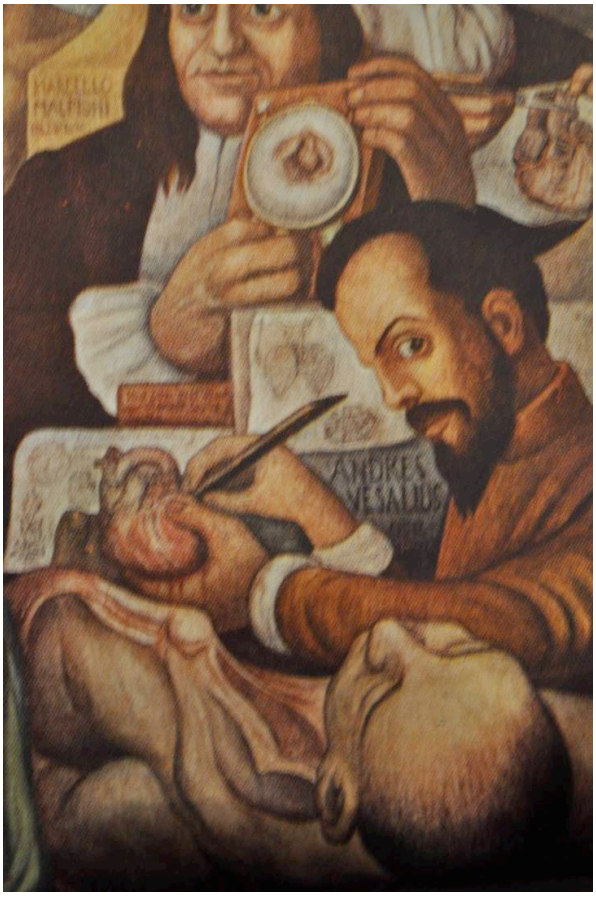


Fig. 1: Andreas Vesalius conducts a dissection.

Vesalius, Philip II and the New Spain

It is well known that Vesalius left his position as Anatomy professor [Fig. 1] at Padua University by the time his *Fabrica* was published. It is not easy to understand why, in the year the book was ready in Basel, Vesalius left Padua and Venice to become a part of the Emperor Charles V's medical staff. In fact, the story is simple: in August 1543, at Speyer, Vesalius had a short interview with the monarch and gave him a copy of his recently published book. A little bit later, he was invested with the charge of being the personal physician of the Emperor.

The narrative of Vesalius' work as a Spanish Court physician goes beyond the scope of this study. We can recall his place in the surgical management of Henry II of France's fatal head injury in 1559, participating as a special "medical ambassador" from the Spanish king to his French counterpart, and that for almost twenty years he worked

mainly in Madrid, Valladolid and Toledo following the Spanish King and his Court, in their various locations.

Relating to our theme, that of Vesalius' indirect presence in New Spain, (Mexico), is a very complicated story. In 1562, Vesalius was the surgeon who attended Don Carlos, Phillip II's son and the natural heir to the throne. The prince, then eighteen years old, fell down a staircase when he surreptitiously left the room of a servant. The result was very serious craneo-encephalic trauma. Some sources mention only a simple fracture and others suggest bone fragments in the brain. Apparently the prince had a good recovery, but some months later, in 1563, he was victim of an illness which left him with serious physical and mental health problems. The contemporary narrative does not give us any precise details about this illness nor about its possible relation to the cranial trauma suffered some months before. It only insists that, for the rest of his life, the prince was severely affected with medical problems. Two portraits by an eminent Spanish painter, Sánchez Coello, suggests a thoracic deformity, as one of the shoulders is represented lower than the other one and also a mentally disturbed facial expression. All these traits are present in both portraits but are more evident in the later one.

We do not have evidence that Vesalius was involved in the treatment of Don Carlos' new illness nor about his participation in his later management. In fact, Vesalius left Spain sometime later, going on his pilgrimage to the Holy Land from which he never returned, dying in Zakynthos on the way back.

The interest of Don Carlos illnesses and Vesalius participation in his treatment and their relationship with Mexico is not a direct one; it is derived from a legend. Until his death, in 1568, Don Carlos played a very unpleasant role in Spanish Court life. He was always in the worst terms with his father, acting most of the time in opposite ways to his indications and his desires, being a disturbing factor in family and official life, following a life of sexual excess and showing pleasure in provoking severe suffering to animals. (As a curious fact, he possessed a *xoloitzcuntli,* a Mexican hairless dog).

In 1568 his father decided to put him under guard and ordered his seclusion, a situation followed by suicidal intent and his death some days later. The official report, at the time said that he was 'in recuperation'. The 'black legend' suggests that Don Carlos had been assassinated on his father's orders and that his physicians were the people to carry it out. Vesalius was not of course involved in this story as he had died four years before.

Fig. 2: Gregorio Lopez.

But the Mexican legend goes in a very different way. A little time after Don Carlos' accident, in 1562, Gregorio López arrived in New Spain. He was a man of about the same age as the prince and showed in his latest portraits all the characteristic traits of the members of the Habsburg family [Fig. 2]. In fact Gregorio López was born on the 8th July 1546, after the date recorded in his biography by Francisco Losa, his confessor and companion in his later years[1] (Don Carlos was born on the 4th July 1542). Some authors, from early times had believed that this difference in age was used only as a subterfuge to conceal the truth. Following a nineteenth century story, Fernández del Castillo gave 1542 as the year of López' birth, the same year as Don Carlos.[2]

López' conduct was not normal. He intended to be a hermit and live in solitude and was suspected to have heterodox beliefs. He became subject to Inquisition surveillance with the result that Francisco Losa's sympathetic biography was only published many years later. The opening of a beatification process, proposed and seriously sustained by the Spanish Crown, led to his recognition as 'Venerable'.

Gregorio López was supposed to have Don Carlos put out of the way to upset Spanish politics. In this way that he could be a patient of Vesalius, who was close to the King of Spain. Thus, López could come to Mexico and live in New Spain until his death in August 20th 1596.[3]

The medical history of Gregorio López in New Spain is an interesting one because he was prey to a severe liver abscess, and after that was involved in acquiring a good amount of knowledge on medicine. On his own testimony he passed some time at the Guadalupe monastery in Extremadura. Around 1580 Gregorio López composed a book called *Tesoro de Medicinas* which recalls the well-known *Tesoro de Pobres,* medieval text from the entourage of the Spanish-born Pope Juan XXII. In his book, López described the treatments available in New Spain for the most common illnesses.[4]

The enigma persists: was Gregorio López actually the prince Don Carlos? Was he an illegitimate son of Phillip II? If the first case is true, then he had been a patient of Vesalius.

Vesalian Anatomy in Spain

Now, we will explore the knowledge of Vesalian anatomy in the Spanish world. In the middle of the Sixteenth Century Spain had a significant interest in anatomical studies. The first movement towards the regular practice of human body dissections was the creation in Valladolid of a cathedra commended to Alfonso Rodríguez de Guevara in 1550. Another anatomical theater opened later in Salamanca, following the traditions of Galen.

At the same time, two scholars, both disciples of Vesalius, took the lead in this renewal of anatomical studies with regular dissections. This led both to the establishment of anatomical theatres and to introducing the new knowledge based on Vesalius' work. These scholars were Pedro Jimeno, Professor at Valencia from 1547, moving later to Alcala de Henares to continue his work, and Luis Collado, who continued his teacher's traditions when Jimeno left Valencia.

A third anatomist, leading a new generation, was Cosme de Medina, Collado's disciple, who obtained later, in 1552, the chair in Salamanca against the opinion of the conservative representatives at the University Court.[5] This important achievement was consolidated in 1561, when, in the new statutes regulating the Salamanca curricula, Diego de Covarrubias proposed that only the texts of Galen and Vesalius should be used at dissections and received approval to utilize the engravings in Vesalius' book when dissections were not possible.[6]

This data is important because when Mexico University was founded in 1552, it was established that its regulations should follow the statutes of Salamanca University. In 1578, when the first Chair in Medicine was established, that of Prima, Covarrubias' regulations were formally promulgated though these dispositions were not mentioned in the Cathedra Ordinances.

Official Teaching of Anatomy at Mexico University

The first Medical Cathedra, Prima de Medicina, was founded in Mexico University during 1578, with the courses beginning in the following January. The chair was occupied by a professor selected through a contest. The winner, but curiously also the only competitor, was Juan de la Fuente. After a four years as a provisional professor, de la Fuente was formally designated as professor with his appointment ratified by the University Court because of his efficiency and capability in the exercise of his duties.[7]

The official documents related to the texts of the lectures do not include any mention of Vesalius, nor any other of any other contemporary author. Galen's authority was pervasive and his *De Usu Partium* was the main, if not the only text used in the study of anatomy. Apart from the officially recognized texts, most of the Spanish physicians in the second half of the sixteenth century had a more than reasonable knowledge of modern books and were conscious of the theoretical developments and problems involving medical practice from recently acquired knowledge.[8]

It has recently has been documented that Juan de la Fuente owned some books by Vesalius. It would seem, as known by the authorities in Seville, that he travelled to Mexico with three works by Vesalius. We have no data on the editions of these books, their year and place of publication place, but they are listed as Anatomical Works, his Commentaries on Book IX of Rhazes *Ad Almazorem* and his treatise on the *China Root,* an oriental therapy proposed as a good and cheaper substitute for zarzaparrilla in the treatment of syphilis.[9]

We do have certain knowledge that de la Fuente, the first Professor of Medicine at the University of Mexico, knew and owned anatomical works by Vesalius and possibly also commentaries derived from the corrections made by Vesalius to Galen. Unfortunately, we do not possess many catalogues of Mexican sixteenth century libraries. However, in that of Santa Cruz de Tlatelolco College, from the late forties and early fifties Vesalian works are not mentioned. But today there are some copies of the 1543 Basel edition of *de Humani corporis fabrica* in the Palafoxian Library in Puebla, in the San Carlos Faculty of Arts Library and in the National Library in Mexico City. A copy of the 1555 Basel edition and of the Venetian 1568 edition are also in the National Library. It is not known when these books arrived in Mexico, but the Mexican scholars believe that the *Fabrica* was in the country from the 1560s.

Juan Valverde de Hamusgo's *Historia de la composición del cuerpo humano*

Beside the *Fabrica,* a most reliable source for the early introduction of Vesalius' thought was the *Historia de la composición del cuerpo humano* (History of the composition of the human body) by Juan Valverde de Hamusgo, published in Rome in 1556.[10]

For many surgeons who did not understand Latin, Valverde's book offered an indisputable advantage being written in Spanish. This work was cited directly by some authors writing in Mexico in the late 16th Century and there are also some copies of the first edition in the country, one of them at the National Library.

Valverde, in his prologue, presents a short history of Anatomy, constantly referring to the difficulties inherent in its study which affected all the medical students and researchers in Antiquity.[11] Special emphasis was put on the impossibility to practice dissections on human bodies. Some of them, in particular Galen, says Valverde, were compelled to study comparative anatomy using animals instead of humans.

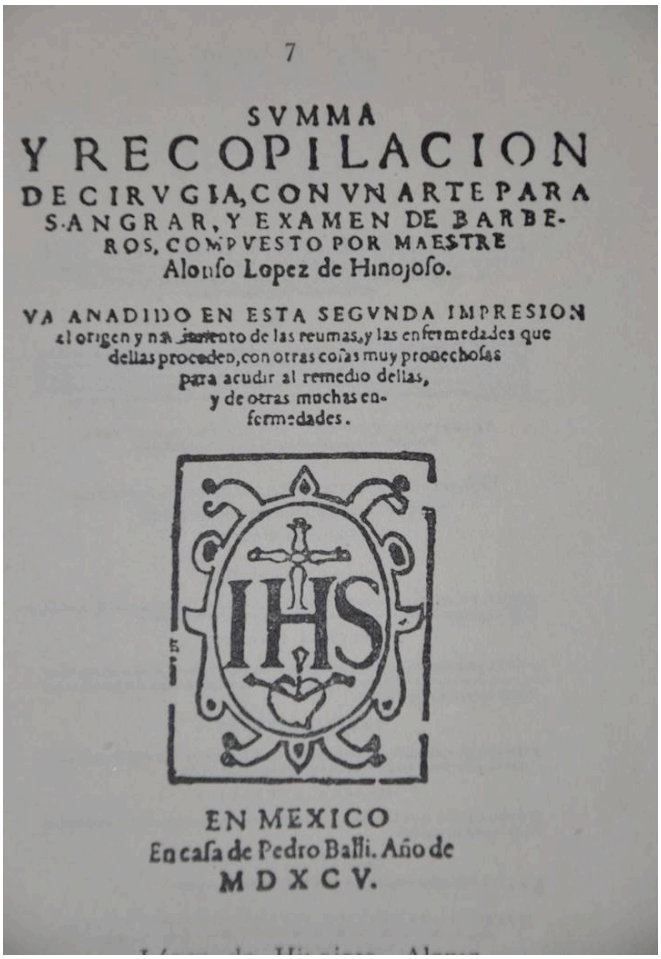
The rational basis to sustain this possibility as a valid one was the conviction that all the creatures in this world derived from the same structural order illustrating the belief of a perfect unity in *physis* (nature). Valverde noted that Galen had used the Gibraltar monkey in his dissections:

> *"…there were not many people in his time who wrote [on Anatomy] and none of them were credited with the authority in the field of Medicine [as was Galen], everyone accepts his teachings as correct, it never being possible demonstrate any contrary view it being prohibited to [study] anatomy in man…until Andreas Vesalius started to opening the eyes of everybody, showing that they should not believe previous writings".*[12]

Valverde illustrated his own book with figures from Vesalius because these were the most accurate at the time and ensuring that readers of his book would not be confused with different illustrations. Further, his text was very well known by physicians and surgeons working in Mexico in the second half of the sixteenth century.

The First References to Vesalian anatomy by Authors in New Spain

The first book on Surgery and Anatomy published in Mexico was *Summa y recopilación de chirugía* by Alonso López de Hinojosos. The book had two editions, the first one in 1578 and the second in 1595.[13]Alonso López de Hinojosos practiced as a surgeon but had no knowledge of Latin and it was suspected he had not undertaken studies of surgery or medicine. However, he developed a surgical practice in the Nuestra Señora and Real de Indios hospitals and also in a Jesuit convent in his later years.[14]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SVMMA
Y RECOPILACION
DE CIRVGIA, CON VN ARTE PARA
SANGRAR, Y EXAMEN DE BARBE-
ROS, COMPVESTO POR MAESTRE
Alonſo Lopez de Hinojoſo.

VA ANADIDO EN ESTA SEGVNDA IMPRESION
el origen y nacimiento de las reumas, y las enfermedades que
dellas proceden, con otras coſas muy prouechoſas
para acudir al remedio dellas,
y de otras muchas en-
fermedades.

IHS

EN MEXICO
En caſa de Pedro Balli. Año de
M D X C V.

Fig. 3: The first medical text published in Mexico - *Summa y recopilación de chirugía* by Alonso López de Hinojosos. 2nd edition, 1595.

His anatomy sources are only Galen and Guy de Chauliac (Guido de Cauliaco) after transliteration. In his surgical chapters he makes frequent references to Juan de Vigo, Pope Julius II's surgeon, and Juan Fragoso, an eminent surgeon and author of a celebrated surgical treatise, who graduated in Alcalá de Henares University and had a very good knowledge of the works of Vesalius and Valverde. Thus, it is possible that Alonso López knew Valverde, and maybe also Vesalius, through Fragoso's texts.

In both editions of his *Summa y recopilación*, López de Hinojosos reviews the anatomy of the human body in a few folios. He doesn´t present any detailed descriptions, but only includes an enumeration of body parts. In the second one (1595), he became more explicit and offered a little more detailed description of the eye, the diaphragm, the liver and the abdominal organs. Writing on the small intestine, he criticized some contemporary authors, without mentioning their names, because they propose dividing it into three different intestines: duodenum, jejunum and ileum, describing, in a rudimentary way, the place of the gastric curvature in relation to the pylorus and the duodenum.[15]

On heart anatomy, López description is very poor:

> *"The thorax is the arch where the vital spirits are found, the place where the lungs and the heart are, which, as the principal center is located in the very body center…It has two ventricles, one which receives the arterial vein from the liver, and the other one which finishes the blood purification in order to distribute it through the arteries and there is another artery which, by means of the lungs, supplies the air".*[16]

A curious description comes when he makes a long description of the way the tears are made, noting that they could be provoked by happiness and also by sadness:

> *"It is to note that vapors derived from the boiling (coction) realized in the heart, in arriving to the pericardium, which is a nervous tissue made from the pleura…, with its coldness it condenses and converts the vapors in water, which serves to refresh the heart, and from this same water the tears are made. The tears are in two forms, one from sadness, and other from happiness; anger and sadness move the melancholy, whose sites are the left side of the stomach and the spleen, and from there the vapors go up to the lungs bloating them, and are a heavy and earthly burden over the heart and they press the pericardium, which being plentiful with water, sends it upwards to the eyes".*[17]

The description of the liver follows medieval galenism. It refers to the concave and convex faces of the liver. The vena cava goes out from the first face and the portal vein from the convex face.
Because the small intestines push the diaphragm up in the left side, the liver goes up almost to the breast level on the right and precisely at this place the arterial vein goes out from the liver to the heart carrying with it arterial blood.[18]

Everything indicates that Alonso López de Hinojosos did not know Valverde de Hamusgo's Anatomy not only because he never mentioned it but also taking into account the descriptions he offers, which do not include any of Valverde's details, in accordance with Vesalius.
In the surgical section of the book, dealing with fractures and dislocations, López de Hinojosos cites Juan Fragoso's opinion explicitly.

Agustín Farfán and his *Tractado de anathomía y cirugía* and *Tractado breve de medicina*

Agustín Farfán [Fig. 4] was a well-qualified physician with the degrees of Bachelor in Arts and Medicine in the University of Seville and in 1552 he obtained the MD degree. Later, in 1567, obtained his PhD in Mexico. Farfán arrived in Mexico in 1557 and after his wife's death in 1568, he became a friar at the St. Agustin Convent.[19]
He wrote and published two books: *Tractado de anathomía y cirugía*, published in 1579, and *Tractado breve de medicina* [Fig. 5], this last with two editions, the first one in 1592 and the second in 1610.[20]

Fig. 4: Agustín Farfán - graduated in Seville and reached New Spain in 1557.

In the 1595 edition, the Fifth Book contains a brief treatise of anatomy. He remarks on the importance of anatomical knowledge with the statement that many surgeons make multiple errors due to their ignorance of anatomy, "hacen yerros irremediable cadadía".[21]

In general terms, the conceptual frame is that of Galen, defining and describing the body parts precisely following galenic nomenclature. Galen is his definitive authority and he took special care to present the anatomical terms in Greek, Latin and Arabic, following the model established by Andrés Laguna in his translation of Dioscórides *Materia Medica,* published in 1555 a text well-known by Spanish scholars.

In describing the cerebral ventricles, he affirms they are three and his description is very short and schematic, and does not include any detail on their anatomical relations. He simply follows the functional theory based on the five senses, localized in the brain substance surrounding the ventricles, all of these in full concordance with the model exposed by Aristotle and developed by Galen.

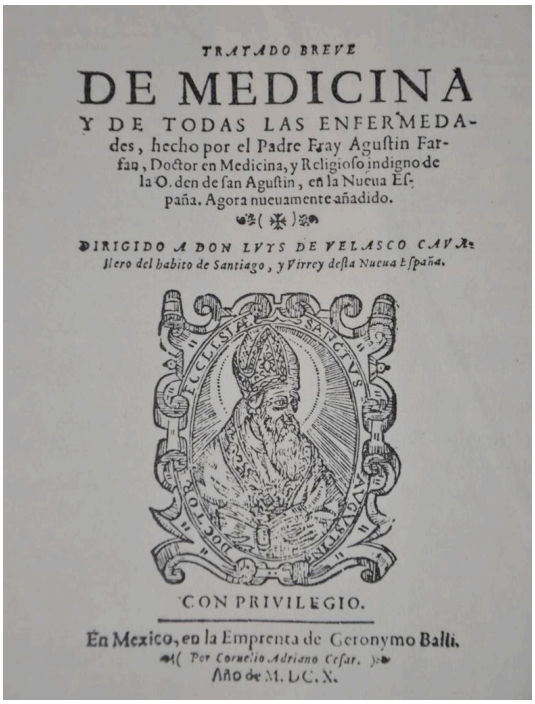

TRATADO BREVE
DE MEDICINA
Y DE TODAS LAS ENFERMEDA-
des, hecho por el Padre Fray Agustin Far-
fan, Doctor en Medicina, y Religioso indigno de
la O. den de san Agustin, en la Nueua Es-
paña. Agora nueuamente añadido.
DIRIGIDO A DON LVYS DE VELASCO CAVA-
llero del habito de Santiago, y Virrey desta Nueua España.
CON PRIVILEGIO.
En Mexico, en la Emprenta de Geronymo Balli.
Por Cornelio Adriano Cesar.
Año de M. DC. X.

Fig. 5: Agustín Farfán's *Tractado breve de medicina,* 2nd edition, 1610.

In the ninth chapter, describing the anatomy of the thorax, Farfán says expressly that his sources were Avicenna and Rhazes. He says that multiple nerves from the brain come to the breasts and veins come from the liver and arteries from the heart.[22] It is evident that the image accepted by him as true is the same as in Galen's *De Usu Partium.*

But interesting details appear in his description of the heart. The first phrases are strictly traditional, but when he evokes an image to make it understandable to his readers, he says that the form of the heart is like a pineapple. This fruit was not known in Europe. Its origin is in India and presumably came to Mexico in the early second half of sixteenth century.

Farfán affirms, following Galen, that the cardiac muscle is a very 'hard flesh', because it is necessary that this organ should not be "easily offended and injured" as no human, or indeed, any animal cannot exist without it. It is clear, quoting Avicenna, that the hard flesh (of the heart) successfully resists almost any kind of trauma and aggression.

Following Rhazes, Farfán describes three ventricles, right and left and in their upper and central part another one, described as a little compartment hermetically closed by means of clusters of nerves. Farfán affirms that many anatomists share Galen's view on blood movement but does not mention their names.[23]

Indeed, the most relevant fact in his detailed description of heart anatomy, Farfán doesn't say any word about the existence of orifices or pores in the interventricular septum.

He doesn't mention Vesalius or Valverde by name, but it is plausible that he knew at least some of contributions to anatomy.

Differing from the opinion of Alonso López, Farfán accepts the Vesalian division of small intestine into three parts and presents an accurate description of them.
He also mentions the "strong uterus ligaments" which minimise the risk of uterine movement at childbirth.
The nerves are enumerated, following Galen in his differentiating between the cranial and peripheral nerves.[24]

Farfán never mentions any contemporary author and his only anatomical sources, mentioned by name in the pages of his books, were Galen and the Islamic authors: Rhazes, Haly Abbas ('Ali ibn al-'Abbas al-Majusi) and Avicenna.

Juan de Barrios

The first explicit evidence of the adoption of Vesalian anatomy in Mexico appears in *De la Verdadera Medicina, Astrología y Cirugía* by Juan de Barrios [Fig. 6]. The book was published in México in 1607, when the author was 44 years old.[25]

Barrios birthplace was Colmenar el Viejo, a small village near Toledo, and he studied medicine at the 'progressive' University of Alcalá de Henares where he would have learned anatomy in the tradition of Vesalius.

In his very precise and well documented study of the physicians that came to the New Spain or graduated there in the 16th century and the first years of the 17th, Germán Somolinos recalls that he never confirmed Barrios' graduation in this university in his study of the original records.[26]

However, in the prologue of Barrios' book there is an affirmation of his academic qualifications by a Dr. Urieta, referring to his presence in "all the distinguished universities in Spain" like Salamanca, Alcalá de Henares, Lérida, Valencia and Seville.

Barrios arrived in Veracruz sometime between the last months of 1588 and 1590, giving account of one consultation with a patient in the Canary Islands in 1589 and of a patient examined by him there in December 1590.

Barrios' work is divided in several treatises. In the first one the theme is the anatomical description of human body. It is a short text, with only 12 pages, each with recto and verso.

Fig. 6: Juan de Barrios from Colmenar el Viejo in Spain.

The first pages contain material similar to most other anatomical treatises of the time. The work begins by analyzing the relationship between form and function in the different parts of the body, illustrating the reasons why Nature has made the forms and functions in that way.

In the first chapter, there is the assertion that Nature created the head at the top of the body, far from the heart, signaling that like the beliefs of many authors in the past, this is because the head is the site of the higher functions of man. This is a late affirmation of the belief which places the site of the rational soul in the brain rather than the heart, a common theory dating back to Hippocrates. Barrios cites Plato, Galen, Pliny, Hippocrates, Celsus and Aristotle as favoring a brain-centered theory of reason and emotions, and not a cardio-centric one. His view of Aristotle is erroneous, based on medieval interpretations of his philosophy proposed by Albertus Magnus and Saint Thomas Aquinas. Barrios remarks that is why Hippocrates calls epilepsy the sacred illness, and Plato affirmed that the brain is the center of all nervous impulses that come to and from the brain.[27] A teleological approach says that the head is round

so it cannot be easily injured, and it is always referred to as a "principal organ". In the next paragraph, Barrios recalls that a brain structure, the *rete mirabile,* is the place where the animal spirits are made because of the perfection attained there by the vital spirits produced in the heart, namely the ability to feel.[28]

It is evident that the majority of his citations are form Galen, but Vesalius is cited twice, and this is the first direct reference to him in New Spain. The most prominent tract in the texts on cardiac anatomy is the old Galenic preoccupation with the relationship between structure and function. A major concern is the explanation of the physiopathology of the fact that, after air entry after a chest wall wound, the death of the wounded person comes quickly, possibly even not immediately. Galen believed that he normal way for air entrance to the body is via the trachea to the lungs and then to the heart through the pulmonary vein. Barrios accepted Galen's views though suggesting that the blood in this vein is arterial.
To us, it seems very interesting that, like Farfán ten years earlier, Barrios makes no reference to the cardiac septum and the presence or absence of openings between the ventricles.[29] Avoiding this issue is how medical authors in New Spain at the end of the 16th century kept clear of Inquisition suspicions regarding their Catholic orthodoxy. Thus, they tacitly accepted Galen's authority but discreetly reserved their own views on indisputable anatomical reality for their own commentaries.

Barrios refers to Vesalius in Chapter 11, mentioning difficult topics that are hard to prove in anatomical dissections and which require a special expertise. Special emphasis is observed in the text about the function of veins, and Barrios criticized Aristotle for his assertion, in the second and third chapters of the first book of *The Parts of Animals* and in the second of *The Generation of Animals,* that the veins comes from the heart and not from the liver. The heart, says Barrios, is the primary source of natural heat and its cavities the place where humoral coction, (boiling or digestion), takes place. This belief, continues Barrios, was also held by Averroes, Alexander of Tralles, Erasistratus, Pietro d'Abano and Vesalius. Curiously, the paragraph finishes by conceding the truth to Galen, using an analogy with the nourishment system of trees. Thus the vena cava vein enters the liver and substance goes out of the liver in a one large vein which soon branches into two, one going down and the other up. Barrios here makes an interesting observation: the vein that goes up, the portal vein, has inside light red blood, and affirms that it is so because of the hepatic origin of all the veins in the organism, the cava and portal veins bringing every kind of nourishment to the most remote parts of the body.[30]
Barrios criticizes Realdo Colombo for his affirmation of the existence of the auricles. The reason to say this is that if the auricles really existed it would not be possible to purge humors, because these humors need to pass from the liver to the stomach and never in the opposite way.[31] This insistence shows that Barrios, despite his knowledge

of Vesalius and Colombo, continued to attach himself to the Galen's explanation of venous blood distribution. This is confirmed by reading his second reference to Vesalius:

> *"I admire that Vesalius did not follow Galen, but said that the veins go out the heart…".*[32]

It is clear that Barrios had a good knowledge of Vesalius' opinions, but it is also evident that he did not agree with everything that Vesalius asserted in correcting the anatomical details and errors transmitted by Galen.
We have good reason to assert that Barrios and the other New Spain medical authors of the period did not mention anything about modifying Galen descriptions of the anatomical details of the heart. But their views show the possibilities for accepting the new views that the New Spain physicians wrote in their anatomical texts.

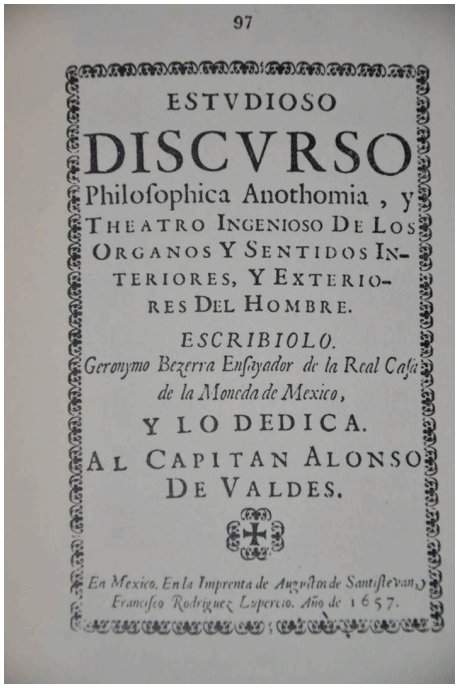
Although Vesalius, and his followers Realdo Colombo, Fabrici d' Acquapendente and others were known and read in Mexico, the transmission of their views was not made at the University but mainly in informal ways. It is worth commenting that at the University, it was always and only Galen's anatomical text *De Usu partium*, that was used until the end of 18th century.
So, it is not a surprise that in 1621, when the Chair in Anatomy and Surgery was founded, Galen's text was prescribed as the official one. A huge complication was that teaching aimed to produce surgeons who did not understand Latin.
Therefore, the lectures were given in Spanish, the lecturer translating Galen's texts as the dissection proceeded, leaving the new interpretations for informal discussion.

Jerónimo Bezerra

The next text to be considered is that of Jerónimo Bezerra, *Estudioso discurso de filosófica anatomía,* published in 1657 [Fig.7].
There is little information about Bezerra's life. There is no information about his professional status and it is even possible that he was not a physician. There is no mention of him in the records of the University of Mexico Faculty of Medicine, not as a student or as a graduate.

In addition, his name does not appear in the documents of the New Spain authorities concerning the registration of physicians who qualified in foreign universities. The only certain fact is that Bezerra worked as a Mint House tester.[33]

Bezerra wrote a very interesting book, *Estudioso discurso de filosófica Anathomía,* published in Mexico City in 1657[34].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ESTVDIOSO
DISCVRSO
Philoſophica Anothomia, y
THEATRO INGENIOSO DE LOS
ORGANOS Y SENTIDOS IN-
TERIORES, Y EXTERIO-
RES DEL HOMBRE.
ESCRIBIOLO.
Geronymo Bezerra Enſayador de la Real Caſa
de la Moneda de Mexico,
Y LO DEDICA.
AL CAPITAN ALONSO
DE VALDES.
En Mexico, En la Imprenta de Auguſtin de Santiſtevan,
Francisco Rodriguez Lupercio. Año de 1657.

Fig. 7: Jerónimo Bezerra, *Estudioso discurso de filosófica anatomía,* published in 1657.

The relevant characteristic of the work is that it did not contemplate among its objectives any description of anatomical structures nor body parts, but that, for him, philosophical anatomy consisted of the detailed identification and description of all the data required to integrate the identification of the anatomical site of the five senses in the structure of the brain.
His intention was to understand an integrated way of studying the brain as a basis for the production of rational thought.

Another book which was important in New Spain was *Rhetorica Christiana*, published in Perugia in 1579, by the Franciscan friar Diego Valadés. This book was the main vehicle through which knowledge of the theories of Aristotle, as interpreted by St. Albert the Great (Albertus Magnus) was diffused in New Spain.
It begins with a detailed description of the localization of every integrative function in the brain ventricles.
Common sense is localized in the anterior part of the walls of the lateral ventricles, which were considered as a unity. Other senses and emotions, phantasy, imagination, rational judgement and memory, were located at the posterior end of the fourth ventricle. So far this fits in with pre-Vesalian anatomy, but Bezerra, in his *Estudioso discurso,* which purports to be an anatomical study of the soul, and significantly as Aristotelian *psyche,* does not describe anatomical *minutiae*, "*the anatomical materialities*", which, he insists, could be found easily in the writings of the distinguished scholar Juan de Valverde. It is clear that the novelty of Vesalius' contributions were not decisive as the main preoccupation of the author, which is the functional integration of mind.[35]

The relevant question is the complete acceptance by Bezerra of the authority of Valverde regarding anatomical knowledge and the fact that he doesn't make any mention of Galen's anatomical works. Indeed, to Bezerra, the valid anatomical concepts are those coming from Vesalius, but transmitted through Valverde's book.

Diego Osorio y Peralta

We can be disappointed with the writing, work and thought of Diego Osorio y Peralta. In the last quarter of the 17th century, a time of marked contrasts in attitudes in New Spain to intellectual openness and scientific knowledge. There was a hard conservative official position while some people surreptitiously explored the modern theories. In this scenario, Diego Osorio y Peralta, was a very conservative figure. Professor of Anatomy for many years at the University of Mexico and holder of the Chair in Medicine in the last years of his life, he represents the most influential trend in the training of young physicians and surgeons.[36] He published, *Principia Medicinae Epítome*[37] with the intention of providing Mexican medical students with a simple and accessible text [Fig. 8].

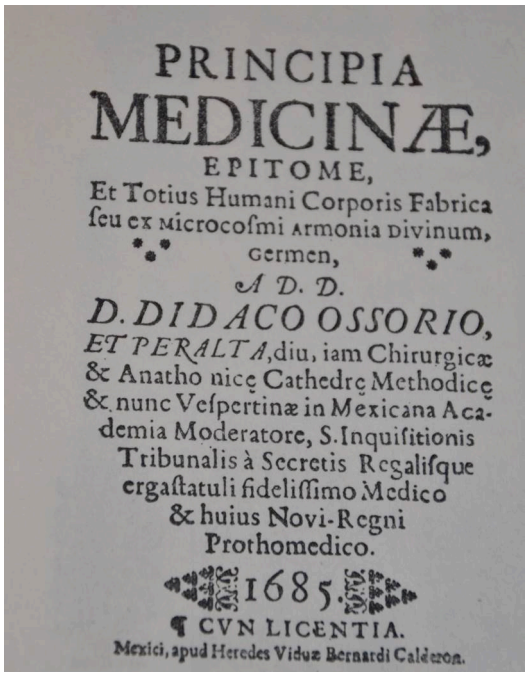
PRINCIPIA
MEDICINÆ,
EPITOME,
Et Totius Humani Corporis Fabrica
seu ex Microcosmi Armonia Divinum,
Germen,
A D. D.
D. DIDACO OSSORIO,
ET PERALTA, diu, iam Chirurgicæ
& Anatho nicę Cathedrę Methodicę
& nunc Vespertinæ in Mexicana Aca-
demia Moderatore, S. Inquisitionis
Tribunalis à Secretis Regalisque
ergastatuli fidelissimo Medico
& huius Novi-Regni
Prothomedico.
1685.
¶ CVN LICENTIA.
Mexici, apud Heredes Viduæ Bernardi Calderon.

Fig. 8: Frontispiece of *Principia Medicinae Epítome* of Diego Osorio y Peralta (1685).

Many students, mainly those following surgery courses, did not understand Latin and were unable to read the official texts. The proposed solution was to include in the book a special section: "anatomía lingua nostra" (anatomy in our language) beside the Latin text. The rest of the *Epitome* contained a short treatise on the parts of the body, *De partibus*, a study on leprosy in Spanish, The *Aphorisms* of Hippocrates in Leoniceno's Latin version and a table relating aphorisms to specific illnesses.

It is obvious that Osorio y Peralta knew Vesalian anatomy, possibly directly from the *Fabrica,* but he never cited him directly. He clearly showed his erudition citing other anatomists who followed the Vesalian tradition, such as Andreas Laurentius and Andrés Calvo, and the surgeons, Juan Fragoso and Bartolomé Hidalgo, who promoted Vesalius' anatomical precision. In a brief paragraph he considers the vascular structures showing some acceptance of the circulation of blood.[38] About the aorta, he said that it had its origin in the heart and that it conducts *vital pneuma,* but he supported the view that the vena cava originated in the liver and conducts nourishments, a view followed by a precise description of the azygos system.[39]

In his Spanish anatomical text, Osorio explains more about the parts of the body, asking if some of them are simple or are more complex. He constantly cites Galen and frequently makes reference to Fragoso and Calvo, both, as we have noted before, surgeons with a good knowledge of Vesalius work either directly but especially through Valverde de Hamusgo's anatomical treatise. Osorio cites Realdo Colombo in his description of the fifth cranial nerve, associating it with the perception of taste. In the folio 69r, Osorio declares openly that there are little orifices in the heart septum which permit the flow of blood from left to right ventricle and vice versa. He based his view that blood flow depends on 'impulsion and suction', this last function said to attract venous blood to the heart, on Calvo's authority, but he cites also Galen, Valles, a well reputed Spanish author, and Realdo Colombo. The vena cava's description is more detailed, but he always supports the old theory of its hepatic origin associated with the idea that caval blood system goes from center to periphery.[40]

Conclusion

We can now deduce from our exposition and analysis, that Vesalian anatomy was well known by the most important authors in 16th and 17th century Mexico, but was not adopted by all of them. With the exception of Osorio, almost all the Prima de Medicina professors explained Galen's anatomy publically but commented ex-cathedra on the corrections and specifications made by Vesalius.

It is important to signal the important role played by the anatomical and surgical 16th century Spanish treatises of Valverde, Fragoso and Calvo, for example, in spreading of Vesalian knowledge among New Spain surgeons who did not read or understand Latin.

Finally, in the new intellectual tendencies developed in Mexico after the Spanish dynastic change in the early 18th century, Vesalian and modern anatomy and physiology were naturally accepted without major discussion, but Galen's *De Usu Partium* continued to be the officially recognized textbook, but now along side Willis and Wirsung.

A significant fact is that Joseph Salgado, Prima de Medicina professor, in his *Cursus medicus mexicanus,* a new comprehensive textbook published in 1727, includes the innovations of Vesalius, Harvey's theory of blood circulation, which he submitted in his graduation thesis from 1695, and most of the other contemporary medical advances.[41]

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Vesalius' legacy. The *Tabulae pictae* of Girolamo Fabrici d' Acquapendente

Giorgio Zanchin

Abstract

Girolamo Fabrici d'Acquapendente (ca.1533–1619) left a rich collection of anatomical paintings in colours, which are today preserved in the Marciana Library in Venice.

The third series, entitled *De Anatomia Capitis Cerebri Nervorum*, contains the only known illustrations by Fabrici regarding neuroanatomy since, apart from them, he never published on the nervous system.

For this reason, a thorough study of these plates is pivotal to a better understanding of his contribution to the knowledge of the Nervous System.

A recently found unpublished manuscript reporting on a lesson of Fabrici, given in the Anatomical Theather in Padua, constitutes to this day the only written description, however indirect, of this subject by him.

Résumé

Girolamo Fabrici d'Acquapendente (ca.1533-1619) nous a laissé une riche collection de planches anatomiques en couleurs, se trouvant actuellement à la Bibliotheca Marciana à Venise.

La troisième série de ces figures, intitulée *De Anatomia Capitis Cerebri Nervorum*, contient les seules illustrations faites par Fabrici, détaillant la neuroanatomie. En effet, jamais n'a-t-il publié d'autres figures du système nerveux.

Dès lors, une étude approfondie de ces planches est essentielle pour une meilleure compréhension de la contribution de Fabrici à la connaissance du système nerveux. La découverte récente d'un manuscrit non publié, décrivant une leçon de Fabrici, donnée dans la salle de dissection anatomique de Padoue, représente à ce jour le seul témoignage, quoique indirect, écrit à ce sujet.

A biographical outline

After Andrea Vesalio (1514-1564), Realdo Colombo (1516-1559), and Gabriele Falloppia (1523-1562) [Fig.1], Girolamo Fabrici d'Acquapendente (1533 ca.-1619) ranks fourth in the genealogy of the great Paduan School that during the Renaissance laid the foundation of modern anatomy [1-3].

Fig. 1: Left to right: Andreas Vesalius, Realdo Colombo and Gabriele Falloppia, prominent anatomists from the golden age of Padua University School of Medicine. Courtesy of Padua University.

Born around 1533 in Acquapendente, a village in the countryside of Viterbo, Fabrici d'Acquapendente [Fig.2] was educated in Padua under the protection of the powerful Venetian family of Lippomano. He graduated in Medicine in 1559 and six years later he was appointed by the Venetian Senate to the Chair of Surgery, which included the teaching of anatomy.

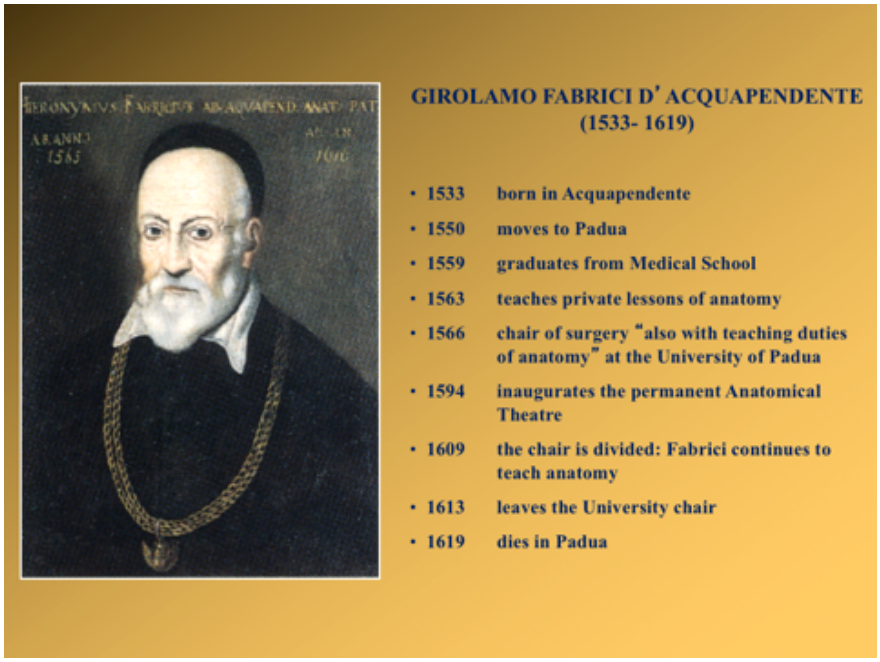

Fig. 2: Girolamo Fabrici D'Acquapendente along with his biographical sketch. Courtesy of Padua University.

Acquapendente devoted himself entirely to the clinical practice, academic teaching and research, where he gave outstanding contributions summarized in the words of an anonymous verse: *"Acquapendente was my birthplace, I rest in Padua. My fame is entrusted to the theatre, to the anatomic tables, to the studies on the fetus and on*

the valves of the veins" (*"Aucula me genuit, tenet Urbs Patavina. Theatro sum, Tabulis, Foetu, clarus et ostiolis"*(1).

He wrote extensively, as this list of his main works indicates: *Pentateuchos chirurgicum* (1592); *De visione, voce, auditu* (1600); *De formato foetu* (1600); *De locutione et eius instrumentis* (1601); *De venarum ostiolis* (1603); *De brutorum loquela* (1603); *De musculi artificio* (1614); *De respiratione et eius instrumentis* (1615); *Operationes chirurgicae* (1617); *De motu locali animalium* (1618); *De gula, ventriculo, intestinis tractatus* (1618); *De formatione ovi et pulli* (1621). Especially relevant among them are his investigations on embryology and comparative anatomy, particularly in the book *De formato foetu*[4], published in 1600, and his research on the venous valves [Fig. 3].

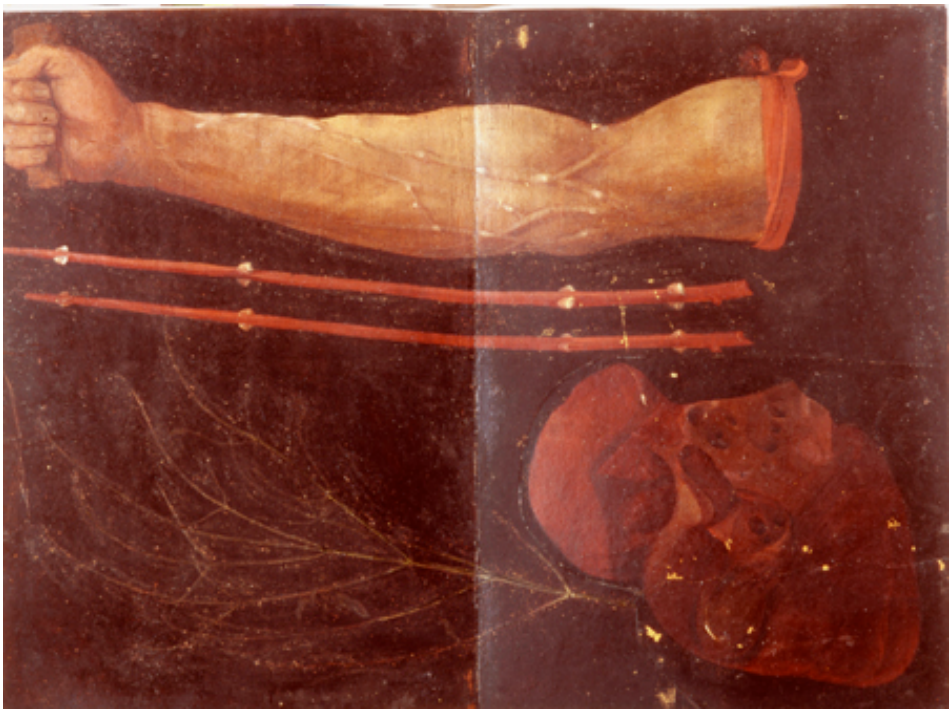

Fig. 3: Venous valves of the arm. Illustrated with a b/w copper engraving in *De venarum ostiolis*, they were also reproduced in colour in this *Tabula picta*. Courtesy of Biblioteca Marciana, Venice.

The study *De venarum ostiolis* (1603), was instrumental for the discovery of the circulation of blood by one of his most brilliant students, William Harvey [Fig.4].

From the Fabrici's description of the valves as a structure allowing only a unidirectional pathway, Harvey developed a strong anatomical argument to demonstrate the circular movement of the blood.

Indeed, the outstanding contribution of Harvey, *Exercitatio anatomica de motu cordis et sanguinis in animalibus* (1628), published after returning to England[5], is recognized as directly connected with his Paduan education, since there he learned of the

existence of the valves of the veins from Fabrici and of the quantitative method from Galilei.

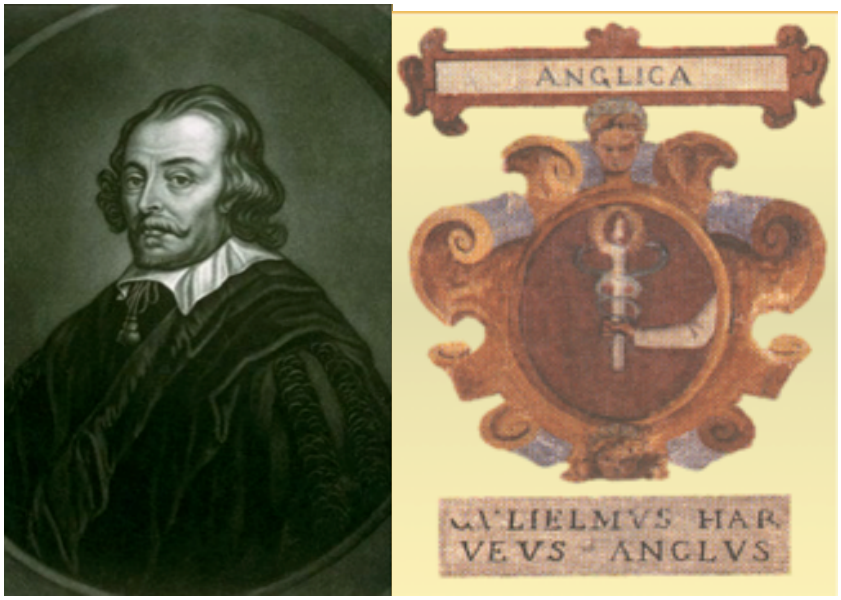

Fig. 4 a-b: William Harvey's (1578-1657) portrait and his coat of arms still preserved in the Old Yard of the University of Padua, where he graduated in 1602.

The Anatomical Theatre

In 1594, Acquapendente's permanent anatomical theatre was completed. It still stands today and is testimony to the ancient and glorious tradition of anatomy in Padua [Fig.5]. This theatre represented a model which inspired other academic centres[6].

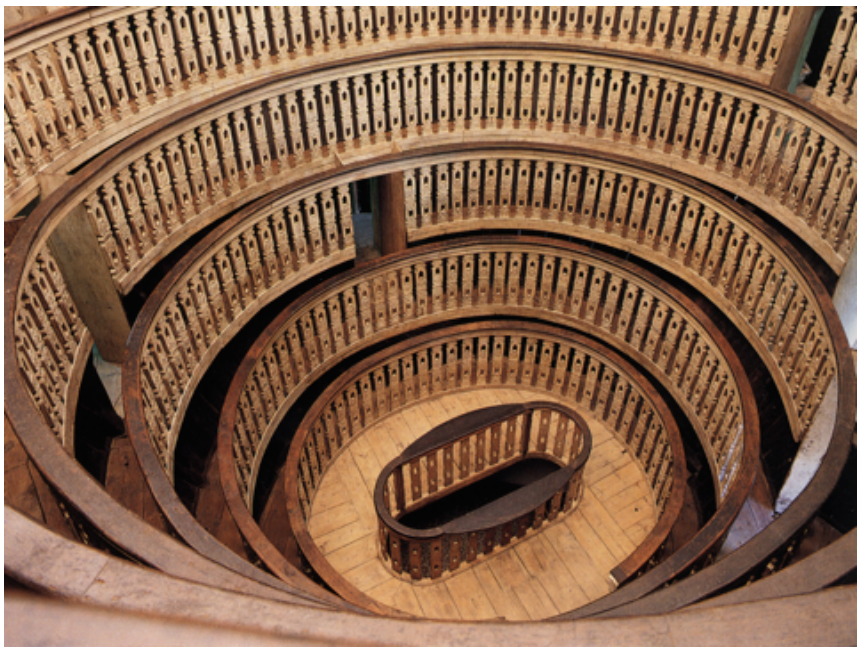

Fig. 5: The Anatomical Theatre of Girolamo Fabrici D'Acquapendente. Inaugurated in 1595, it is the first stable anatomical theatre. Courtesy of Padua University.

At the end of the 16th Century Caspar Bauhin (1560-1624), a student of Fabrici, promoted the erection of an anatomical theatre in Basel. Thanks to the Dutchman Pieter Paaw (1564-1617), also a disciple of Fabrici, a permanent theatre was built in Leiden. Later several similar structures were also erected in Copenhagen, Uppsala, Amsterdam and Halle, all of them based on the Paduan original model. Officially opened in January 1595, the structure continued to be used as an anatomical theatre for many years. Among the notable professors who later taught there, we remember Giovanni Battista Morgagni (1682-1771), founder of the anatomo-clinical method. A century after Morgagni's era, in 1872, the *publica notomia* (public dissection) moved to a new facility, which is still the Department of Anatomy. Since then, the original Anatomical Theater became one of the symbols of the Padua University Medical School, being for this reason portrayed on its seal[7].

The *tabulae pictae*

Acquapendente is also credited for being the first to realize the relevance of the use of colours in anatomy. During his long life, he had planned an ambitious, comprehensive anatomical treatise, which encompassed an atlas, *Theatrum totius animalis fabricae*, containing more than 300 hand-painted pictures representing, in natural colour, both human and animal structures. This *Theatrum*, which should include his other publications as well - he refers to this project in *De visione, voce, auditu*[8] - was never completed. In his will, Acquapendente donated the collection of paintings, called *Tabulae pictae* in subsequent years, to the *Signoria* of Venice. Highly appreciated by his contemporaries, they were later considered lost[9].

In 1910, Giuseppe Sterzi, an anatomist at Padua University, with a strong interest in the history of medicine, rediscovered the pictures[10] in the Marciana Library in Venice. Curiously, these had always been part of the collections of the Marciana, where they were stored following their gift to the Serenissima Repubblica by d'Acquapendente. The entire collection of 167 pictures is divided into eight volumes, accordingly to the anatomical subject: *De Anatomia Venarum; De Anatomia Ossium; De Anatomia Capitis Cerebri Nervorum; De Anatomia Animalium; De Partibus esternis; De Anatomia Thoracis; De Anatomia Musculorum; De Anatomia Abdominis.* We find 44 more pictures bound within three volumes, which are also part of the d'Acquapendente's heritage: *De locutione et eius instrumentis, De venarum ostiolis and De larynge voce instrumento*. As a whole, there are 211 pictures which are still preserved today in the Marciana Library. Along with about 40 more plates identified elsewhere, they constitute the first systematic approach to the representation of anatomical parts in colours and testify the highest momentum of the naturalistic approach of the 16th century Anatomical School of Padua.

Painted with oil and tempera, unfortunately on relatively fragile paperboard instead than on canvas, they were clearly produced by different hands, as there are evident differences in style. Some artists have been proposed, among them the Varotaris, father and son (but this is still an open debate) for a series of illustrations possessing an exceptional pictorial quality [Fig. 6].

Fig. 6: *Tabula picta* of the open abdomen. From *De Anatomia Abdominis Figure Varie*, Rari. Courtesy of Biblioteca Marciana, Venice. The Biblioteca can be seen in the background picture in the forefront of San Marco Bell Tower.

I'm pleased to quote here the comment of my master of the History of Medicine, Prof. Loris Premuda:

> *"Worthy of the utmost consideration is the personality who made the drawings so naturalistically accurate... with a correspondence of colours such as to actually give the impression not only of the form, not only of the colour of an organ… but also, so to speak, of its physical state, lean or fleshy, rough and viscid, and even of the suffering from manipulation..."* [11].

What was the motivation behind this innovative accomplishment? The answer is given by Acquapendente himself:

> *"We therefore wanted all the tables in duplicate: oneset coloured and the other uncoloured so that all kinds of scholarly people can thus more easily benefit from this by no means unnecessary product, if I'm not mistaken, of our ingenuity"* [12].

Therefore, he planned them as a sort of *reference book* of anatomical preparations, to be used temporarily when a body to be dissected was not available, and possibly, as we will see later, as a support to his teaching, to be placed alongside the dissected part to better illustrate it.

At the end of the 16th century, in a period in which the monochrome xylographies, wood engravings, of Vesalius remained an example of unsurpassed beauty and naturalism [Fig. 7] Fabrici deserves merit for having first established, with his collection, the outstanding relevance of the use of colour in anatomical images.

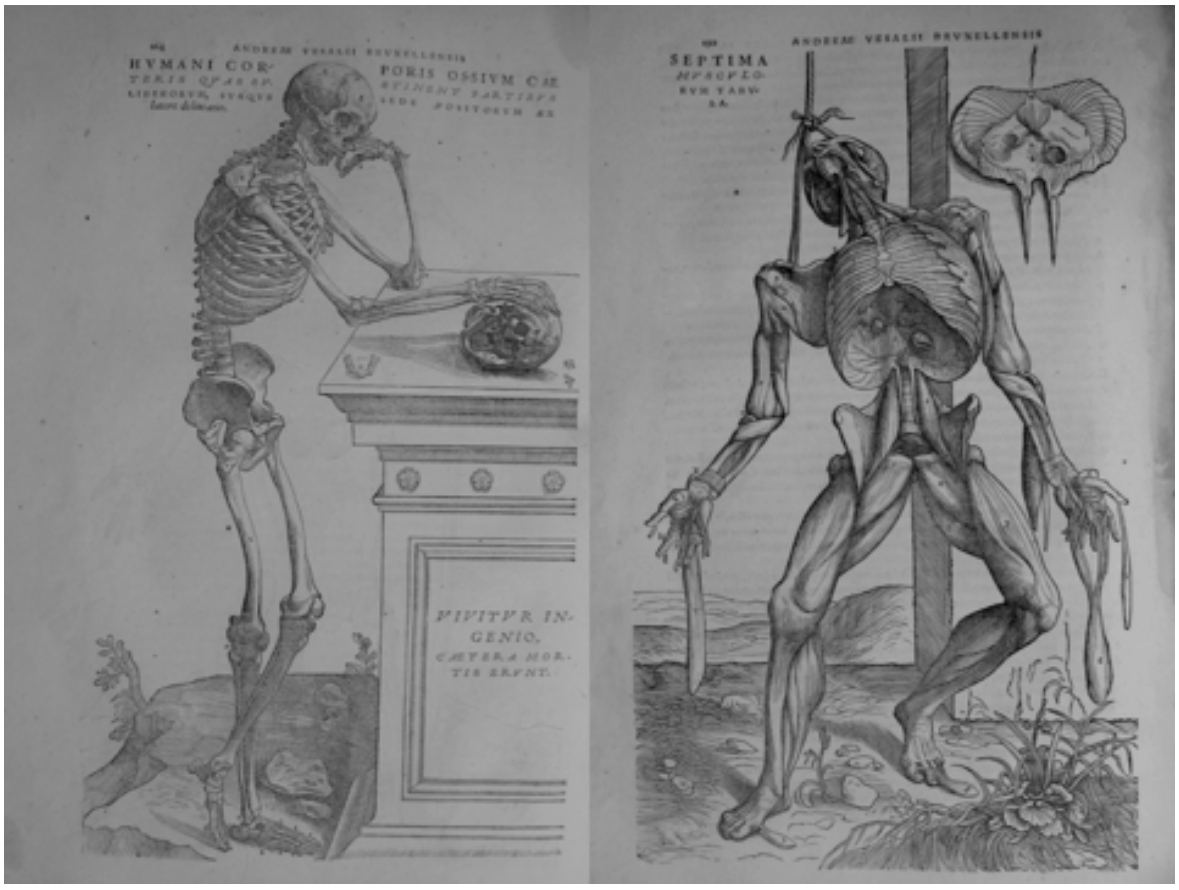

Fig. 7: From the *Fabrica* of Vesalius (1543). Naturalism merges art and science. Courtesy of the Biblioteca *"V. Pinali"*, University of Padua.

We believe that this important precedent stimulated the transition, over a few years, to the pioneering attempts to print coloured engravings.

Although current colour printing would become possible only centuries later, the earliest essay in this sense was that of Gaspare Aselli (1581–1626).
Published posthumously (Milano 1627), his book *De lactibus sive lacteis venis*[13], where the discovery of lymphatics is reported, contains four woodcuts, which are the first anatomical pictures printed in colours [Fig. 8].

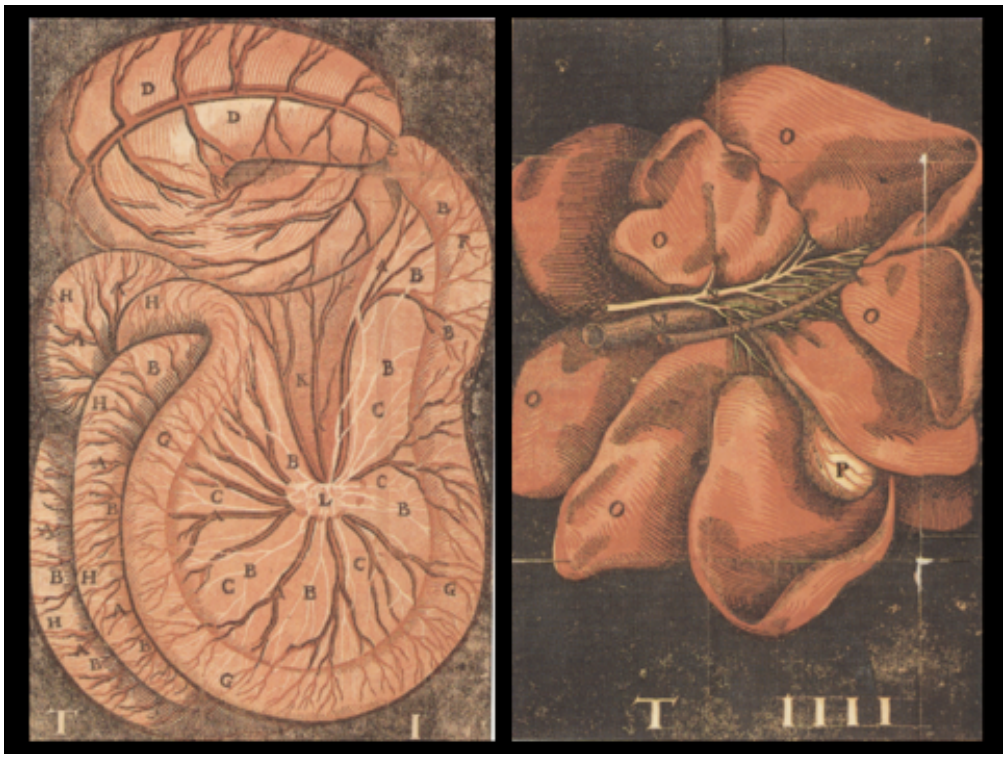

Fig. 8: First and fourth tables from *De Lactibus sive lacteis venis dissertatio* by Gaspare Aselli (1627), representing the gut and liver of a dog. On the first table the lymphatic vessels are displayed for the first time. The four woodcuts are the first anatomical illustrations printed in colour.
Courtesy of the Biblioteca *"V. Pinali"*, Padua University.

During the first half of the XVIII century pioneering, isolated prints of polychrome anatomical illustrations were produced in France by Jacob Christoph Le Blon (1670-1741), who conceived the idea of copper engraving in colours, and by his pupil Jan Ladmiral (1698-1773).

The work of Jacques Fabian Gautier d'Agoty (1717-1786), also a pupil of Le Blon, was more relevant.
In his *Essai d'Anatomie* (Paris 1745) and *Myologie complète ... en tableaux imprimés en couleur et grandeur naturelles* (Paris 1746) he perfected this technique [Fig. 9].

Although d'Agoty's prints had not been considered of good anatomical quality by Choulant, he fully recognized their historical importance:

"His anatomic illustrations, while they may perhaps be fascinating to the layman, on account of their size and vivid execution, … do not recommend themselves to the student of anatomy either for their faithfulness and reliability …, but they will always retain their value in the history of art and especially in the history of anatomic illustrations."

Fig. 9: Figure illustrating the brain and the sinuses. From *Essai d'anatomie en tableaux imprimés... par le Sieur Gautier, seul Privilégié du Roy dans le nouvel Art…* (Paris, 1745).
Courtesy of the Biblioteca *"V. Pinali"*, Padua University.

However, the technique was very expensive and it was not exploited further, so these accomplishments remained isolated. It was only at the turn of the century that the lithographic technique was introduced by Aloisius Senefelder (Prague 1771-1834), and this was later followed by chromolithography, so that the print in colours became widespread.

The *Tabulae pictae* and a manuscript on the nervous system

The third volume of the *Tabulae pictae,* entitled *De Anatomia Capitis Cerebri Nervorum Figure Varie,* deals with the Nervous System and contains the only known illustrations by Fabrici regarding neuroanatomy. It consists of 21 coloured paintings representing the meninges, the brain, the spinal cord, the cranial nerves, the spinal plexuses and the nerves of the limbs with their muscles and blood vessels[14].

Despite this splendid collection, we have not found, in our extensive search on the whole of Fabrici's printed scientific production, either a systematic description or an iconographic record regarding the nervous structures which he published[15].

However, we definitely know that Fabrici composed neurological works[16]: the fact is documented by two lists of manuscripts, respectively contained in his holograph will of 1615, and in a letter of 1622 written by the *Rettori* to the *Riformatori dello Studio di Padova*.

In the first list, three manuscripts dealing with neurological subjects are quoted: *De Capitis facultatibus, earumdemque actionibus, et proprio ac praecipuo actionum organo, De communibus Instrumentis, ut puta venis, arteriis et nervis in totum corpus discurrentibus, De instrumento odoratus.*
In the second list, are quoted five: *De cerebro et anatomia cerebri*, *De fantasia, De intelectu, De memoria, De nervis.* At present, none of them has been recovered.

Nevertheless, some indirect information on the specific interest of Fabrici about the illustration of the Nervous System can be obtained from a paper we just published in this same journal[17].
We found in the Biblioteca Comunale degli Intronati of Siena a manuscript[18] entitled *De anathomia quaedam excerpta sub excellentissimo Aquapendente anno 1584,* illustrated with 13 anatomical sketches.
A careful analysis of the manuscript precludes its being from the hand of the famous anatomist himself. But even if it appears to be a collection of lecture notes taken by an anonymous student, this manuscript constitutes the only written description, although indirect, of the dissection procedure of neuroanatomical parts by the renowned anatomist.

Closer examination of the thirteen anatomical sketches drawn by the diligent Paduan observer shows the representation of some structures which could not have been easily visible during dissection, especially when considering that a close approach to the body was possible only to a few observers.
Indeed, the space situated immediately around the anatomical table (*"luoghi da basso"*, i.e. *"the lower positioned places"*, which were those immediately surrounding the dissection) was not for the students, but was reserved for public authorities.

Therefore, even supposing that our note-taker had the most favourable position in the first row, the distance would have been too considerable to see clearly and to be able to draw structures such as the so called *rete mirabile* [Fig.10].

It is reasonable to infer that the professor would indicate, with auxiliary illustrations, the anatomical parts which were difficult to make visible through dissection.

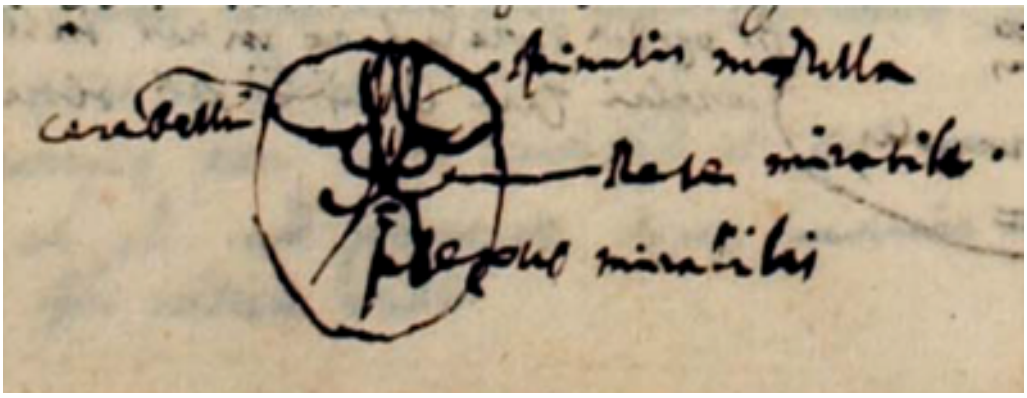

Fig. 10: Fifth drawing of the neurological section of the manuscript *De anathomia quaedam excerpta sub excellentissimo Aquapendente anno 1584* (c.69 verso), possibly by an anonymous student. On the right is written *"Spinalis medulla, Rete mirabile, Plexus mirabilis"*. On the left side: *Cerebellum*. Courtesy of the Biblioteca Comunale degli Intronati. Siena, Italy.

The existence of these sketches suggest the use of antecedents of the *tabulae pictae*, that could therefore be dated in the early 1580's. If so, at least some of those dealing with the representation of the nervous system could have been painted as early as in 1584 or before, even though the first explicit reference to the *tabulae pictae*, that of Fabrici himself, was made in 1591[19]. This in turn would expand the chronological range regarding the attribution to the still unknown artist/s who painted the *tabulae*, adding a new element to the open debate on the authorship of this anatomically and artistically outstanding iconography.

The information gleaned from the text and the accompanying drawings appear reliable, not least because unidentified student's notes seem to be accurate and faithful, even echoing what could only be the voice of his famous teacher addressing his students with words which, while manifestly referring to Aristotelian cosmology, possess a fascinating poetical accent:

> *"I am undertaking to describe a marvelous miracle of nature, the head… the most divine of the parts [of the body] and connected with God because of its faculties. I am not astonished by the sky, by its splendor, light, vastness, movement, for it originates from pure celestial substance. I am instead overwhelmed by the head and the brain, which, although constituted of impure and corruptible matter, are nevertheless a site of the divine intellect…"* [20].

But despite the above quoted important source, since no original manuscript on the Nervous System by the hand of Fabrici reached us, a thorough, direct study of his

Tabulae pictae is pivotal to better understand the contribution given by him on the subject. As we have seen, the *Tabulae pictae* were produced by Fabrici as a document of high scientific value and of notable practical use: however, it should be noted that, until now, compared to aesthetic evaluations, paradoxically, neither a detailed description of the morphological aspects nor analysis of the research content within them have been carried out in a comprehensive manner. We previously proposed a study of the anatomical structures of seven tables of this neurologic collection and are now completing a conclusive report on the entire neurological series. Here, a detailed anatomical analysis of just one table is presented, to give a sample of the innovative content of these pictures besides the naturalism conferred to them by using colour [Fig. 11].

Fig. 11 a-b: Demonstration of the cavities of the central nervous system.
After complete removal of the *cerebellum*, the fourth ventricle has been opened (a), as well, downward the spinal cord, exhibiting the central channel (b). Upward, the posterior aspect of the *mesencephalon* has been cut, between the left and the right *colliculi*, to show the *aqueduct* (c). The dissection continues further upward: the floor of the third ventricle (d) is made visible after removal of the *commissura posterior*. On the left of the painted table, a T shaped cut demonstrates the temporal (e) and the occipital (f) horns of the left lateral ventricle. The *thalamus* (g) is well represented together with the *choroid plexus* (h) in the correspondence of the *sulcus terminalis*. *De Anatomia Capitis Cerebri Nervorum Figure Varie,* Rari 112-3. Courtesy of the Biblioteca Marciana, Venice. Reproduced from [15].

This *tabula picta* gives an innovative demonstration of the cavities of the central nervous system, through an anatomical preparation that is unprecedented for its unusual point of view and is really daring. Indeed, in order to obtain a view of the whole central nervous system, the difficult removal of the posterior aspect of the spine and of the skull had to be performed.

We can conclude that, besides their aesthetic quality, Fabrici's *Tabulae Pictae* appear as a unique document of exceptional scientific value, which remained unsurpassed for centuries. Some representations of the topographical relationship between different parts of the Nervous System are totally innovative[21-22], as can be seen in the upper part of the plate [Fig. 12], showing the cranial nerves entering the skull.

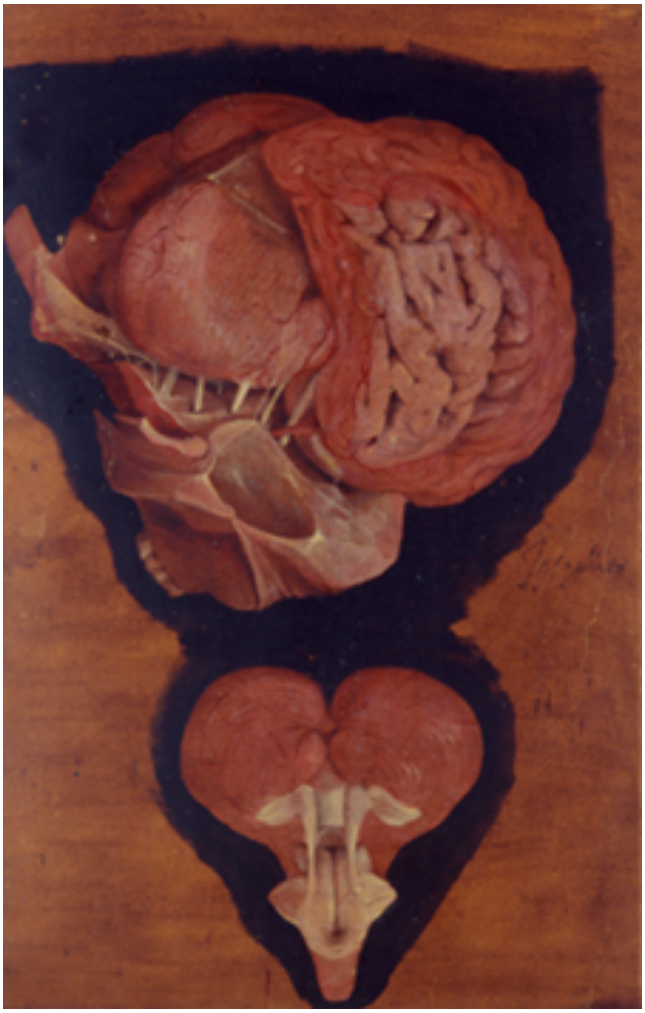

Fig. 12: In the upper part of this illustration, the relationship between cranial nerves and the base of the skull is shown. *De Anatomia Capitis Cerebri Nervorum Figure Varie,* Rari 110-2. Courtesy of the Biblioteca Marciana, Venice

Fabrici deserves merit for having first established the outstanding relevance of the use of colour in anatomical images, realised in the only possible way then available, that is by painting.

Thanks to the innovative use of colors, his *Tabulae Pictae* represent the highest iconographic achievement attained by the 16th-century Padua Medical School, well demonstrating its aim for a sound naturalistic approach, in the line of Vesalius' heritage, and are to be considered the colourful sunrise of modern Neuroimaging.

The present paper is based mainly on G. Zanchin *Il teatro anatomico di Padova*. In: Rappresentare il corpo. Arte e anatomia da Leonardo all'Illuminismo. Bologna 2004, pp. 216-22; G Zanchin *De Anatomia Capitis Cerebri Nervorum. Le tabulae pictae di Fabrici sul sistema nervoso.* In: Il teatro dei corpi. Le Pitture colorate d'anatomia di Girolamo Fabrici d'Acquapendente. Mediamed, Milano, 2004 pp. 235–245; G. Zanchin, R. De Caro *The nervous system in colours: the tabulae pictae of G. F. d' Acquapendente*. J. Headache Pain 7:360-66, 2006; G. Zanchin, M. Panetto *Le "tabulae pictae" di G. F. d'Acquapendente*. In: Atti della XXXVIII Tornata degli Studi Storici dell'arte medica e della scienza. Fermo 2008, pp.143-52; G. Zanchin, M. Panetto, E. Hellman Dalla Francesca *Echoes from the anatomical theater of Padua: Fabrici on the nervous system.* Vesalius XXI: 54-62; 2015. Reference to these papers should be made for a more detailed bibliography.

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Former Director of the *Neurological Clinic,* the *Interdepartmental Center for Headache* and the *Neurology School of Specialization* of the University of Padua*,* he is President of the *International Society for the History of Medicine,* Honorary President of the *Italian Society for the Study of Headache* and of the *Academia Panamericana de Historia de la Medicina*. He has produced more than 400 publications in extenso, mainly in the field of headache and of history of medicine, among which the recent volumes *Trattato Italiano delle Cefalee; In Corpore Sano, a medieval medical manuscript; Storia della Società Italiana di Neurologia*.

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18. The entire manuscript consists of 4 unnumbered plus 85 numbered leaves; on page 1 we find the title *De methodo anatomico Excellentissimi Aquapendentis anno 1585*, on page 22 that of *De anathomia quaedam excerpta sub excellentissimo Aquapendente anno 1584.* In this second part are the four chapters bearing the titles *De nervis, De nervis brachii, De nervis cruris*, and *De capite,* illustrated with 13 anatomical sketches.
    The manuscript is preserved at the "Biblioteca Comunale degli Intronati di Siena". The pressmark is C.X.28. It is a paper codex with millboard binding. Size mm. 210 ca. x 160 ca
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Vesalius, Röntgen and the origins of Modern Anatomy.

Adrian M K Thomas

Abstract
The discovery of X-rays in 1895 by Wilhelm Conrad Röntgen transformed our understanding of both the physical world and our understanding of ourselves. Traditional anatomy as shown by Andreas Vesalius was learnt from dissection of the supine deceased body. Radiology showed anatomy in the living in a manner previously not possible, and has transformed our anatomical understanding, particularly of human growth and variation.

Résumé
La découverte des rayons X en 1895 par Wilhelm Conrad Röntgen a complètement transformé notre compréhension autant du monde physique qui nous entoure, que de nous-mêmes. L'anatomie traditionnelle introduite par André Vésale a été montrée et enseignée par la dissection du cadavre en position horizontale.
La radiologie a fait découvrir l'anatomie du vivant d'une façon inconnue jusque-là, et a dès lors transformée notre connaissance de l'anatomie, en particulier du corps humain en croissance et de ses multiples variations.

Introduction

Andreas Vesalius may be seen as the father of our modern understanding of anatomy. Vesalius performed his dissections in the standard manner, using corpses lying supine on a bench. However, in his *De humani corporis fabrica* (On the Fabric of the Human Body) of 1543 he presents human anatomy in both an artistic and scientific manner.
His dissections are shown as animated figures in a landscape, and the figures resemble the living.
This brings to mind the European Dance of Death, otherwise known as the Danse Macabre or Totentanz. The famous Totentanz by Bernt Notke was located in Lübeck's Marienkirche and was destroyed during World War II. It presented the dead dancers as very lively and agile, making the impression that they were actually dancing, where as their living dancing partners looked clumsy and passive in comparison.

Traditional Anatomy

Traditionally human anatomy is encountered in defined locations. These are the anatomy theatre, in operative surgery, the graveyard, and the battlefield.

The discovery of the X-rays by in 1895 Wilhelm Conrad Röntgen was to transform our understanding of both the physical universe and ourselves, and internal anatomy could now be seen in the living.
The famous radiograph that Röntgen made of his wife Bertha's hand was taken on 22 December 1895, and Röntgenthen presented his preliminary report *Übereineneue Art von Strahlen* (On a New Kind of Rays) to the Physical-Medical Society of Würzburg on December 28 1895 [1].

The discovery caused a worldwide sensation, and the public had to be reassured that this was an authentic discovery by a respected scientist [2,3].
This early post card of figures dancing on a beach *Strand-Idyll á la Röntgen* as shown by the X-rays, resembles both the Danse Macabre and the anatomical figures of Vesalius in a landscape [Fig.1].

Fig.1: Strand-Idyll á la Röntgen. X-ray figures dancing on the beach.

Charles Thurstan Holland

The impact of Röntgen's discovery is shown clearly in the work of the Liverpool pioneer Charles Thurstan Holland[4,5] [Fig 2].
Holland became a leader of world radiology, and in 1925 was President of the first International Congress of Radiology.

Charles Thurstan Holland was working as a general practitioner in Liverpool when on 7 February 1896 he saw some of the early X-ray work of Sir Oliver Lodge at Liverpool University College.

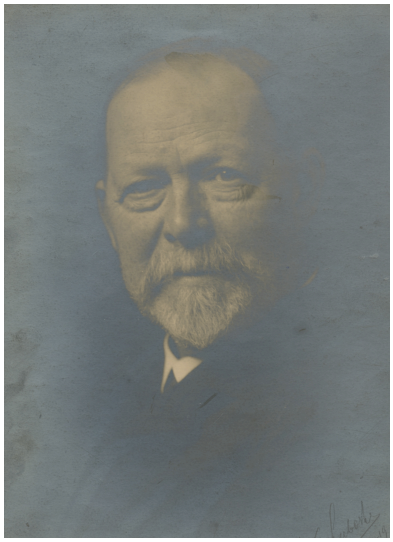

Fig.2: Charles Thurstan Holland

Lodge took some radiographs of a boy who had shot himself in the hand. A successful radiograph was obtained, and writing in 1937[5] Holland says that one cannot today imagine the excitement in the department when the plate was brought out into the daylight and the shadow of the bullet was demonstrated.

Fig. 3. September 17th 1896: Hand of a child at the age of one year. (2 min. exposure, 6 in. coil.)

By the end of May 1896 Holland had an X-ray kit, and as he later recalled, '*There were no X-ray departments in any of the hospitals. There were no experts. There was*

no literature. No one knew anything about radiographs of the normal, to say nothing of the abnormal.'

On September 17th 1896 Holland examined the hand of a child at the age of one year and was fascinated to see the ossifications in the skeleton [Fig 3]. The bones were seen with a clarity never before possible. Holland noted the absence of ossification of the epiphyses, and Holland immediately realized the role that X-rays could have for anatomical studies and in observing skeletal growth.
He started collecting radiographs at different ages of development and later that year he showed them at the British Association Meeting in Liverpool.

John Poland

This early work on bone age by Holland was developed by the surgeon John Poland from the Miller Hospital in Greenwich near London. His bone age atlas[6] was published in 1898, and in it Poland pointed out that the development of the ossification centers differed quite considerably from that which had been previously described [Fig 4].

Fig. 4: Hand of boy aged seventeen years taken by William Webster for John Poland in 1898.

For the hand radiograph of a boy aged 17 years John Poland commented that *'In this instance the epiphyses of the metacarpal bones and phalanges of finger and thumb, though fully developed, have not, as in the two preceding skiagrams (radiographs), joined their respective shafts.'* So the older boy had a lower bone age, showing the need for further work.

This information on normal skeletal development would be essential with the establishment of well-baby clinics, school health programs, and the routine health examination of children, which developed in the first half of the 20th century.

So in 1921 Prof T Wingate Todd in Cleveland, Ohio, began his studies looking at of human growth and development. In 1931, three-month-old children were introduced into the program and children up to the age of 14 years were introduced into the study, which lasted until the summer of 1941. Todd published his *Atlas of Skeletal Maturation of the Hand* in 1937[7]. This ground breaking book used data from the study group and also children from public schools (that is state run schools) and from various social agencies. Todd found that there was a measurable difference between these two groups.
In 1950 William Walter Greulich and D Idell Pyle, who were both anatomists from Stanford, published their Radiographic *Atlas of Skeletal Development of the Hand and Wrist*, with a second edition appearing in 1959[8]. This book remains the standard over 60 years later.

Eugene Corson
John Poland had a particular interest in epiphyseal anatomy. Considerable effort was made in the late 19th Century and early 20th Century in understanding the anatomy of the developing epiphyses and radiographic anatomy.
Eugene Corson, from Savannah, GA, wrote to John Poland 21 November 1900, admiring his book on the *Traumatic Separation of the Epiphyses* and enclosing some reprints. In the November 1900 *Annals of Surgery* in an article *A Skiagraphic Study of the Normal Membral Epiphyses at the Thirteenth Year* Corson had written that *'The X-ray will prove to be a valuable aid in the study of many points of normal anatomy'*, and that *'The bone relationships in joints, the various joint movements, and the different steps in bone development can all be studied in a striking way by the X-ray.'*
It was the clarity of radiography that impressed Colson, who commented that *'the discovery of Röntgen, a discovery which makes possible and easy and an absolutely correct diagnosis where previously uncertainty and error outweighed definite knowledge.'*

William J Morton
William J Morton was an important early figure in radiology in the United States. Morton was 'Professor of Diseases of the Mind and Nervous System and Electro Therapeutics' in the New York Post Graduate Medical School and Hospital.
My copy of his book *The X-Ray or Photography of the Invisible*[9] is undated, however the preface is dated September 11, 1896. Morton's co-author was Edwin Hammer who was an electrical engineer. This book was written following the huge worldwide interest that had taken place following the discovery of x-rays by Wilhelm Conrad

Röntgen and summarised the current state of knowledge. It is important because it is the first book on radiology that was written by a physician, and Morton made speculations about potential future uses for the new rays. Morton makes the very pertinent observation that:

> *'In teaching the anatomy of the blood vessels the X Ray opens out a new and feasible method. The arteries and veins of dead bodies may be injected with a substance opaque to the X Ray, and thus their distributions may be more accurately followed than by any possible dissection. The feasibility of this method applies equally well to the study of other structures and organs of the dead body. To a certain extent, therefore, X Ray photography may replace both dissection and vivisection. And in the living body the location and size of a hollow organ, as for instance the stomach, may be ascertained by causing the subject to drink a harmless fluid, more or less opaque to the X-Ray, or effervescent mixture which will cause distension, and then taking the picture.'*

Morton's words are very perceptive. This book was written less than a year following the discovery of X-rays, and Morton is not only predicting contrast gastrointestinal studies, but also the use of radiology in the equivalent of modern virtual autopsy, or virtopsy.

The pioneers so often realise the exact significance and importance of their observations. Morton had immediately seen that the radiological examination of the body, either living or dead, could produce more information than could be found in either the operating theatre or the pathology department[10].

Angiography and Vascular Anatomy

Morton had indicated that radiography with opaque material, what we would call contrast media, would show vascular anatomy.

In fact, the first angiographic demonstration of anatomy was undertaken in Vienna in January 1896. The physicist Edward Haschek and his medical friend D Th Lidenthal injected a calcium carbonate emulsion (Teichmann's mixture) into the severed arm from a cadaver[11]. The arteriogram exposure was for 57 minutes, and showed the vessels well.

The angiographic work in Vienna was soon followed by work of the group in Sheffield in England.

Prof. Hicks, who was the Principal of Firth College in Sheffield, and Dr. Addison, achieved both a renal and a hand arteriogram. Radiological work had been started at Firth College in Sheffield on February 1, 1896. Hicks and Addison injected specimens that were available in the medical school with red lead and their results were

published later that month in the British Medical Journal of 22 February 1896 in an article entitled *The New Photography in Sheffield*[12].

Dr. Addison in the medical school had performed the vascular injections and on February 6 1896 he had injected samples using the ordinary red lead mass, which was used in the dissecting rooms showing radiographic images of the arteries in the hand and kidney. Delicate branching pattern of the arteries in the kidney and hand were shown in a similar manner to those that have been demonstrated in Vienna a few weeks earlier.

The first X-ray atlas of the arteries of the body was written by H C Orrin, and was published in 1920[13] as The X-ray Atlas of the Systemic Arteries of the Body. Orrin is described as a Civil Surgeon who was attached to the 3rd London General Hospital RAMC (T) located in Wandsworth. The book is beautifully illustrated with beautiful radiographs [Figs. 5,6,7].

Fig. 5. Orrin (1920) Systemic Vessels of the Superior Half of the body.

Fig. 6: Orrin (1920) Vessels of the lower half of the body.

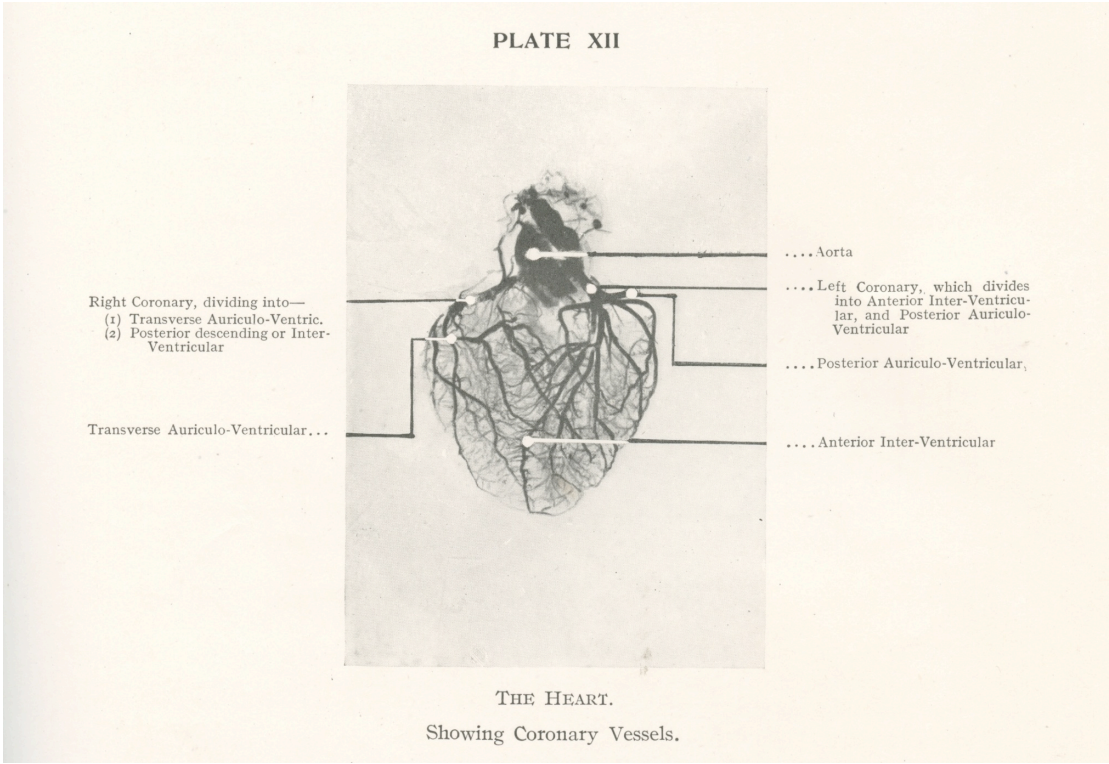

Fig. 7: Orrin (1920) The heart showing coronary arteries.

The book was designed to be used by students of anatomy, surgical anatomy, and operative surgery. It was intended to provide a series of natural illustrations of the systemic arteries in continuity, and precisely as they exist in situ in the undissected body. The aims of the book were therefore purely anatomical in nature. Orrin wrote in his introduction that:

> *'No matter how well dissection is performed, complete continuity of the vessels; their exact relationship to bones; their finest terminal branches; the series of anastomosis into which they enter are seldom if ever accurately displayed or intelligently appreciated by dissection alone.'*

Orrin therefore echoes the earlier words of William Morton. The atlas was accompanied by a full set of stereoscopic radiographs [Fig 8], *'which provide the only possible means of accurately rendering visible the points and details specified.'* It is interesting that in 1920 Orrin recognized the value of 3-D angiography, which is now shown so well using CT or MRI scanning.

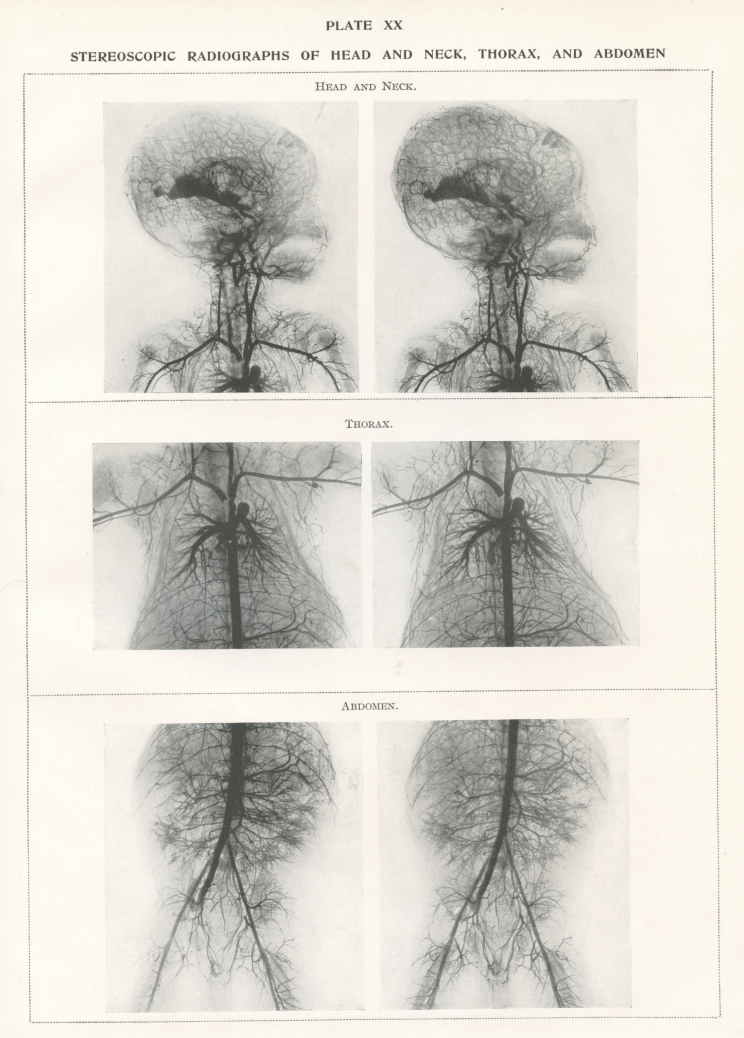
PLATE XX

STEREOSCOPIC RADIOGRAPHS OF HEAD AND NECK, THORAX, AND ABDOMEN

HEAD AND NECK.

THORAX.

ABDOMEN.

Fig. 8: Orrin (1920) Stereoscopic Radiographs of Head and Neck, Thorax and Abdomen.

It was thanks to the work of Egas Moniz and other Portuguese radiologists that the goal of practical angiography in the living was finally realized[11,14]. Moniz had initially tried to opacify the brain itself, and when this failed he started performing intra-arterial injections. His desire to directly show the brain prefigures modern cross-sectional imaging with intra-venous contrast enhancement. Moniz had surmised that if he could concentrate radiopaque material in the brain then the brain would be visible on radiographs. After initial techniques failed, Moniz tried using intra-arterial injections using an iodide salt and was successful on 28th June 1927.

Alban Köhler

Until normality is defined the clinical and legal use of radiographs can only be very limited. However, the question as to what is normal is not as simple as it might seem. On December 4 1896 Thurstan Holland had radiographed a 7-month fetus and the congenital deformities were shown clearly [Fig. 9].

Fig. 9: December 4th 1896: Foetus, about seven months, Six toes, deformed face, no nose (5 min. exposure. 6 in. coil, accumulator).

Variations from normal, either as congenital abnormalities or normal variants were poorly understood at that time. The majority of congenital variations were unknown before X-rays were introduced, and it was largely due to the work of Alban Köhler[16] of Wiesbaden that variations were first described.

As has been stated, traditional anatomy had been learnt on the dead and the new living anatomy shown on radiographs required a new appreciation and understanding of anatomy and its variations.

Since earliest times variations from normality had been recognised, particularly in the animal kingdom. Before radiography the knowledge of human congenital anomalies, apart from gross and visible anomalies, was limited to those found by anatomists at dissection. If the nature of normality is not appreciated in clinical practice there is a danger of medical intervention for non-existent conditions. For example, a lack of understanding of the normal anatomy and physiology as shown on radiography lead to the 'fantasy surgery' for dropped organs (visceroptosis and floating kidneys) and chronic intestinal stasis[17].

The *Lexikon der Grenzen der Normalen und der Anfänge des Pathologischenim Röntgenbilde* was published by Köhler in 1910 [Fig. 2a] and went through a number of German editions and received the highest Röntgen award in Germany, the "Rieder Gold Medal." The book was enormously influential and an immediate classic[18]. Instead of reproducing radiographs the book was illustrated using line drawings [Fig. 10].

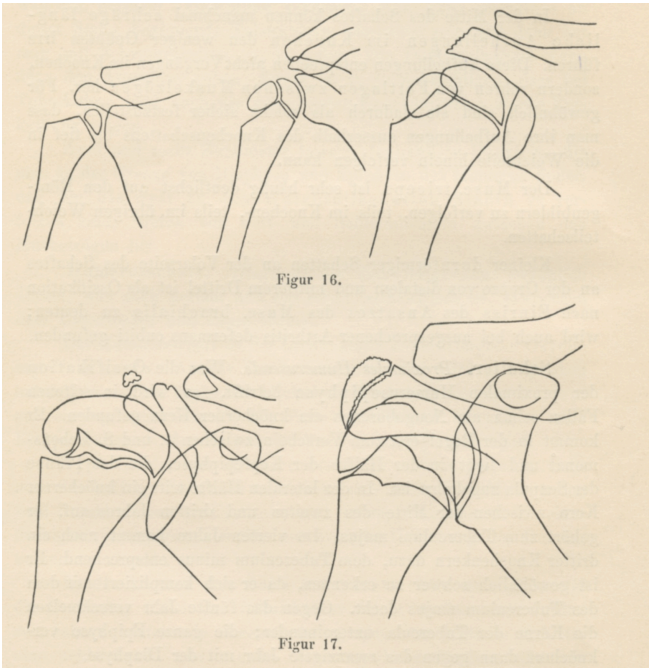

Fig. 10: Line drawings of the development of the epiphyses around the shoulder from the Lexikon der Grenzen der Normalen und der Anfänge des Pathologischen im Röntgenbilde of 1910 by Alban Köhler.

It was translated into English in 1931 appearing as *Röntgenology, The borderlands of the normal and early pathological in the Skiagram* [19] with a second edition appearing in 1935 [20]. In the preface to the 2nd English edition the great American radiologist James T Case indicated the usefulness of the book 'to physicians and lawyers whose work brings them in contact with problems on legal medicine.' Case wrote that 'how many foolish actions would be avoided and unjust decisions righted by a sufficient dissemination of the knowledge of developmental appearances in the radiogram.' He then described a ridiculous damage suit over an alleged fracture of the spine, allowed as a just claim in a high court of law. The deciding testimony was that

of a surgeon who declared the radiograph clearly demonstrated a fracture, where as in reality was a long-standing hypertrophic osteoarthritis with huge osteophytes almost uniting the lumbar vertebrae into one bony mass; and what the surgeon interpreted as a fracture was in reality only a small island of calcification just separating two of the opposing bony outgrowths. In this instance faulty evidence based on ignorance lead to a serious miscarriage of justice.

The work of Alban Köhlerhas been continued by Theodore Keats from Charlottesville, Virginia. His *Atlas of normal Roentgen variants the may simulate disease* first appeared in 1973 and is currently in its 5th edition [21] and is a modern classic and its presence in most, if not all, radiology departments is a witness to its value. As each new imaging technique develops the normal and abnormal appearances need to be learned afresh.

Modern Anatomical Studies

With the development of the CT and MRI scanners in the 1970s and 1980s the internal anatomy can now be shown routinely in exquisite detail. The level of anatomical detail shown is now so detailed that many have recommended that dissection for learning anatomy be no longer used. The replacement of dissection by medical imaging in medical schools has taken place for a variety of reasons. So in the Peninsular Medical School[22,23] it is believed that since we encounter anatomy in clinical practice through living and surface anatomy and medical imaging, that it would be best to teach students anatomy in these contexts right from the beginning of their studies. However, Gunderman and Wilson[24] reviewed arguments about how radiology and anatomical dissection can work synergistically to create a level of understanding that is difficult to achieve by either method alone. Dissection of a body will give an insight into the nature of mortality and the human condition that medical imaging alone cannot provide.

Cadaveric dissection offers an active and hands-on exploration of human structure, and provides deep insights into the meaning of human embodiment and mortality[24], and can also offer a rite of passage into the medical profession. As Gunderman and Wilson emphasise, despite its important strengths radiology cannot be simply substituted for cadaveric dissection, and so the best models for teaching gross anatomy will use both approaches. The combination of dissection and radiology will therefore allow the student to develop a clinically appropriate and useful three-dimensional image of the body.

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Neuroimaging Five Hundred Years Later

Giuseppe Rolma

Abstract
The rapid technological progress of these last decades has brought refined instruments to neuroradiologists and consequently to anatomists, physiologists, neuroscientists. A short outline is given on recent advancements in the field. Looking at these wonderful images we must not forget the works of our predecessors, to whom we owe an inextinguishable gratitude.

Résumé
L'évolution technologique des dernières décennies a conduit à des instruments de haute qualité à l'usage des neuroradiologues et par conséquent aussi des anatomistes, physiologistes et neuroscientifiques. Un aperçu général est présenté ici, détaillant les découvertes récentes dans ce domaine. En admirant les images actuelles superbes, on ne peut oublier les travaux de nos prédécesseurs, à qui nous devons toute notre gratitude.

Galen's influence lasted almost thirteen centuries. His theories, uncritically accepted, dominated this incredibly long period until the Renaissance, when Vesalius turned to systematic dissection of human corpse as a mean of direct verification, therefore laying the anatomical fundaments for the physiological and pathological revolution that brought to contemporary medicine. The faithful, precise observation and report of the body structures, the naturalistic method, opened the era of realistic reproduction of the morphology of different organs. Indeed, if we look at the brain engravings of the Vesalius' revolutionary treatise on anatomy, *De Humani Corporis*

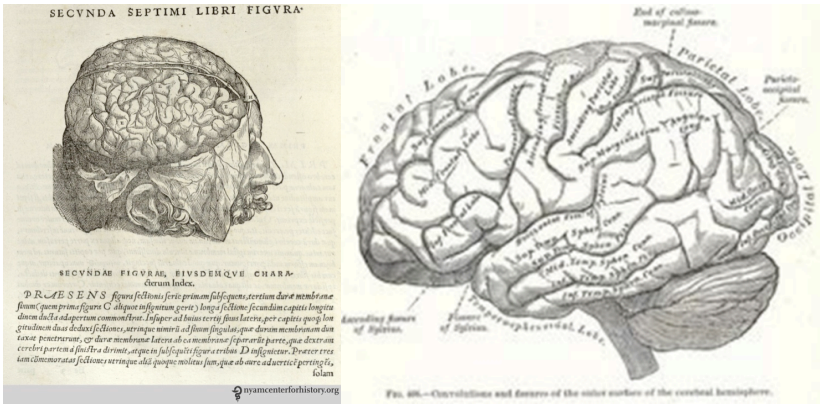


Fig. 1a: An engraving from *De humani corporis fabrica* showing the surface of the brain (1543). Fig.1b. An illustration of the brain from *Gray's Anatomy* (1918).

Fabrica (1543), and at the pictures of *Gray's Anatomy* (1918), besides the obvious differences, we appreciate the continuation of the same methodology laid down by the Vesalian heritage bound to the accurate, objective report of the anatomical details [Fig.1 a & b].

But, this early phase of neuroimaging, that lasted for centuries, was limited to the reproduction of the anatomy studied in the cadaver. During the first decades of twentieth-century neuroimaging was based mainly on angiography [Fig.2 a & b], first performed in 1927 by António Caetano de Abreu Freire (Egas Moniz), a Portuguese psychiatrist and neurosurgeon, pneumoencephalography [Fig.3 a & b], introduced in 1919 by the American neurosurgeon Walter Dandy.

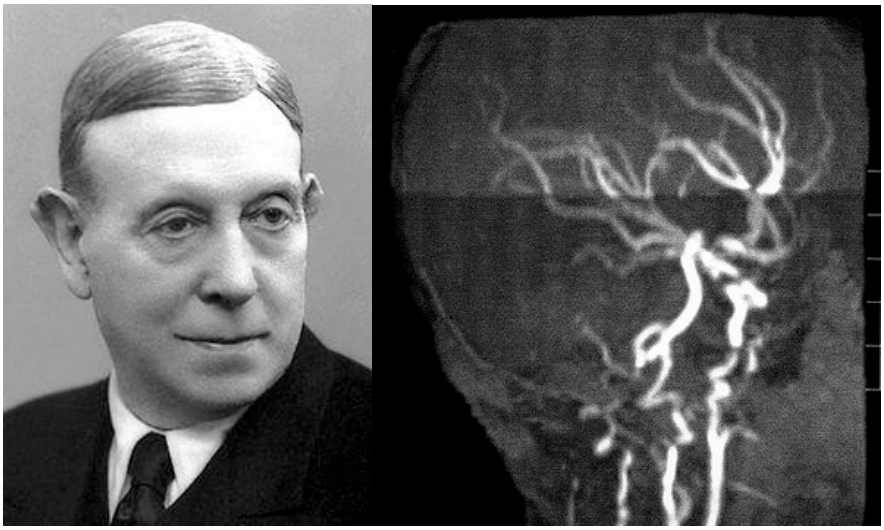


Fig. 2a: Egas Moniz and Fig. 2b One of the first cerebral angiograms.
A História da Neuroimagem, R. M.E. Sabbatini, 2003.

Fig. 3a: Walter Dandy

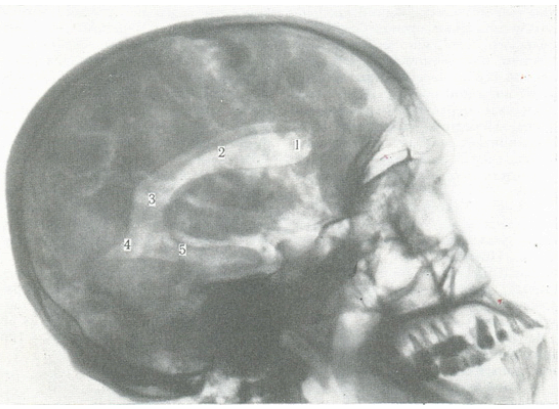


Fig. 3b: Early pneumoencephalography

Only with the first computed tomography (CT) head scanner, installed at Atkinson-Morley Hospital in 1971, Godfrey Hounsfield obtained direct images of a live human brain [Fig. 4 a & b]; a cutting edge innovation in medicine, of outmost clinical usefulness, comparable to the discovery of the X-rays made by Roentgen in 1895, that opened a new era in neuroimaging.

For this accomplishment Hounsfield shared the 1979 Nobel Prize for Physiology and Medicine with Allan McLeod Cormack.

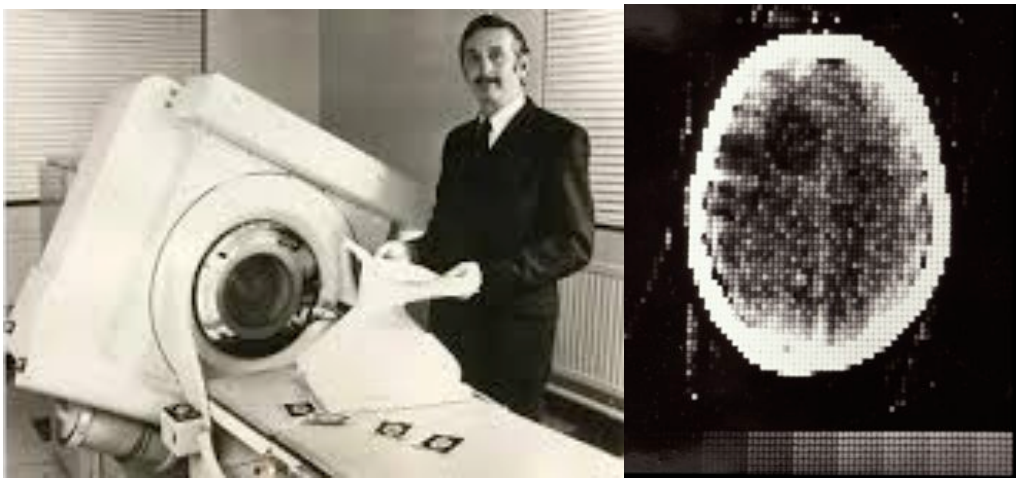


Fig. 4a: Godfrey Hounsfield beside his CT head scanner at Atkinson-Morley Hospital.
Fig. 4b: The first CT brain image showing a cystic lesion located in the right frontal lobe.

This concise historical reference shows that, due to methodological and technological improvements, scientific progress is nowadays developing exponentially, especially in the field of radiology. Neuroradiology, in particular, greatly benefited from new advancements. Coupling X-ray or magnetic resonance imaging techniques with powerful and fast computers provides *in vivo* superb details of parenchymal structures and vessels, and allows studies of functions and perfusion, giving metabolic and molecular information (DWI, Spectroscopy). The "tools" for obtaining this are Computed Tomography (CT) and Magnetic Resonance (MR) with their different applications. Angiography, who was the pillar of neuroimaging until the 70's, is losing its diagnostic role in favor of interventional neuroradiology.

COMPUTED TOMOGRAPHY

The earlier scanners worked in a stepwise way ("stop and shoot"). They were slow and acquired only two-dimensional images, or axial images; so resolution along the "z" axis, a line that courses in a cranio-caudal direction through a patient positioned horizontally in a scanner, was consistently inferior to short axis (CAT or Computed Axial Tomography).

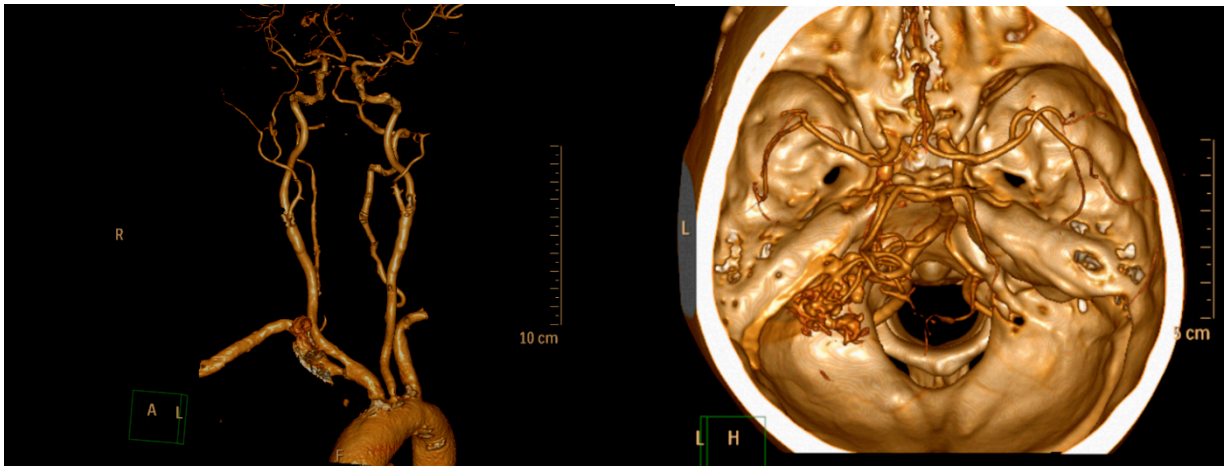
CT scanners technology evolved, becoming spiral, or helical, in the 80's, coupling a 360° rotation of the X-ray tube to a simultaneous patient table movement. A subsequent development of helical CT was multi-slice (or multi-detector, MDCT); instead of a single row of detectors, multiple rows of detectors are used capturing multiple cross-sections simultaneously. MDCT has rapidly evolved from 4-detector row systems in 1998 to 256-slice and 320-detector row CT systems[1]. With smaller detector element size and faster gantry rotation speed, spatial and temporal

resolution of the MDCT scanners has greatly improved, allowing rapid examination especially of critical patients (stroke, trauma). Recent advances in multi-detector CT technology have made the acquisition of isotropic data feasible in nearly every CT examination[2]. Anisotropic data consist of voxels (volume element) that along an axis have a section thickness greater than the other two, so that there is an intrinsic difference in different planes of the space, worsening the quality of images when developed in a non-axial dimension. Instead, when the section thickness is equal to the pixel size, so that the voxel is a cube, the data are isotropic.

Since modern CT scanners acquire large amount of data, post processing applications allow reconstructions in the three planes of the space, with transformation of axial CT data into nonaxial, tridimensional images. Such applications include multi-planar reformation (MPR) and maximum intensity projection (MIP) for the reconstruction of two-dimensional images and volume rendering for the creation of three-dimensional images. Two-dimensional (2D) and three-dimensional (3D) visualization methods are routinely employed for accurate imaging facial fractures or spinal traumatic lesions [Fig. 5], providing detailed and easy understandable images for rapid surgical planning. In the emergency situation (stroke or subarachnoid hemorrhage), a robust and fast imaging technique capable of answering vital clinical questions and allowing clear therapeutic decisions is mandatory.

Fig.5: Volume rendering CT of complex orbital, maxillary and mandibular fractures and control surgery.

CT angiography (CTA)[3], using multi-slice scanning non-invasively, provides imaging of whole supra aortic circulation from the aortic arch to the intracranial vessels [Fig.6 a & b]. CTA has been shown to have a sensitivity of 95% and specificity of 98% for the detection of stenosis greater than 70%.



Figs. 6a & b:3D angio-CT of carotid, vertebral and intracranial arteries obtained with multi-slice scanner and contrast-medium injection (Neuroradiology Unit, Padua).

Differentiation between lipid, fibrous and calcified plaques may be possible, especially with multi-slice scanning. Multislice CTA can in addition detect "tandem stenosis" in the region of the carotid origin from the aorta, the carotid siphon, and the intracranial portion of the carotids. CT is able to provide a comprehensive evaluation of patients with acute stroke by using a combined approach: pre-contrast CT can detect hemorrhage or manifest infarction; CT brain perfusion differentiates between *penumbra* and infarct, being able to delineate ischemic areas of the brain which may be salvaged by intervention (e.g. thrombolysis or clot retrieval), known as the *penumbra*, from the parts which are infarcted or irrevocably destined to go onto infarct regardless of therapy, known as the infarct core; CTA detects the occluded vessel as well as potential concomitant carotid abnormalities.

MAGNETIC RESONANCE

MR is the most promising technique for brain functions mapping and tissues characterization. The broad spectrum of MR contrast mechanisms makes MR~~I~~ one of the most powerful and flexible imaging tool for diagnosis in the CNS. From the very beginning MRI was multi planar and provided *in vivo* tissues characterization and superb detail of parenchymal structures. The amount of available signal in magnetic resonance imaging (MRI) is tied to the static magnetic field strength of the imaging system. Most MRI scanners for clinical use operated at field strengths ranging from 0,5 to 1.5 Tesla, but 3 Tesla clinical scanners are now widely available. There is a sort of gold rush for higher field scanners (7-11 Tesla), due to the benefits of higher signal-to-noise ratio, contrast-to-noise ratios and spectral resolution, since in any case increasing the field strength increases the quality of the anatomical detail. One of the most interesting applications of MRI is Diffusion Weighted Imaging (DWI). This technique shows the diffusion process of molecules, mainly water, in biological tissues *in vivo* and non-invasively. Molecular diffusion in tissues is not free, but reflects interactions with many obstacles, so restricted diffusion occurs in presence of

macromolecules, fibers, and membranes. A typical example is brain abscess [Fig.7], in which cellular debris and bacteria limits the free diffusion of water molecules, leading to an elevated signal. In this way it is possible to make a differential diagnosis with necrosis, occurring for instance in metastasis or glioblastoma, that shows a low signal.

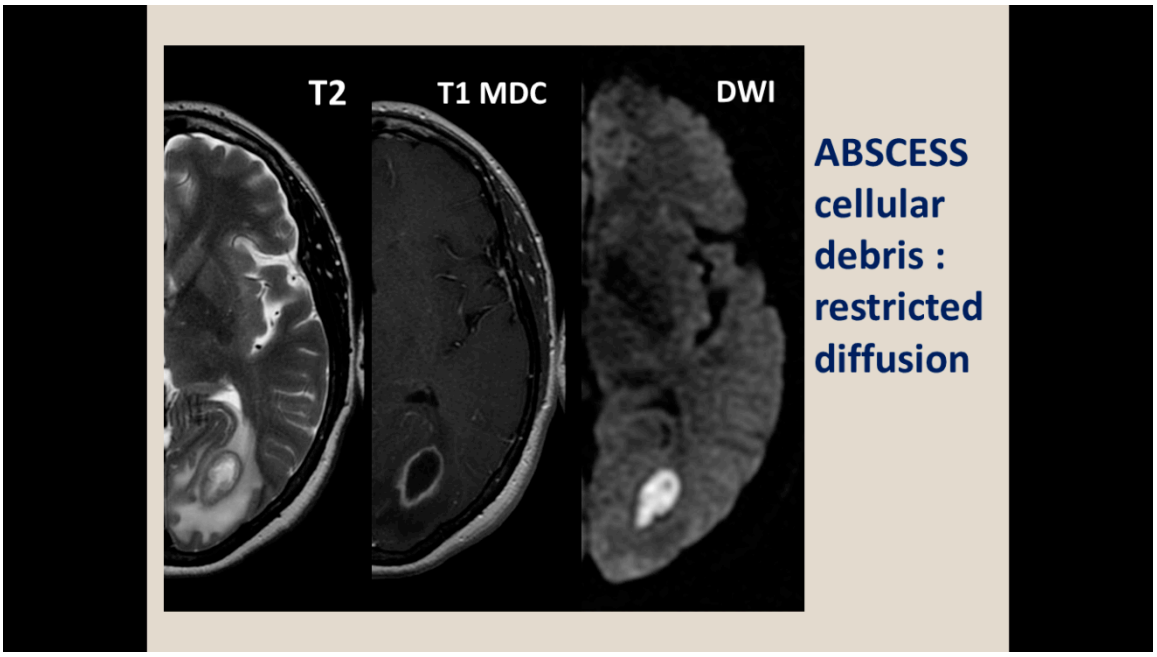


Fig. 7: From left to right: small lesion in the left occipital lobe; T2 weighted image shows fluid content in the core of the lesion. After contrast administration (gadolinium) T1-weighted image shows subtle enhancement of its wall. The DWI sequence shows restricted diffusivity of the content of the lesion suggestive of purulent material (pyogenic abscess).

Another pivotal application of DWI imaging is the differentiation of cytotoxic versus vasogenic edema. We know that the Na/K pump has a crucial role in cell osmotic stabilization. In case of brain ischemia, there is a lack of energy and consequently a failing of the Na/K pump, with water accumulation inside the cell (so called "cytotoxic edema"). The increase of water inside the cell leads to an enhanced MRI signal, allowing to detect hyper-acute brain ischemic changes.

We know that protons in different molecules resonate at slightly different frequencies because the local electron cloud affects the magnetic field experienced by the protons. Thank to this, it is possible to obtain spectra of distribution of brain metabolites. Magnetic resonance spectroscopy (MRS), is a non-invasive analytical technique used to study metabolic changes in various diseases (tumor, stroke, seizure, metabolic or degenerative diseases) affecting the brain [Fig. 8].

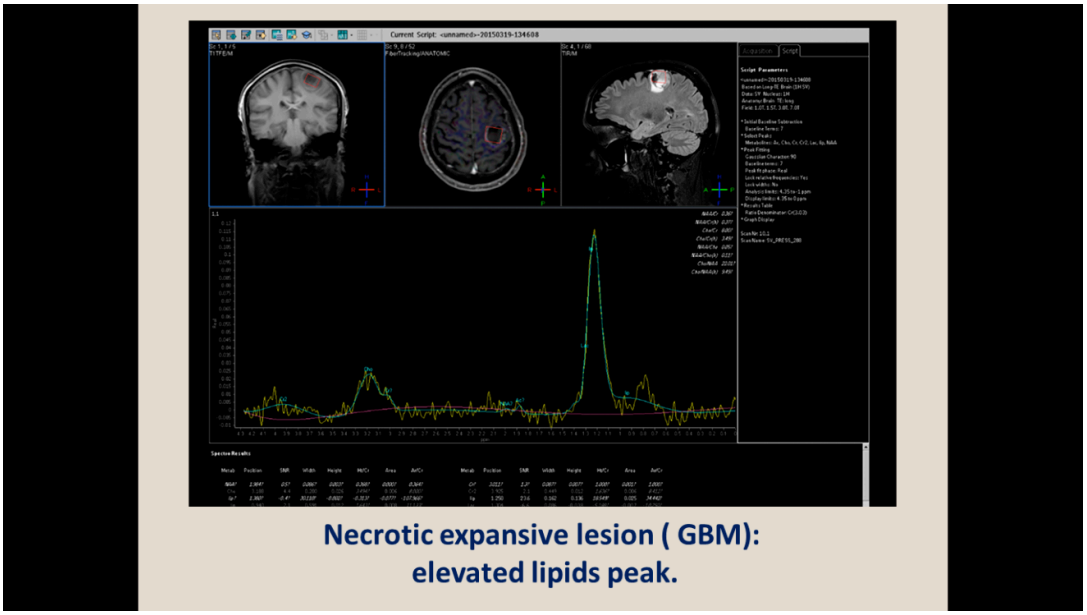


Fig. 8: Left frontal necrotic tumor (GBM) spectroscopy: an elevated lipids peak is caused by the presence of products of brain destruction (Neuroradiology Unit, Padua).

MRS is often coupled with MRI techniques, allowing for the identification and quantification of metabolites in previously-determined volumes in the brain. The commonest observables metabolites are lipids (products of brain destruction); lactate (marker of anaerobic glycolysis); NAA (N-acetyl aspartate, neuronal marker); creatine (energy metabolism indicator); choline (cell membrane marker); myo-inositol (glial cell marker).

A further application of DWI is Diffusion Tensor Imaging (DTI); this is important when a tissue, such as the neural axons of white matter in the brain, has an internal fibrous structure analogous to the anisotropy of some crystals. Water will then diffuse more rapidly in the direction aligned with the internal structure, and more slowly as it moves perpendicular to the preferred direction (anisotropy). DTI describes the magnitude, the degree and the orientation of diffusion anisotropy. Estimates of white matter connectivity patterns in the brain from white matter tractography may be obtained using the principal diffusion directions. Measurement of the signal attenuation from water diffusion is one of the most important contrast mechanisms. In particular, DTI may be used to map and characterize the differences in the three-dimensional diffusion of water as a function of spatial location. Traditionally, in DWI, three gradient-directions are applied, sufficient to estimate the trace of the diffusion tensor or "average diffusivity", a putative measure of edema. More extended DTI scans derive neural tract directional information from the data using 3D or multidimensional vector algorithms based on six or more gradient directions, sufficient to compute the diffusion tensor. Moreover, the principal direction of the diffusion tensor can be used to infer the white-matter connectivity of the brain (i.e. tractography) trying to see which part of the brain is connected to which other part [Fig. 9 a & b].

The localization of tumors in relation to the white matter tracts (infiltration, deflection), has been one of the most important applications of tractography. In surgical planning for some types of brain tumors, surgery is aided by knowing the proximity and relative position of the corticospinal tract, for example, and of the lesion.

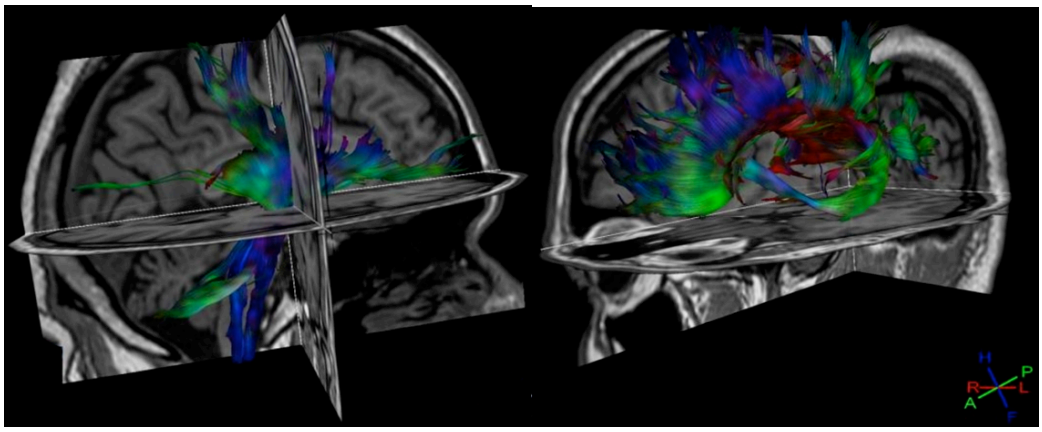


Fig. 9a & b: Tractography in healthy volunteer delineating cortico-spinal tract (on te left) and corona radiata (on the right). Neuroradiology Unit, Padua.

Studies on the relationship between cerebral blood flow and metabolism had a pioneer in Angelo Mosso, an Italian physiologist who in the late 19th century invented the human "circulation balance" [Fig. 10 a & b].
Mosso began by recording the pulsation of the human cortex in patients with skull defects following neurosurgical procedures, finding that these pulsations change during mental activity; so he inferred that during mental activities cerebral blood flow increases.

Mosso's human circulation balance operated on a simple idea, untested at the time: the brain needs more blood when it works harder.
He would have volunteers lying down on a long wooden plank, carefully balanced on a fulcrum, like a seesaw. He calibrated for anything that might throw off the balance, like the rise and fall of the volunteer's breathing.
Then with everything secured, he would ring a bell. Mosso reasoned that his volunteer's brain would have to process the sound, requiring more blood, in turn increasing the cerebral weight, which would tip the scale toward the head's side.

This brilliant intuition somehow anticipated the current functional MRI[4]. Neurons do not have internal reserves of energy, so when they are activated there is a need for

more energy to be brought in quickly. Through a process called the hemodynamic response, blood releases oxygen to them at a greater rate than to inactive neurons.

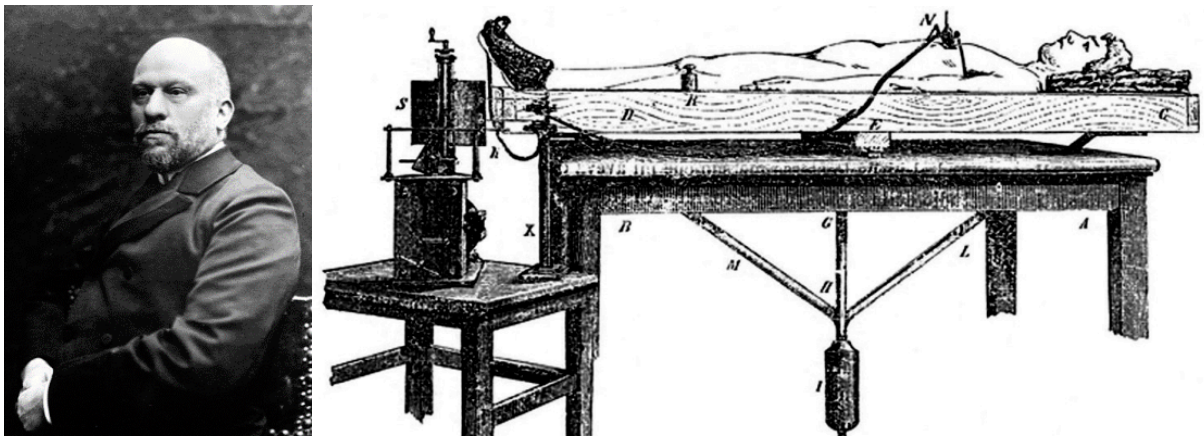


Fig. 10 a & b: Angelo Mosso and his human "circulation balance".

This causes a change of the relative levels of oxyhemoglobin and deoxyhemoglobin (oxygenated or deoxygenated blood) that can be detected on the basis of their differential magnetic susceptibility. This complex phenomenon is called blood-oxygen-level-dependent (BOLD) effect and it is the basis of functional MRI.

Seiji Ogawa and colleagues in 1990, following an experiment which demonstrated that an in vivo change of blood oxygenation could be detected with MRI, first explained the phenomenon. Other notable pioneers of BOLD fMRI include Kenneth Kwong and colleagues, who first used the technique in human participants in 1992. To obtain activation of definite areas of the brain, we must submit the subject to an appropriate task, for instance finger tapping to cause motor cortex activation [Fig.11].

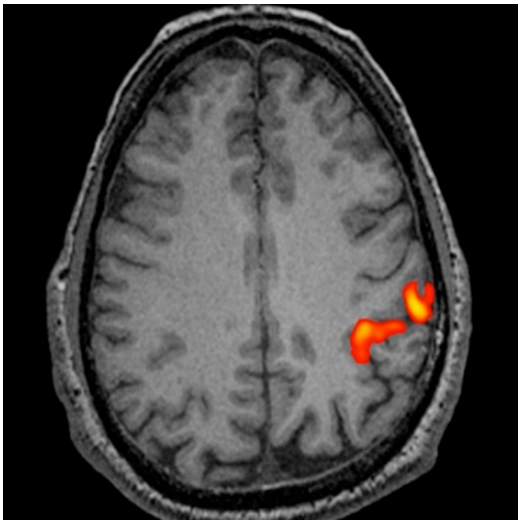
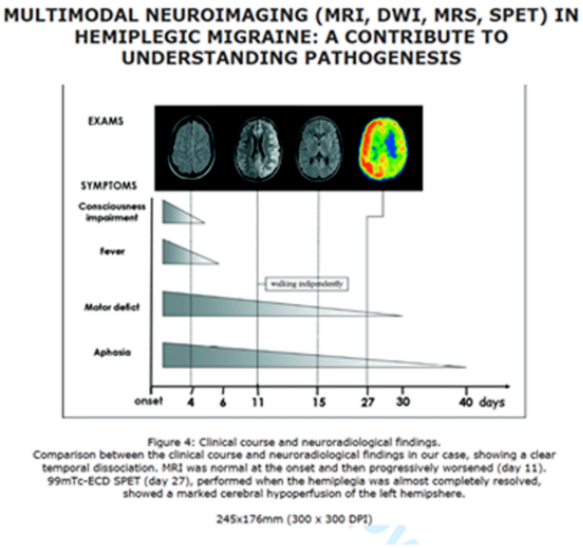


Fig. 11: fMRI evidences cortical activation of motor cortex during motor task (finger tapping) in healthy volunteer. Neuroradiology Unit, Padua.

But there exists also a method that can be used to evaluate regional interactions that occur when a subject is not performing any explicit task. This is called resting state functional MRI (rsfMRI)[5] and explores the network that links different regions of the brain, which continuously share information with each other. The Default Mode Network (DMN) for example, is a network of brain regions that are active when an individual is awake and at rest. This application is particularly useful in non-collaborating patients. Current and future applications of DMN studies are disease condition and changes in rsfMRI, among which: Alzheimer's disease (decreased connectivity); autism, depression, schizophrenia, aging brain, Parkinson's disease, pain disorders (altered connectivity); attention deficit hyperactivity disorder (altered "small networks" and thalamus changes); epilepsy (disruption and decrease/increase in connectivity); obsessive compulsive disorder (increased/decreased connectivity).

Neuroimaging is getting new impulse from the coupling of Positron Emission Tomography (PET) and MRI[6], combining the advantages of functional imaging proper of nuclear medicine and those of magnetic resonance, such as anatomic detail and tissue characterization [Fig.12]. The relatively symmetric, stationary, and rigid structure of the brain makes it ideal for imaging. Combining PET MRI unit, it is possible having PET detector units that do not interfere with magnetic fields (avalanche based photodiodes).



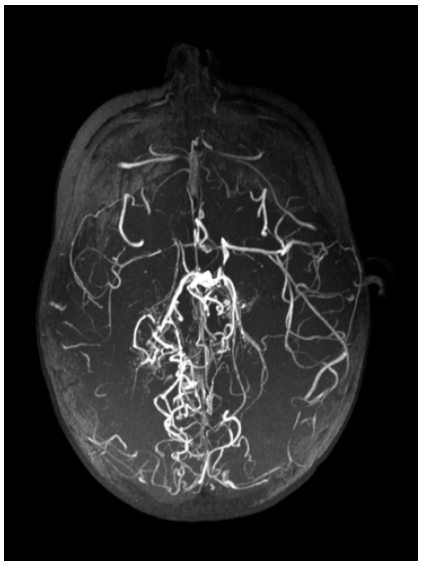


Fig.12a: Multimodal Neuroimaging - MRI, SPET in a case of hemiplegic migraine. Fig.12b: angio MRI for study of moya-moya. (Figs.12 a,b,c all courtesy of Prof. D. Cecchin–Nuclear Medicine–Padua).

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more energy to be brought in quickly. Through a process called the hemodynamic response, blood releases oxygen to them at a greater rate than to inactive neurons.

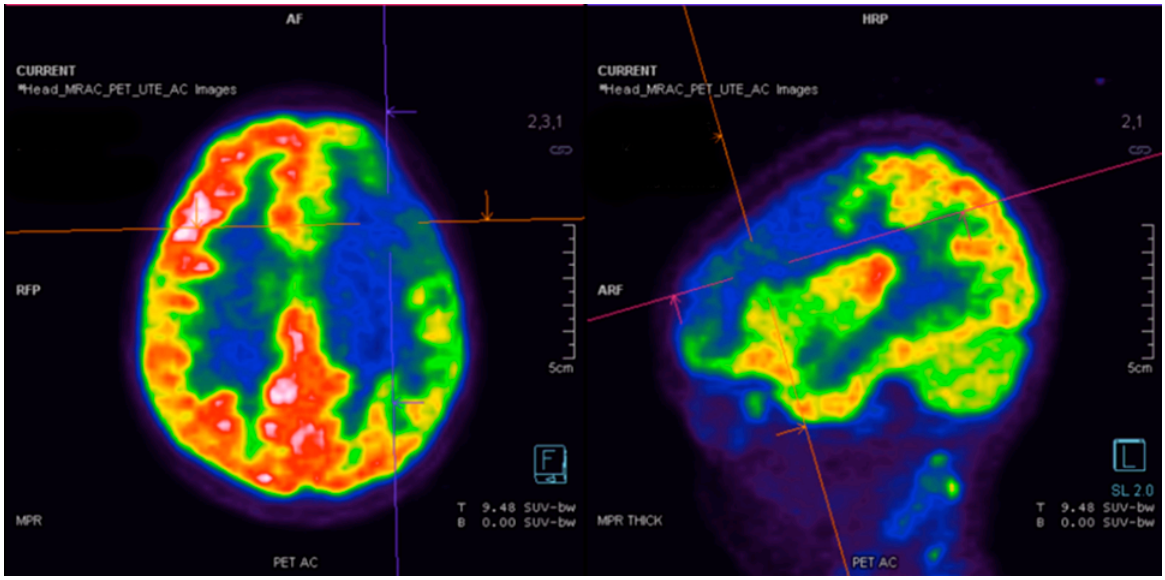

Fig. 12c: Multimodal Neuroimaging PET/MRI.

The future of neuroimaging[7] shows an increasing trend toward physiologic imaging and quantitation. Hybrid imaging blends advantages from multiple modalities to provide a comprehensive anatomic, functional, physiologic, and metabolic data set.

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Andreas Vesalius and his hoaxes, *con variazioni*[1]

Theo Dirix

Summary
Andreas Vesalius's popularity increases with every anniversary. The commemorations in 2014/2015, the quincentenary of his birth, were no exception and may mark the turning point in Vesalius research. Hoaxes surrounding the life and death of this famed anatomist, some of which have survived despite strong counter-evidence published some fifty, and even one hundred, years ago are finally dying out, while new myths are swiftly nipped in the bud thanks to today's speed of publication and communication.

Résumé
La figure d'André Vésale connait un regain d'intérêt à chaque anniversaire. Les commémorations de 2014/2015 ne font pas exception. Le cinq-centième anniversaire semble marquer un tournant dans la recherche sur Vésale. Des lieux communs qui ont survécu aux nombreuses études publiées aux alentours des célébrations de 1914 et 1964 disparaissent enfin. D'autres lieux communs sont rapidement mis hors d'état de nuire grâce à la rapidité des modes de communications et de publication actuels.

In 2011, in a brochure published and distributed by the Embassy of Belgium in Athens, I confessed to having been infected by the Vesalius bug[2]. In the beginning hardly more than an observer, I eventually became the coordinator of the search for Vesalius's lost grave.

At the Vesalius Continuum Conference (4–8 September, 2014 in Zakynthos, Greece), organised by British paediatrician Prof Mark Richard Gardiner, medical artist Pascale Pollier and I, the quest for the lost grave reached an intermediate result: a geographical information system (GIS) developed and presented by Belgian archaeologist Dr Sylviane Déderix.

Her multilayered map may indicate the exact location of Andreas Vesalius's grave in the city centre of the Ionian island on which he was buried in 1564.

With that first phase of the quest, finances dried up during the busy run-up to the Vesalius quincentenary.
The commitment of people and institutions that backed the search, Professor Jan Driessen, Université Catholique de Louvain (UCL) and Director of the Belgian School in

Athens (EBSA) and Dr. Apostolos Sarris, Deputy Director of the Cretan Institute for Mediterranean Studies at the Foundation for Research and Technology – Hellas (IMS-FORTH) still stands. However, additional funds are yet to be found for the next phases, which would allow for verification of the GIS findings on the ground.[3]

Apostolos Sarris (Deputy Director IMS-FORTH), Theo Dirix (Consul of Belgium in Greece), Jan Driessen (Prof. Université Catholique de Louvain and Director of the EBSA (Ecole belge d'Athènes/Belgische School te Athene) and Akis Ladikos (former Deputy Mayor for Culture, Zakynthos), photograph in *Imera Zante* Newspaper, 24.04.2013.

With Pollier, who initiated the search for Vesalius's skull before becoming occupied with curating the touring exhibition *Fabrica Vitae* in 2015, I am ready to launch a new fundraising campaign.
The Greek people and their authorities have yet to see the end of their political and economic turmoil.

In Zakynthos, the seemingly never-ending refurbishing of the Solomos Square, and the question of the position of the Pollier-Neave statue[4] of Vesalius, appears to rouse more attention than the question of Vesalius's grave. This sort of thing is not a first.[5]

"If somebody wants to make history too, he or she should contact me", I have regularly appealed to potential sponsors. Sometimes people giggle, right on time to allow for the next sentence to work: "Why the chuckles?" Why is recent research on Vesalius not being picked up? Why do people hesitate to sponsor the quest for the lost grave?

Dr. Theodoor Goddeeris, Prof. Jacqueline Vons, Prof. Dr. em. Omer Steeno and Dr. Maurits Biesbrouck during the Vesalius Continuum Conference in Zakynthos, September 2014, photograph Maria Verstraete.

Render to Caesar the things that are Caesar's[6]

After sacrificing a great deal of his academic life by serving Charles V, Emperor of the Holy Roman Empire, and his successor, Philip II, as family physician, Vesalius, 450 years after his death, was called upon to serve public diplomacy again. With the support of my employer, the Belgian Federal Service of Foreign Affairs, the conference in Zakynthos led toseveral spin-offs facilitated by Belgian embassies across the world.[7] Some of my colleagues asked for advice, others sent requests to participate. The first of these came in September 2014 from Copenhagen, Denmark, in cooperation with Prof. Ron Kupers of the Panum Institute. In December, Greek researcher, bio-artist and curator, Vasia Hatzi, and I organised a Vesalius birthday party in the Syngros Museum in Athens, Greece.

In 2015 more invitations rolled in from Atlanta, Georgia (March 2015), Geneva, Switzerland (May 2015), Astana, Kazakhstan (October 2015) and Madrid, Spain (January 2016). Also on the programme, but outside the diplomatic circuit, were talks in Antwerp (October 2014), Ghent (November 2015), Hove (on national radio show, *Interne Keuken,* November 2015) in Belgium, and in Padua, Italy.

My luggage on this stint as a Vesalius hoax-buster was the articles, suggestions and the continuous advice of the Cerberus of Vesalius research, Omer Steeno, Maurits Biesbrouck and Theodoor Goddeeris. This restless trio of Flemish Vesalius researchers

continues to find new angles that refute the legends and unfounded stories surrounding Vesalius's life. They have already published dozens of articles to this effect and I'm honoured to have had more drafts sent my way more recently. Their presentations at Zakynthos continue to make an impact[8], though the trio resist sentiments to speak abroad.
"Psychology says", Steeno wrote to me, *"that if you repeat the same message, over and over again, the content will land in the end."*

The quest for the lost grave may have been halted, temporarily, but the continuing fight against hoaxes may be paying off. Nobody, though, is immune to hoaxes, neither prestigious institutes nor novices, nor everybody in between.

***Silentium Triplex: naturale, civile et sacramentale*[41]**
An effective opener to my lectures has always been a reference to *Pantheon*, an application, developed by the M.I.T. Media Lab, mapping data of cultural production from 4000 B.C. to 2010.[9] Obviously the "Belgian physician" has a lemma there too – but "his" portrait is not Vesalius at all. The coat of arms and the seal on the ring point to Melchior von Brauweiller, a lawyer from Cologne, Germany, and definitely *not* to the Flemish anatomist.[10]The application is a sophisticated calculator but doesn't as such judge or correct its sources, just as Wikipedia submits a biography that Vesalius wouldn't recognise as his. The app of Pantheon merely preserves the mistakes.

Illustrating how motivated she is to find the skull of Vesalius to reconstruct his face, Pollier sometimes projects Diego Velazquez's portrait of court dwarf and jester Don Sebastián de Morra: *"If we find his skull we can also prove he didn't suffer from dwarfism."* Vesalius definitely was not a small man and if the only portrait he ever approved of shows some peculiar measurements, the explanation is simple: either the scene is composed of several drawings of different artists, or the dissected arm is that of a mannequin (as Alfredo Musajo Somma, Professor of Plastic Surgery, argued in Padua). Innocently showing a picture of a small man is how myths are maintained or reinforced.

New hoaxes continue to pop up too. A member of a Belgian local history society, confused by another van Wesele family of some decades later, creatively filled in the historical gaps. His "discovery" was covered by several newspapers. We agreed to cover him gently with the quilt of the *Selentium Triplex* and not to make a fuss. But hoaxes are resilient: in Ghent, Belgium, Biesbrouck, Goddeeris and I were questioned about his theory by a delegation made up of half of the meagre public who had shown up.[11] Some suspected the writer to be incognito among them.

Spoiler Alert

A metaphor for all the urban legends is the many portraits of the anatomist in museums and publications. Vesalius is portrayed as grave robber, imperial doctor, wonder kid, wise old man, ill-tempered redhead, saint and devil, or not as Vesalius at all. Some portraits continue to illustrate the proposition that the Inquisition led to his last voyage and a fatal shipwreck as his tragic end. As long as his skull is missing and we cannot do a facial reconstruction, nobody will know how he really looked and biographers will continue to express more about the portrayer than the portrayed.

An explanation as to why the general public remains unaware of the updated research may be that many of the serious articles appear in specialised journals and magazines, and not always in a world language; my mentors, for instance, mainly publish in Dutch.

Another reason may be that studies on Vesalius's work and legacy are taken more seriously than the study of his biography, considered to be more anecdotal or superficial. Vesalius's genius also fascinates fiction writers who fill in the gaps with fantasy. This undoubtedly sells better than the truth. New findings can also be an uncomfortable truth if they do not match personal agendas. For example, although formal proof of a trial and sentencing by the Inquisition does not exist, some may still prefer this version.

During the 2014/2015 commemoration years something did change, though. Maurits Biesbrouck, bibliographer of Vesalius, agrees that "colleagues' reactions are more nuanced today, they are more careful in their publications and they mostly refer to what really happened – mostly, because a (decreasing) minority still seems to read the outdated literature".[12]

It is a truism that commemorations generate more attention for those being celebrated. Eventually papers and proceedings of the events find their way to libraries, bookshops and the internet. Has the moment come when hoaxes that were refuted fifty, or in some cases one hundred, years ago, finally cease to circulate?

The case of the mixed-up portraits has been known since 1964, when French medical historian, André Pecker, analyzed the original painting on display in the Louvre Museum in Paris and came up with Melchior von Brauweiler. We know that Wikipedia and Pantheon are wrong.

Four letters that state the doctor had left Madrid for Jerusalem out of devotion, with a royal gift in his luggage, and that his employer, Philip II, eagerly awaited his return, were discovered by the Spanish historian José Baron Fernandez in 1962.[13] Already in 1914, physician and historian George Matheson Cullen seriously contested the generally accepted reasons why Vesalius left Madrid and travelled to Jerusalem. And

although the letters from and to Philip II had yet to be discovered, Cullen had well-documented arguments to dispute any involvement of Vesalius with the Inquisition.[14]

Speculations about Vesalius's death[15] have circulated for decades. Many Researchers had already refuted the story of the wreck of a ship that sailed on, with Vesalius as its sole victim. When Goddeeris discovered a report about Vesalius's death dated May 1566, heand his co-researchers connected the dots. Indeed, the trio raised the question if the different eyewitnesses, some named and others anonymous in earlier sources, are not one and the same. From the detailed report of Reinerus Solenander[16] it is clear that, according to his very convincing witness, Vesalius indeed collapsed moments after the docking of his ship in the port of Zakynthos.

The trio also discovered the German account of a journey Führer Von Haimendorf undertook in 1565, arriving in Zakynthos on August 6, less than ten months after Vesalius's death. This account confirms in further detail what earlier sources suggest: Vesalius was buried in the Catholic church of Santa Maria delle Grazie with the regard a man of his standing deserved. The church, since sacked by invaders, converted to army barracks and damaged by multiple earthquakes, with the most devastating being that of August 1953, has been located by Déderix's GIS.

Geographical information system (GIS) by Dr. Sylviane Déderix for Laboratory of Geophysical-Satellite Remote Sensing & Archaeo-environment (IMS-FORTH), Crete, Greece.

Santa Maria delle Grazie Church before the earthquake of 1953.
Photograph from private collection of Spiros Gaoutsis, Corfu, Greece.

In Search of Vesalius in a Bibliography

Building on Dr. Harvey Cushing's list of publications on Vesalius and his works, Biesbrouck has expanded his so-called *Vesaliana* to 3,453 titles today, 450 pages in total. Such a bibliography can never be complete: *"Growing numbers of new articles, books and the internet result in a daily avalanche of new publications concerning the history of medicine and even more so Vesalius, who still plays such a prominent role in it."*[17] The increase of publications in the commemoration years of 2014 and 2015 is impressive: 15% growth.[18] A previous peak in growth was the year of the commemoration year of 1964: the list then grew by 12%.

As only published works are registered, more titles from 2014/2015 may show up in the coming years; many issues indeed appear later than their official date. Research is kicking in at a slower pace than newsfeeds. Today's pressure on academics and journalists to publish is, however, overwhelming. And although the interdependent players – universities and journals, writers and researchers – gradually come to dislike the rat race for always more articles, citations and rankings, the speed of reaching an audience does help to counter the legends in Vesalius's biography. Even blogs and Facebook pages – not yet very common in academia – have been proven efficient means of fighting the stereotypes. Nobody denies that the digital revolution has made more sources available. Finally, although the miles earned as a frequent speaker may be criticised as a boost for the ego only, the numerous events have nonetheless been scrutinised by all Vesalius enthusiasts.

Of course, as we have already seen, a higher speed of publication, better techniques of communication and everyman's access to new sources will not prevent unfounded stories from seeing the light. But the same revolutions will help disprove them. Isn't

that the difference between the most recent commemoration and those of the past, when major hoaxes continued to survive despite having being invalidated decades earlier?

By 2064, five hundred years after his death, the Andreas Vesalius we have been searching for will surely resemble his portrait more than the one we are drawing today. Better still: if, by then, a second and a third phase[19] in the quest for his lost grave has uncovered his skull, the portrait may finally be a true representation.

As Consul of Belgium in Greece Theo Dirix has taken the initiative in clarifying the issues around the final days of Vesalius. He was the Coordinator of Vesalius Continuum, Zakynthos, Greece, September 2014.

References

1. Dirix T. 'Portraits and other hoaxes: Why some research about Andreas Vesalius is not picked up', *Interalia Magazine 19/12/15,* has evolved into this account.
2. Dirix T. 'Acknowledgments', in *Vesalius 2014*, Embassy of Belgium, Greece, Spring 2012, p.5.
3. A reconnaissance trip by Sarris and Driessen to Zakynthos, in May 2013, was financed by me and by the University of Antwerp; Agfa HealthCare Greece sponsored 5000 € for the GIS.
4. Richard Neave is the British forensic artist who, together with Pascale Pollier, created the 2015 Vesalius monument which represents not the anatomist but his work. Placed on a plinth sculpted by Chantal Pollier, it was inaugurated on Solomos Square during the Vesalius Continuum Conference. Soon after, the refurbishing of the square started, lasting more than a year.
5. In the 1960s, the Vesalius bust on Ladikos Square was moved from the periphery to the centre of the square. In the 1950s, a memorial erected by N. Barbianis in Kalogerata, off Laganas beach, disappeared. Several streets and squares have also been renamed and lost all reference to Vesalius – including Ladikos Square, previously Vesalius Square.
   On 10 December 2015, Maria Zougra, PR for Culture at the Municipality of Zakynthos, wrote to me in an e-mail, on behalf of the Mayor: "*Mr Kolokotsas wouldn't move the monument without asking you first. I spoke with him earlier this morning, providing him with all your thoughts, which he took into consideration. He asked me to tell you that we respect your opinion and that the statue will not be moved*."
6. *Mark* 12:13-17, King James Version
7. Embassies of Belgium in Athens, Astana, Atlanta, Bucharest, Budapest, Cairo, Copenhagen, Dar es Salaam, Geneva, Havana, Jakarta, Cologne, Kigali, Lisbon, Lima, Los Angeles, Madrid, New York, Prague, Riga, Rio de Janeiro, São Paolo, Washington and Vienna organised a Vesalius commemoration.
8. Biesbrouck presented his talk to gynaecologists in Kortrijk and to stomatologists in Roeselare; Steeno addressed an audience of retired colleagues; Goddeeris gave an answer to the question "*What did we learn during the Vesalius year of 2014?*" in a seminar on History of Medicine, AZ Groeninge, in cooperation with Montanus Collegium-Medico-Historicum Brugensis. The trio should have been featured more prominently in Louvain's commemorations, but it seems "*a prophet is not without honour except in his own country, among his own relatives, and in his own house*". (*Mark* 6:4, New King James Version)

9. From an e-mail, 19 December 2015.
10. *Silentium Triplex*: it is definitely more appropriate to refer to a book (by Winther, David and Schmidt, Accursius, Monachium, 1701) with such a distinguished title than to be ordered to be silent, threefold.
11. http://pantheon.media.mit.edu/people/Vesalius
12. Pecker A, Contribution à l'étude d'un tableau de Calcar, in *Congres Bazel*, 1964, p. 80
13. Ghent, 10 November 2015, in the auditorium of the Forensic Institute that hosted the Post Mortem Exhibition.
14. In an e-mail, dd 19 December 2015.
15. The letters are replicated by Biesbrouck and Steeno with translations and comments in 'The last months of Andreas Vesalius. Part I'in *Vesalius, Acta Internationalia Historiae Medicinae*, 2010, 16 (2): 100-6.
16. Matheson Cullen G. 'The Passing of Andreas Vesalius'. *Edinburgh Medical Journal*, 1914, 13, p. 326.
17. Find both sources, Solenander and Von Haimendorf, in Maurits Biesbrouck, Theodoor Goddeeris and Omer Steeno's, 'The last months of Andreas Vesalius: a Coda in *Vesalius –Acta Internationalia Historiae Medicinae*, 2012, 18 (2); 70-75.
18. A German medical doctor who also studied philosophy in Louvain.
19. Biesbrouck M, *Bibliography* in http://www.andreasvesalius.be, January 2016 (most recent version), accessed 12 January 2016, see also p. 6 of *Introduction*.
20. 122 new titles in 2010; 75 in 2011; 130 in 2012; 180 in 2013, 235 in 2014 and more than 292 new in 2015
21. The second phase should consist of non-destructive ground-penetrating radar (GPR) and electrical resistivity tomography (ERT) methods on the ground. A number of test or rescue excavation trenches may also be needed to validate the results.

Visualizing Vesalius

Alfredo Musajo-Somma

Abstract
The anatomist whose name became a trademark for all that is high standard in medicine was more engaging and nuanced than his portrait suggests.
Padua was the epicenter of the Italian Renaissance in the XVI century, a place of unparalleled artistic and intellectual attainments where Vesalius started the revolutionary road towards the development of medical knowledge.

Résumé
L'anatomiste, dont le nom est devenu une marque déposée pour tout ce qui représente haute qualité en médecine, est plus engageant et nuancé que son portrait ne peut suggérer.
Padoue était au seizième siècle l'épicentre de la Renaissance italienne, un centre de performances artistiques et intellectuelles inégalées, où Vésale a débuté son parcours révolutionnaire vers le développement de la connaissance médicale.

Introduction

It is extremely hard to know oneself! According to Plato's idea, it's impossible to understand the world around us if we are unable to understand our own selves. Western philosophy is based on the idea of *thinking about thinking*, which is basically the human consciousness that sets us apart from other species.

A new foundation for the quest of truth was laid down by the French thinker René Descartes (1596-1650), who started to explore the idea that we could be aware of our own existence and became famous for his sentence *cogito, ergo sum* ("I think, therefore I am").
All his writings led Descartes to the notion, now known as "Cartesian dualism", that there are two substances, one of them material - and accounting for bodies - and the other immaterial - and accounting for souls and/or selves.

In the scientific and innovative view of mankind, the dominant paradigm claims that "self" is a function of physiological activity, in the same way that learning, memory, cognition and homeostatic processes are functions of biophysiology in action.

This biodynamic approach to conceptualizing self as a physiological process is both fascinating and more accurate than Cartesian "ghosts" haunting our biological "machines".
It is not only about personal identity but also about a "communication system", a self is a mental entity which comprises, refers to, or represents you, and includes your experiences, memories, beliefs, "character", interests, knowledge and everything else that goes into making up an identifiable "you."

One of the most effective ways to know yourself is to see yourself as others see you. Vesalius was an artist and a scientific outsider and his printed masterpiece *De humani corporis fabrica* is a piece of art in every page and even in the author's portrait[1].

Of course, every piece of art bears an enigma within itself, something that is not entirely clarified by historians, nor exhaustively interpreted by the critics.
We might define it as a creative enigma, which, like a restored shadow, moves according to the light of the times, permanently renewing those unresolved questions about itself and about the human condition on which art feeds, reanimating, arousing at every step the dynamics of uncertainty and restlessness.

Dealing within aesthetic imagery implies an in-depth, risky undertaking of the mystery of existence, just like unveiling that other, parallel imagery that is science. However, experiencing a mystery does not at all mean solving its enigmas: rather it means challenging them, recognizing them, defining their limits and recharging one's own personal energy from the knowledge of a radical inability to understand any one of the so-called "truths".

The Protagonist

As far back as Ancient Egypt, people of wealth and power have commissioned their portraits, although not yet related to self-exploration but mainly to personal glorification.

Vesalius' carved portrait – probably by the Flemish artist Calcar - at the start in *folio 6 v* of the printed masterpiece *De humani corporis fabrica*, seems to be a way of ego-showing [Fig.1].

In the Renaissance era in which appearance became so important, portraits started to be printed everywhere, because your image is what you are, so you show it. It turns to be not a big leap to go from a pursuit of self-exploration to the desire for a portrait. Appearance means also to be seen and to make sure to be seen.

Vesalius' *Hintergedanke* turns out to be: "I can be seen, so I will be seen, for what I am as a person is my image".

Fig. 1: Portrait of Vesalius in the *Fabrica.*

Trying to figure out who Vesalius is and what he is about is a distinctly human pursuit for Vesalius himself as well as for almost everyone. Offering to the readers' attention a portrait of internal coherence and coordinated interaction with the world is a goal achieved only by masters of Arts.

Vesalius acts as a spatial information dealer and the cartography began with the mapping of the body inside which the brain sits allowing the messages he wants to exploit with each picture to fly as darts aimed at a big target.

The image that the others see of Vesalius - that is interesting to Vesalius himself - is the one that could convey a larger truth about self than any one image could.

The Territorial Background

Padua, Venice's most strategically vital *Terra Firma* holding, its mainland possession, was a cross point for University students from all Europe. With the start of the Lutheran revolt, both Venice and Padua had substantial numbers of Germans in residence and many had adopted Lutheran beliefs, causing additional difficulties for the *Serenissima* Republic.

One of the leading personalities of the Protestant Reformation, the first Protestant in modern Europe, was Venice's Cardinal Gasparo Contarini (1483-1542), who was also the leader of the Catholic Counter-Reformation.
Contarini was a pupil of the Padua Aristotelian Pietro Pomponazzi, who denied the immortality of the human soul. He sponsored St. Ignatius of Loyola and secured papal approval for the creation of the Society of Jesus as an official order of the Church.

Contarini also began the process of organizing the Council of Trent with a letter on church reform that praised Aristotle while condemning Erasmus, the leading Platonist of the day. The Venetians dominated the College of Cardinals and created the Index of Prohibited Books.

The establishment of the Roman Inquisition in 1542 and the pressure to control heterodox printing in Venice, resulting in a Venetian index in 1543, illustrated the need to protect Venice's unique freedom, thriving printing industry and book trade, as well as ensuring that students and even professors of heterodox or unconventional belief would continue to study and teach Arts, Law and Medicine at Padua.

The departure of Vesalius from Italy in 1544 effectively ended his career as an anatomist. However, he left with his printed masterpiece clever pupils, medical heirs and a singular back and forth connection and dialogue among the anatomist, the hired artists, the dedicated publisher and their readers[2].

The Printing Network

To understand the striking printing privilege Vesalius achieved, it is fundamental to interpret the inscription at the bottom of the *De Fabrica* front-page: he was successful in the applications for privileges (like formal proto-copyrights) not only from the Emperor, the King of France but also from the Republic of Venice: *"ac Senatus Veneti gratia & privilegio"* [Fig.2].

Ioannes Oporinus (1507-1568), was the expert friend and financial supporter of Vesalius' studies aiming to the anatomic revolution: he offered the privileged links to get the copyrights *erga omnes*, according to Basel Printers' Statute of 28 October 1531[3] plus a close collaboration among the author, artists, wood-craftsmanship crew and the publisher himself.

Originally, making images was a real craft left to professional artists and to artisan woodcutters and it was the province of the *élite* either in status or in skill. Vesalius was also well aware that he needed official support to achieve the goal of printing his masterpiece *De humani corporis fabrica*. The "big book", an *in folio* edition, was printed during 1543 but Vesalius had been working on the text since 1538, when he

printed in Venice the *Institutiones Anatomicae* (Venice, 1538) and *Tabulae Anatomicae Sex* (Venice, 1538).

Fig. 2: Front page of the *Fabrica* with its important approbations at the foot.

Vesalius was a man of handsome look, which served to reinforce a somewhat narcissistic disposition. He was well aware of his junior's year's studies, of his age, of his professional status, of his academic position, of his pivotal profile both in a scientific *milieu* and in the book printing enterprise. Consciously he lets us to understand his identity in a scientific and technologically innovative world: his image

for the world to see as he wanted to be seen. Only the close connection that the portrait's author must have had with Vesalius, allows him to have a skill needed to create such a stunning portrait. Like in many situations in real life, it is all about communication to achieve the secret how to emphasize open communication. This open dialogue is going to be very important to the success of the project and working with this very special model.

Ioannes Oporinus (1507-1568)- his original name being Johannes Herbster or Herbst - the son of a very well-known, although impoverished painter from Strasbourg, had been persuaded by the Protestant reformer Oecolampadius (1482-1531) to study medicine as a Paracelsus' *famulus* for a couple of years in Basel and in Strasbourg (1537-1538)[4]. He was an expert teacher of Latin and professor of Greek at Basel University, with a working knowledge of Hebrew, all three languages Vesalius used in the *De Fabrica*.

Oporinus bought a printing establishment in Petersberg, a Basel's suburban area, in 1536 by Andreas Cratander and started his joint venture as a publisher and a printer with the social climber Thomas Platter, Balthasar Ruch and his brother-in-law Ruprecht Winter. The positive economic results prompted him towards an almost *solo* enterprise[5]. An art and science community workshop under his planning, executive control and complete supervision allowed the production of an astonishing amount of woodcuts' illustrations.

Jan Steven van Calcar, Domenico Campagnola and Jacopo Sansovino were a few of the many artists (*pictores*) involved and Francesco Marcolini (or Marcolino) da Forlì and one of his workmen, a German, Johann Britt as the main blockcutters (*sculptores*). This highly specialized *équipe* worked not only on almost three hundred images related to anatomy but also to the frontispiece and the author's portrait, offering a longlasting success to the *Fabrica*[6]. Printer and publisher are practically one, the same person, and Oporinus' choice as his trademark was a true publisher's device, an up-to-date design and not the usual merchant's marks linked to Gothic heraldry.

A well-known Venetian printing enterprise owned by Aldus Manutius had published in 1499 *Hypnerotomachia Poliphili*, an outstanding book enriched by many drawings with a close link to Vesalius book's front-page[7]. The printer's ornament, that is Manutius' anchor, first appeared at the turn of the century, yet unborn Oporinus: an anchor- with a dolphin winding around its shaft mimicking a *verso* image of an antique coin (*denarius*) of emperor *Vespasianus* (Neptune standing left, foot on prow, holding dolphin and trident).

The visible code of Oporinus' Basel based enterprise was a graphic representation of the Arion's myth: the well-known image of the Greek poet and musician Arion saved by a dolphin from drowning in the Tarentum gulf, along the Southern Italy's shores. According to Herodotus of Halicarnassus (5th century BC, Greek author and the world's first historian), Arion was the inventor of the *dithyramb*, a hymn with a narrative in it.

Dolphin's symbolism represents harmony and spiritual uplift, crossing ages from ancient Greece culture to Christian faith. Moreover, dolphins live in large social groups just like the special working team's attitude of every publishing house not only at the Renaissance times.
The printer's logo or *emblema* shows a tripartite tipology: "heading" (*inscriptio*), "picture" (*pictura* or *res picta*) and a poetic "text" (*subscriptio*). Reading the artistic metaphor through several versions of the Oporinus' trademark it is easy to understand the printer's mission: towards virtue, there is no obstacle! (Fig.3).
It reminds us - according to Virgil poem - the Sibyl's words to Aeneas before his descent into Hades: *invia virtuti nulla est via* (valor knows no obstacle).

Fig. 3: Oporinus enterprise's trademarks.

Not only a trader but also a very well-known salesman, Oporinus was aware that intellectual property remained in general with the printer - for at least three years following a formal agreement - rather than with the author and he disseminated through the *De Fabrica* first edition drawings, several cryptic marks (*tacitae notae*) as modern hieroglyphs, true printer's landmarks.

The reception of Euclid teachings and especially of his *Optics*, and the development of a perspective theory as a geometric and practical artistic approach representing spatial objects led to a new drawing method in the Renaissance time.
The Book's first drawing offers an open space architecture giving a powerful view to a multi-level message by the writer, the artists and the printer. In the semicircular

architectural arcade is a possible monogram of the publisher, Ioannes Oporinus, and in the central shield there are the three short-tailed weasels as a sign of Vesalius family coat of arms.

The importance of symbolic imagery in the construction of rulers' authority is well known.
The *De Fabrica* frontispiece is a political *manifesto* serving a visual transcodification of the text: human anatomy on display corresponds, as well, to the rise of the public theatre in the Republic of Venice.
Body, image, text and performance are linked alltogether aiming to intellectual surveillance, spectacle and the human bodies offer new chances of intellectual discovery.

A temporary wooden theatre is prepared within a neo-classical structured frame to host dozens of characters, crowding a multiplane area, interested to the one-man-performance on the frontstage: Vesalius standing in the privileged position, side by side with the woman's dead body, enhanced by an accurate perspective depth.

It is possible that the bearded man looking at the naked man, in the frontispiece of the first edition of the Book, represents Oporinus himself: a competent appreciation of the Paracelsus' *alumnus* and Vesalius' supporter to the newly unveiled anatomy[8].

An Aristocratic Portrait, not like a selfie

The fashion for portraiture had spread from nobles to the professional classes. A good-looking and full-face haired young man is woodcarved as a live portrait of a well-known physician and the printed drawing in the *De Fabrica* is like Vesalius' *viva* or *vera effigies.*

Moreover, close friendship between Vesalius and Oporinus offers a possible interpretation of the button-like mark on Vesalius brocade jacket's right sleeve: it is a graphic planar synthesis of the embroidered dolphin's eye - a meaningful part of the printer's logo -, better detailed in a 3D view achieved through a dedicated algorithm. [Fig.4].

When Carl Linnaeus (1707-1778), the Swedish father of taxonomy, was writing his masterpiece (*Systema naturae*), a classification of biodiversity[9], whereby each species of plant and animal is given a *genus* name followed by a specific name (*species*), with both names being in Latin, was done.

Fig. 4: Details from portrait of Vesalius illustrating the embroidered dolphin's eye.

This was realized according to the binomial system he studied in the book that was always on his desktop: the *Pinax theatri botanici* by Gaspar Bauhin (1560-1624, a medical student in Padua following the Vesalius teachings' heirs) printed in 1623 by Officina Oporiniana, bearing the well-known printer's symbol [Fig.5].

Fig. 5: Detail from Pinax front-page, Gaspar Bauhin, Basel, 1623.

Linnaeus classified a species of daylight butterflies under the Arion's name, because their wings show an elegant double circle (*genus*: maculinea, *species*: arion, *subspecies*: arion) – just like the Swiss printer's cryptic logo, a dolphin's eye! [Fig.6]

Fig. 6: The daylight butterflies with the double circle pattern.

The Renaissance enhanced the accentuation of the human form and it was the birth of tailoring and, in fact, of fashion. Venice was one of the most important urban markets where the international network of traders facilitated the commercialization of rich fabrics, before their arriving at the workshop to exploit the Italian production of damasks, silks, satin, plain and cut velvets and the Low Countries well known manufacture of woolen goods and all known textiles.

Master tailors in the growing towns eventually became responsible for the clothing needs of high society members, and the art and science of tailoring became a highly specialized, complex and jealously guarded craft, encouraging consideration of the concept of well-tailored luxury textiles as markers of importance, power and distinction[10].

A monothematic pattern of design and decorative drawing is embroidered on Vesalius' jacket, the *digitifolia* (five lobes like fingers) leaf of the plane tree: the celebrated *platanus orientalis,* the tree of Hippocrates of Kos, the father of learned medicine. Its leaf looks like five fingers' widely diverted and it is as large (*platys*) as a human hand. [Fig.7].

Fig. 7: The plane tree leaf whose pattern is embroidered on Vesalius' jacket.

Indeed, continuous symbiosis between images and words is self-evident in Vesalius' xylographic portrait.

The parallel codes of proportion and comparison open a wide field of relationship between different physical units: the anatomist and the beheaded anatomic manikin! Vesalius is not dissecting a cadaver: he is holding, or more properly embracing, like a Holy Cross, the flayed right forearm and hand of the simulacre of a corpse.

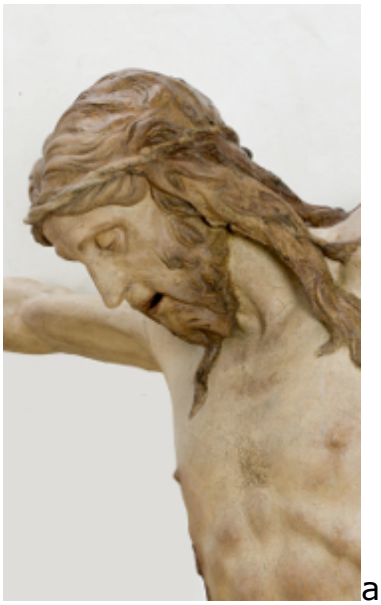
The detailed flexor tendons of fingers are shown, mainly the *flexor digitorum superficialis* (with its split insertion into the middle phalanx) and *flexor digitorum profundus* (gliding beneath and through the bifurcation to insert into the distal phalanx), as well as the position and the insertion of the *flexor pollicis longus* tendon [Fig.8].

Fig. 8: Vesalius' dissection showing flexor tendons of fingers.

Few words written on a small paper detail the flexor muscles examination, even if Vesalius shows no real knowledge of hand intrinsic muscles relationship.

Here again, the structured double scheme is evident: picture and words. It is useful to underline that the manikin is not a female's one, as Choulant suggested[11], because it wears a narrow piece of cloth around the waist, but it seems one of the many wooden articulated figurines used in those days as an aid in drawing religious representations.

Even the curled hair on the neck side of the manikins - some of them with mobile arms - was shown in several Christ's wooden sculptures like the masterpiece by Donatello (1386-1466) hosted in Padua's church of Holy Mary of Servants, from a century before Vesalius' arrival [Fig. 9 a-b].


a

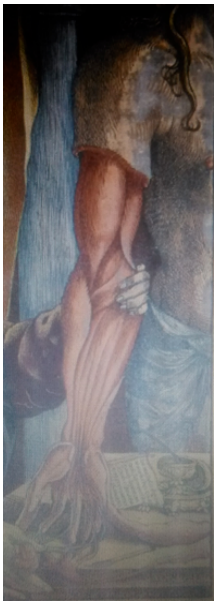

b

Fig. 9a Cadaverous Christ (Donatello). 9b. compared with upper torso mannequin in Vesalius.

The outstanding anatomist and surgeon offers the powerful educational benefit of a master examining with dignity the body after death.

Conclusions

Visual aids are fundamental to the learning process and anatomic illustrations are an integral aspect in teaching, learning and scientific communication[12].

Advances in computer graphics and imaging are generating vast new opportunities for contemporary learning of anatomy. Since the Renaissance age, Vesalius' masterpiece *De humani corporis fabrica*, with its detailed drawings of the human anatomy, started to be the standard anatomy book all over the world. To create a permanent 3D record of the intact cadaver - something not possible with traditional autopsy - is an innovative achievement today, as well as body image two-dimensional printing was an outstanding teaching resource during Renaissance times.

Vesalius wanted his book to be a precious gift, a cultural jewel for wealthy people, but also a professional reference for his medical students and fellow doctors starting a new paradigm in medical knowledge. The images in the "big book" were cutting-edge for their time, as well as its innovative text: a revolutionary icon of knowledge. His portrait already ventured off to the future, where all of others are dead.

Indeed, *Vivitur ingenio, caetera mortis erunt*.

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The Art of Vesalius: The continuing influence of "*De Humani Corporis Fabrica*" on Art

Pascale Pollier

Abstract

A search for the intimate relationship between art and science in the study of the human body inevitably leads to the beautiful pictures of Vesalius' *Fabrica*.

Medical artists and scientific researchers alike discover the enhanced power of text and iconography in transmitting knowledge as well as beauty of expression.

Pursuing this goal, a facial reconstruction was made of Vesalius' portrait in the *Fabrica*.

Final proof of the correctness of this reconstruction will be given when Vesalius' s grave and remains may be found on the island of Zakynthos where Vesalius died and was buried.

Meanwhile medical artists continue to give their vision on anatomy, the human body and its intangible soul.

Résumé

A la recherche de la relation intime entre art et science dans l'étude du corps humain, on aboutit inévitablement aux planches magnifiques de la *Fabrica* de Vésale.

Les artistes médicaux autant que les chercheurs scientifiques découvrent chez Vésale son pouvoir extraordinaire de coupler texte et images, afin de transmettre les connaissances anatomiques, conjointement avec une beauté visuelle iconographique.

En quête de cet objectif, une reconstruction faciale a été entreprise à base du portrait de Vésale dans la *Fabrica*.

La preuve définitive de l'exactitude de cette entreprise sera donnée quand la tombe et les restes de Vésale pourront être retrouvés sur l'île de Zakynthos, où Vésale a péri et a été enterré.

Entretemps les artistes médicaux continuent à donner leur propre interprétation de l'anatomie humaine et de son âme insaisissable.

Introduction

The conference "*Vivitur Ingenio*"-- A tribute to Andreas Vesalius*1514 - 1564* -- held at the Aula Magna of Palazzo Bo (University of Padua, on Thursday 3 December 2015) was a very special occasion indeed, and was greatly enhanced by the realization that Vesalius was actually in Padua in that very building, 477 years ago!

About a year ago I was asked to contribute an article to Professor Robrecht Van Hee's book "*Art of Vesalius* "in which I focussed on Vesalius' living legacy. Rather than discussing the actual woodblock prints of the *Fabrica* I chose to refer to the

Art/Science collaborations which are happening today, both in functional medical illustration and in the conceptual contemporary arts.

Medical Art

Similarly, here I will elaborate on Vesalius's living legacy, and how he continues, even 450 years after his death, to serve as a great inspiration to the artist and the scientist alike.

The very reason I became a medical artist was my admiration for the beautiful anatomical illustrations in the Fabrica. Vesalius understood the importance of Art/Science collaborations as he was aware of the power that images and drawings have in enhancing the written word. He understood that by bringing these two faculties together his findings would be better communicated and understood in a visual manner. I wonder if he could have realised that his passion and genius would be captured in these drawings to inspire generations to come, transcending time for centuries.

In 2007 Medical artist Dr. Ann van de Velde and I organized a conference for the AEIMS and MAA and the Vesalius Trust (medical artists' associations of Europe and Great Britain and the US respectively). The conference entitled "*Confronting Mortality with Art and Science*" was such a success and created so many lasting friendships and collaborations that it seemed only natural that we should continue this endeavor. The conference was accompanied by an exhibition for which I created a wax sculpture, titled "*Confronting Mortality*". The sculpture portrays a man, half flayed, emerging out of two books representing the *Fabrica*. The figure, whilst looking at his dissected biceps, seems to be contemplating his own mortality [Fig.1].

Fig. 1: Confronting Mortality, Pascale Pollier, Wax, 2006.

After the conference we all agreed that we had to continue with this exciting venture and thus colleagues Dr. Ann van de Velde, Prof. Dr. Van Glabbeek of the University of Antwerp and I founded BIOMAB[41].
With BIOMAB we organize dissection drawing weekends, exhibitions, and encourage collaborative Art/Science projects and films. An example of such a film is; "Is the brain the most sexy part of the body" starring contemporary artist Jan Fabre and Professor Edward O Wilson in dialogue at Harvard University, Boston. Another example is the documentary short film titled "*Art: science = Science x Art* "with interviews from Scientist Jeff Wyckoff, Artist Mara Haseltine, AMI medical artist Jill Gregory, Professor E O Wilson and myself. The conference Vesalius Continuum with its international touring exhibition *Fabrica Vitae* and the film bearing the same name, are other examples of projects organized by BIOMAB.

In 2015, Arthur Miller, Eleanor Crook, Bryan Green and I founded a new avant garde movement called Art Researches Science International Collaborations, (ARSIC) [41]. An international collective where Art and Science become entangled. This interdisciplinary association seeks to unite artists, scientists and those with a passion for the synergy between Art and Science, Technology and Philosophy.

The search for the Grave
In 2009, I completed a course on facial reconstruction in Maastricht. It was then that the idea developed to make a facial reconstruction of Andreas Vesalius. Not knowing where he was buried, but assuming it was in Brussels, my colleague Ann van de Velde and I went on a quest to find the grave of the great anatomist.

This quest took us to the Ionian island of Zakynthos, where the death of Vesalius had been an unsolved mystery for the last four and a half centuries. The cause and manner of his death and the exact location of his burial site had not been ascertained, and existing testimonies were considered doubtful.
Many questions remained unanswered. Was he shipwrecked in Laganas? Did he die from starvation, scurvy or the plague, to name but three possibilities? Was he buried in Pantokratoras at the site of the lost Franciscan monastery or perhaps in the church of Santa Maria delle Grazie? We decided to find out for ourselves. We sailed to Zakynthos and embarked upon our quest.

In 1952, pharmacist Nikolaos Barbianis perused the manuscripts of the Roman Catholic bishop of Zakynthos, searching for evidence of the place where Vesalius was buried. Barbianis, or "the saviour of the ruins," as he is known, placed a stone at the place where the Franciscan monastery once existed, at the site Kalogerata, better known as 'Franciscan Church' Laganas Pantokratoras. The inscription read as follows:

"*Here at the place where the Franciscan monastery of Theodores "Kalogerata", 1471, was located, the great anatomist Andreas Bezal died, cast away at the remote coast in 1564.*" Parallel to this theory, we investigated another theory that Vesalius could be buried at Santa Maria delle Grazie.
The Flemish author Giovanni Zuallardo mentioned in 1586 that the Franciscan brothers had a monastery called 'Annunciata,' where they buried their dead. He claimed this as the burial place of Vesalius. The epitaph was lost in 1571.

Evidence provided by various researchers, including Belgian researchers Omer Steeno, Maurits Biesbrouck and Theodoor Goddeeris and Greek historian Pavlos Plessas, now unquestionably point to the Santa Maria delle Grazie church in the city centre of Zakynthos.

The church was completely destroyed by the earthquakes of 1893 and 1953 and any new effort to find the grave must therefore inevitably begin with the identification of the original location of the church.
Coordinated by Theo Dirix, then Consul of Belgium in Athens, the Belgian School (for Archaeology) in Athens and IMS/FORTH in Crete, joined our search. Sponsored by Agfa Health Care, Theo Dirix and University Antwerp.

A historical Geographical Information Systems (GIS) has been developed to digitally register, rectify and analyse contemporary and historical maps, and we have identified the original position of the church that vanished under the rebuilt, contemporary city.
We now need further funding for a second phase, a geophysical approach, employing non-destructive ground penetrating radar (GPR) and electrical resistivity tomography (ERT) methods only. Planning possible excavations is premature at this stage, but depending if substantial evidence is found, a small number of test or rescue excavation trenches may be necessary to validate the above results.

To fund these phases, we have the original wax model of the facial reconstruction portrait for sale [Fig.2].
We need to sell only about 5 of these models to be able to fund the work, we recently sold one to the Stradins museum in Riga. One of these wax models is now on exhibition and for sale at the Gordon museum, London. As soon as the funding is in place we will continue our quest.

The story so far can be read in the book *'In search of Andreas Vesalius, The Quest for the lost grave'* by Theo Dirix (Edition: Lannoo Campus).[41]

Fig. 2: Facial reconstruction portrait of Vesalius, Richard Neave and Pascale Pollier, Wax, 2016.

Vesalius Continuum

Theo Dirix and British Pediatrician Mark Gardiner, Ann Van De Velde and I were the organizers of the conference Vesalius Continuum, which brought together many experts in the field of anatomy, medical history, medical art and contemporary art, and many friends of Vesalius.

We all spent a lovely week celebrating the 500th anniversary of the father of anatomy on the beautiful island of Zakynthos. After the conference we created a website[41], posting all the Vesalius commemorations and related anatomy conferences and events, we would like this to become a platform for scientist and artists to be kept informed on interesting happenings such as this one!

Vesalius monument

There couldn't be a 500th anniversary without a commemoration monument! To sponsor the monument, we had in mind, facial reconstruction expert Richard Neave and I made a bronze facial reconstruction portrait of Andreas Vesalius. Twelve of these heads were made and eleven were sold, one model became part of the touring exhibition.

This bronze facial reconstruction portrait was made in anticipation of finding the skull. We worked from the outside in, from known Vesalius portraits, we imagined what the skull might be like. At the university of Padua some of the skulls of anatomy teachers are on display, and if we are successful in finding Vesalius's skull we will certainly contribute a copy of the facial reconstruction to complete the collection.

Having received the sponsor money, the bronze monument was duly made by Richard and myself and we drove the finished sculpture to Zakynthos where it was placed and unveiled by the Belgian Ambassador and Greek Minister of Tourism. The monument portrays an *écorché*, based on two of the *écorchés* in the *Fabrica*.
The figure is holding a skull, which symbolizes the quest for the grave. Thus the *écorché*, Vesalius 's life's work and creation, is contemplating and looking at the skull of Vesalius [Fig.3].

Fig. 3: Vesalius Monument, Zakynthos. Right to left: Richard Neave, Linda Kindersley (who carved the name plaque), the Mayor of Zakynthos, Theo Dirix, Pascale Pollier, Chantal Pollier (Pascale's sister who carved Vesalius' coat of arms in black marble and the plinth in Zakynthos sandstone).

Film Fabrica Vitae

The documentary film "*Fabrica Vitae*" is an on-going project which we hope will be completed by the end of 2016. The film is made in collaboration with ' Andere Wereld Films '[41].
Fabrica Vitae is a philosophical film about the anatomical mortal body and the study of the nature of consciousness within this body. It questions what it is that makes us human. Seven diverse, world-renowned, pioneers in Science and Art talk about their life's work. In encompassing life and death, with the body as their investigative tool, they have often had to break taboos and push boundaries. They don't avoid controversy, but on the contrary, dare to take a leap of faith into the void, to tread on virgin ground and to tell an unheard and unknown story.

Touring Exhibition Fabrica Vitae

The intention of the touring exhibition[41], curated by Pascale Pollier and Eleanor Crook, is to question what we consider the role of Art and Anatomy to be in this modern world. The work in the collection reflects how contemporary artists, scientists and

thinkers perceive the human body and how the future of anatomical research is seen to be unfolding [Fig.4]. Vesalius would be at the forefront of this exploration if he were alive today and the exhibition wishes to evoke his spirit in pushing the barriers of thought as wide open as he would undoubtedly insist.

Fig. 4: '*Gaze too long into the abyss and the abyss gazes into you'*. Eleanor Crook, bronze, 2015.

After the opening at Zakynthos, and with the support of the Belgian home office, the exhibition was shown in the Syggros museum in Athens on 31 Dec, Vesalius's actual 500th Birthday! The exhibition then travelled to the Pius library in Saint Louis University, The Emory University library in Atlanta, The Stradins Museum in Riga, it then travelled to Geneva and Astana before becoming "Post Mortem" at the University in Ghent, Belgium. The opening of the exhibition was on 15 Oct 2015 on the day of Vesalius's death. We still hope to bring the exhibition to the Specola Museum in Florence and the Life Sciences Gallery at the University of Dundee, Scotland.

The seat of the Intuition

My latest work, "*The seat of the intuition*" brings together two of my greatest inspirations: Andreas Vesalius and Frederik Ruysch [Fig.5].

The anatomical seat of the human soul has been a controversial matter of discussion in the scientific, philosophical and theological fields throughout history.

The pineal gland is a tiny organ in the centre of the brain that played an important role in Descartes' philosophy. He regarded it as the principal seat of the soul and the place in which all our thoughts are formed. The first description of the pineal gland and the first speculations about its functions are to be found in the writings of Galen (ca. 130-ca. 210 CE).

Descartes drew on the Galenic concept of spiritus animalis. He thought that the pineal gland was full of animal spirits, brought to it by many small arteries which surround it.

Fig. 5: 'The seat of the intuition'. Pascale Pollier, Wax and mixed media, 2015.

Descartes described these animal spirits as *"a very fine wind, or rather a very lively and pure flame."* Vesalius, who had been trained in the tradition of Galen, showed that the *rete mirabile* blood vessel network or wonder net, did not exist in humans, and that the structure of the human brain was very different to Galen's description. Vesalius nevertheless wrote in a letter to Charles V, which was used as a preface to his books, the *Fabrica*, that he believed the body to be the lodging place and instrument of the immortal soul. Ruysch came to recognition with his proof of valves in the lymphatic system, the Vomeronasal organ in snakes, and arteria centralis oculi (the central artery of the eye). The half opened skull of my work refers to the brain dissection in the *Fabrica*, and the arm fishing out the pineal and pituitary gland refers to the beautiful anatomical preparations of Frederik Ruysch. The model I used for the arm was that of Theo Dirix, as an ode and reminder that we took this journey together, we were lead by our intuition.

Pascale Pollier

A Belgian National, she studied fine art and Painting in St Lucas art school in Ghent, Belgium and subsequently postgraduate training with the *Medical Artists Association*, London, UK. She is president and co-founder of *Biological and Medical Art in Belgium* (BIOMAB). In 2010 the international collaboration program "*Art Researches Science*" was created organizing exhibitions, dissection drawing classes, collaborative art/science projects, symposiums and conferences. She is an external examiner for the medical art course at *The Centre for Anatomy & Human Identification*, University of Dundee. She is President of the *Association Européenne des Illustrateurs Medicaux et Scientifiques* (AEIMS). She works and lives in London as a self-employed artist" artem-medicalis".

Participants to the Gala Dinner of the *Tribute to Andreas Vesalius*

Renaissance Hall of the Historical Caffè Pedrocchi, Padua, December 3th 2015

From the right side to the left: Adrian and Johanna Kynaston Thomas, Theo Dirix, Pascale Pollier, Stephen and Sandra Joffe, Aziza Essoulaimani, Mariangela and Giorgio Zanchin, Carlos Viesca, Marinella Alfredo Laura Musajo Somma, Serenella Zanchin, Robrecht Van Hee, Paolo Francesco Brunello.

In the background, on the left looking to the Christmas Three, the Bo, ancient Palace of the Padua University.

Welcome to Buenos Aires, September 2016

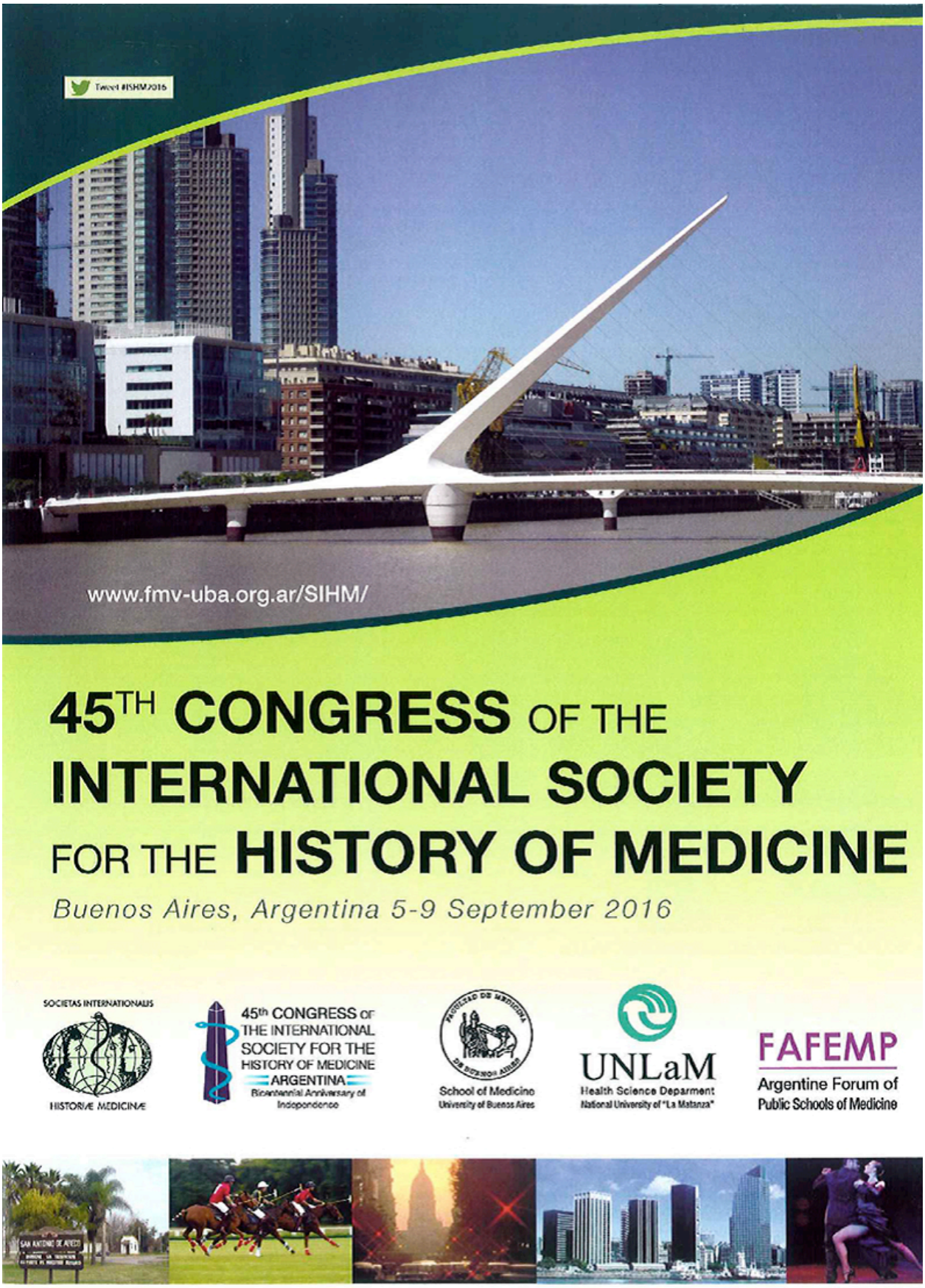
Dear colleagues and friends,

In the long history of the International Society for the History of Medicine Buenos Aires city in Argentina will be honoured to host its delegates and participants to expand its research area in a vast and appealing subject such as the history of Medicine. This has become possible thanks to the support of the Argentine Forum of Schools and Public Schools of Medicine and the Dean´s hospitality has also meant much for us. This group of institutions will provide a worldwide network for the activities of the Society.

Argentina is celebrating the Bicentenary of its Independence in 2016. We have produced three Nobel prizewinners in science due to the presence of a large number of public and private schools of medicine, a significant qualified level of professionals and researchers, as well as laboratories and a highly complex system of health services. Our cosmopolitan culture has encouraged a melting-pot in which diversity is a present and enriching factor.

As President of the Congress and Vice-President of the International Society, I feel extremely pleased to welcome you to our country. I would also like to thank you for the support and cooperation from all members who have contributed to make this feasible.

Ana Maria Rosso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