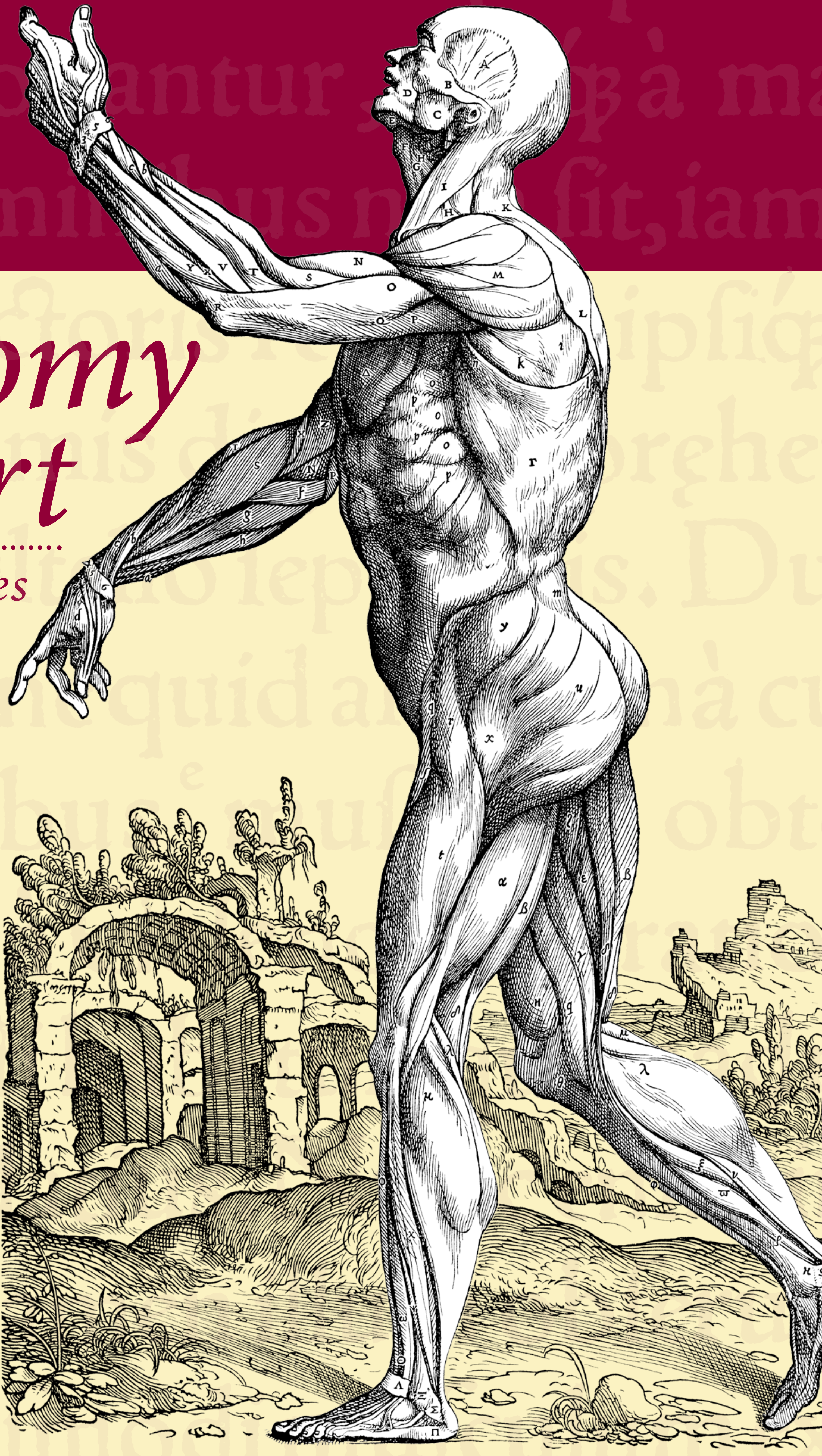
No. 73 Published October 2013

Karger Gazette



Anatomy & Art

through the Ages

Publisher's Note

When we were first approached by the translators of Andreas Vesalius' ground-breaking atlas of anatomy *De humani corporis fabrica*, I was not aware of how much the publication of this English translation from the original Latin would influence our publishing house and me personally. I have always been fascinated by the Renaissance and its art and architecture, but I now fully appreciate the enormous impact the Renaissance invention of the printing press had on the rise of modern science and medicine – and how much this resembles the profound effect that the dawn of the digital age has had on our own times.

Now, after two years of intensive and challenging work, the first comprehensive and annotated translation into English of both editions of the original *Fabrica* has just been published by Karger – a modern and user-friendly edition with a total of over 1,400 pages in A3 format, with greatly enhanced illustrations, and an impressive weight of 14 kg.

The articles in this issue of the *Karger Gazette* introduce you to Vesalius as a pioneer of modern anatomy and also go beyond to look at the role of art and illustration in a medical and historical context. I also invite you to visit our special website www.vesalius-fabrica.com where you will find some more interesting stories about Vesalius, his times and his work as well as background information on the production of the New Fabrica.

With this excursion into the beginnings of modern medicine and printing, I wish you enjoyable reading.

Gabriella Karger

Vesalius and the Achievement of the ***Fabrica***

Daniel H. Garrison

Andreas Vesalius of Brussels (1514–1564) is mainly known for his illustrated atlas of anatomy, *The Fabric of the Human Body,* first published in 1543 under the title *De humani corporis fabrica.* Although he was only 28 at the time of its publication, he wrote a comprehensive description of the body's physical structures providing more than 270 woodcut illustrations, which made his work immediately famous. Another achievement was his reforms in medical education emphasizing direct observation and personal, hands-on dissection as opposed to theoretical learning. Thirdly, his demonstration of errors in Galen due to the fact that he had carried out his dissections on animals rather than humans undermined the conventional authority of Galenic anatomy and began its replacement by specific study of the human anatomy. Published in the same year as Copernicus' *De revolutionibus orbium coelestium*, the *Fabrica* is regarded today as one of the founding works of the scientific revolution.

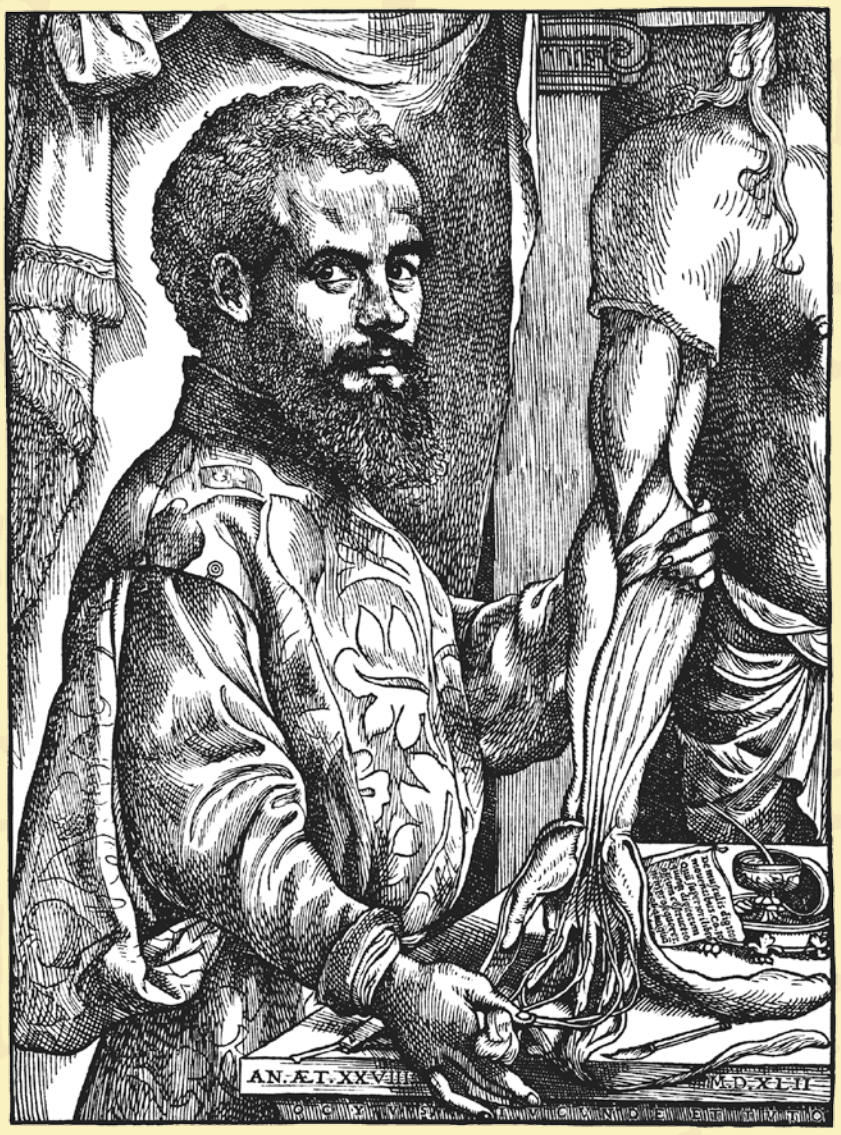


Fig. 1. Portrait of Andreas Vesalius.

Personal Appearance

Vesalius had a distinctly recognizable appearance, as can be seen from the only portrait that he authorized and used as the frontispiece of three of his books (fig. 1). Unlike the usual Renaissance portraits, which regularized the subject's proportions and removed any blemishes, this woodcut features a wart over his right eye and places him next to a table that reaches his waist. His stubby forearms and hands are placed next to those of a suspended cadaver whose hand he is dissecting, and his head appears oversized. Pieced together, these features tell the same story, best summarized as hypochondroplasia, a form of short-limb dwarfism that makes the head appear relatively larger than other parts of the body. Although Vesalius himself never mentioned this condition, as in many of his illustrations he lets the picture do the talking.

It may be no coincidence that the three anatomical features named after Vesalius – the foramen of Vesalius, the vein of Vesalius, and the bone of Vesalius – are all exceptional and rarely found in humans. The anatomist himself remained especially interested in 'natural' canons of form and their anatomical deviations. In the *Fabrica*, he twice mentions his intention to write a book on pathological anatomy. His career as an anatomist was cut short by exhaustion after the 1543 publication of his magnum opus when, in a fit of impatience with his critics, he burned his notes for future works, gave up his academic post at Padua, and took service on the medical staff of his patron, Charles V.

Origins

Scion of a Flemish family that had been prominent in medicine for generations, Vesalius was the son of Holy Roman Emperor Charles V's personal pharmacist. He was expensively educated at the Castle School in Louvain with a curriculum that concentrated on Latin, Greek, literature, philosophy, and rhetoric. He continued his studies at the University of Paris under the faculty of medicine. Both schools were distinctly humanistic with regard to the classical tradition, but with a lingering medieval character. Medical lectures at Paris consisted mainly of readings from Galen or a medieval summary, sometimes demonstrated by an assistant who dissected an animal or human cadaver. One of Vesalius' favorite professors, Jacobus Sylvius, conducted his own demonstrations. Vesalius himself showed a strong talent for dissection, and became the demonstrator for one of his professors, Jean Guinter of Andernach. It was probably at this point that he began to appreciate the value of direct visual inspection, and soon started to understand that some of Galen's descriptions more closely matched animal than human anatomy.

Publishing the Visual World

Vesalius' generation was one that was visually transforming Europeans' knowledge of themselves, the world, and the cosmos around them. Typically, their great works made a pictorial argument through woodcut or copperplate illustrations as a key to the knowledge they transmitted. Vesalius' friend Gemma Frisius (1508–1555) produced a 1529 revision of Apianus' *Cosmographia* which was a great commercial success, followed by a combined terrestrial and celestial globe in 1536–1537 that purchasers could cut out and construct for themselves. The interest in cartography that Frisius stimulated led his student Gerardus Mercator (1512–1594) to produce the cylindrical world projection (1569) that is still in use today. Another Flemish cartographer, Abraham Ortelius (1527–1598), created the first modern world atlas, *Theatrum orbis terrarum,* in 1570, replacing the obsolete maps of Ptolemy (AD 90–168) just as Vesalius and his successors at Padua were gradually replacing the obsolete anatomy of Galen. Sebastian Münster's *Cosmographia* (1544) illustrated world geography in 640 folio pages with 520 woodcuts and 24 double-page maps. Going through 24 editions in 100 years, it was a hugely popular success, not least due to its many woodcut illustrations, and is now described as 'one of the most ambitious scientific publications of its age'.

Plants and animals received their own comprehensive study and illustration. Leonhard Fuchs' *De historia stirpium* (1542) was illustrated with 500 woodcut illustrations of plants. This and subsequent botanical guides supplemented Dioscorides' 1st century *De materia medica* by adding species from the Near East and the New World. Conrad Gesner issued his *Historiae animalium* in four volumes (1551–1558) with ca. 1,200 illustrations, including Albrecht Dürer's famous rhinoceros. At the same time, Guillaume Rondelet (1507–1566) published his *Libri de piscibus marinis* (1554/1555), a survey of species of fish illustrated with 400 woodcuts. Rather than being a lonely eminence of illustrated science, Vesalius was a close follower of the trends of his time. It is because of these replacements of ancient tradition that the Renaissance is sometimes renamed the Early Modern period.

Illustrated Anatomy

The first illustrated anatomy books were already making their appearance when Vesalius received his medical degree and took up a teaching position at Padua in late 1537. An important antecedent can be seen in Giacomo Berengario da Carpi's *Commentaria super anatomia Mundini* (1522), 'the first full-scale illustrated anatomy book', and a condensed version, the *Isagogae breves* (1523). According to Benvenuto Cellini, Berengario was an art collector and connoisseur of drawing. Like Vesalius after him, he placed many of his anatomical woodcuts in a landscape, and his illustrations contain allusions to ancient sculpture (e.g. the Apollo Belvedere, which Vesalius also copied) and art of his own time. He was an advocate of *anatomia sensata* in preference to book anatomy, and he carried out all his own dissections.

Another possible antecedent was Charles Estienne's illustrated *De dissectione partium corporis humani*, written in the 1530s although not published until 1545. Even though their figures are comparable in many ways, neither Berengario nor Estienne achieved the same accuracy or elegance of design that appears regularly in Vesalius' illustrations. No predecessor or successor has attained the classic status of Vesalius' large figures and their 'strange, poetic quality which haunts the mind'.

The Art of the *Fabrica*

Nobody knows the identity of the artists who prepared the drawings on which the woodcuts were based. The scale, diversity and rapidity of their production argue that they were the works of several draftsmen, including Vesalius himself. It has been speculated that the artists included Jan Stephan van Calcar, a student of Titian who had supplied drawings for Vesalius' *Tabulae anatomicae* (1538), a set of six anatomical plates for study by students. But there is little evidence for this. Vesalius' own testimony in the *Epistle on the China Root* (1546) is that there were multiple artists and engravers, none of whom he names.

Although there is no record of who paid to have these woodcuts made, it can reasonably be guessed that the patron was the Holy Roman Emperor Charles V, to whom Vesalius addressed his dedicatory introduction to the *Fabrica*. Even though the illustrations were protected by an imperial privilege operating as a form of copyright, they were quickly copied throughout Europe and became a de facto standard of refinement in anatomical illustration. Today, they remain iconic works of art that have helped school our eyes in the perception of human anatomy.

This prominence is nowhere more evident than in Vesalius' 'muscle men', the ecorchés which introduce Book II of the *Fabrica* and, layer by layer, illustrate the muscles that activate the human body and underlie its exterior shapes (see figure on title page). These large woodcuts, set in the Euganean Hills north of Padua, include a subtle conversation between the human body and nearby architecture, stones, and plants, all of which were commonly seen as metaphors of the body and its parts.

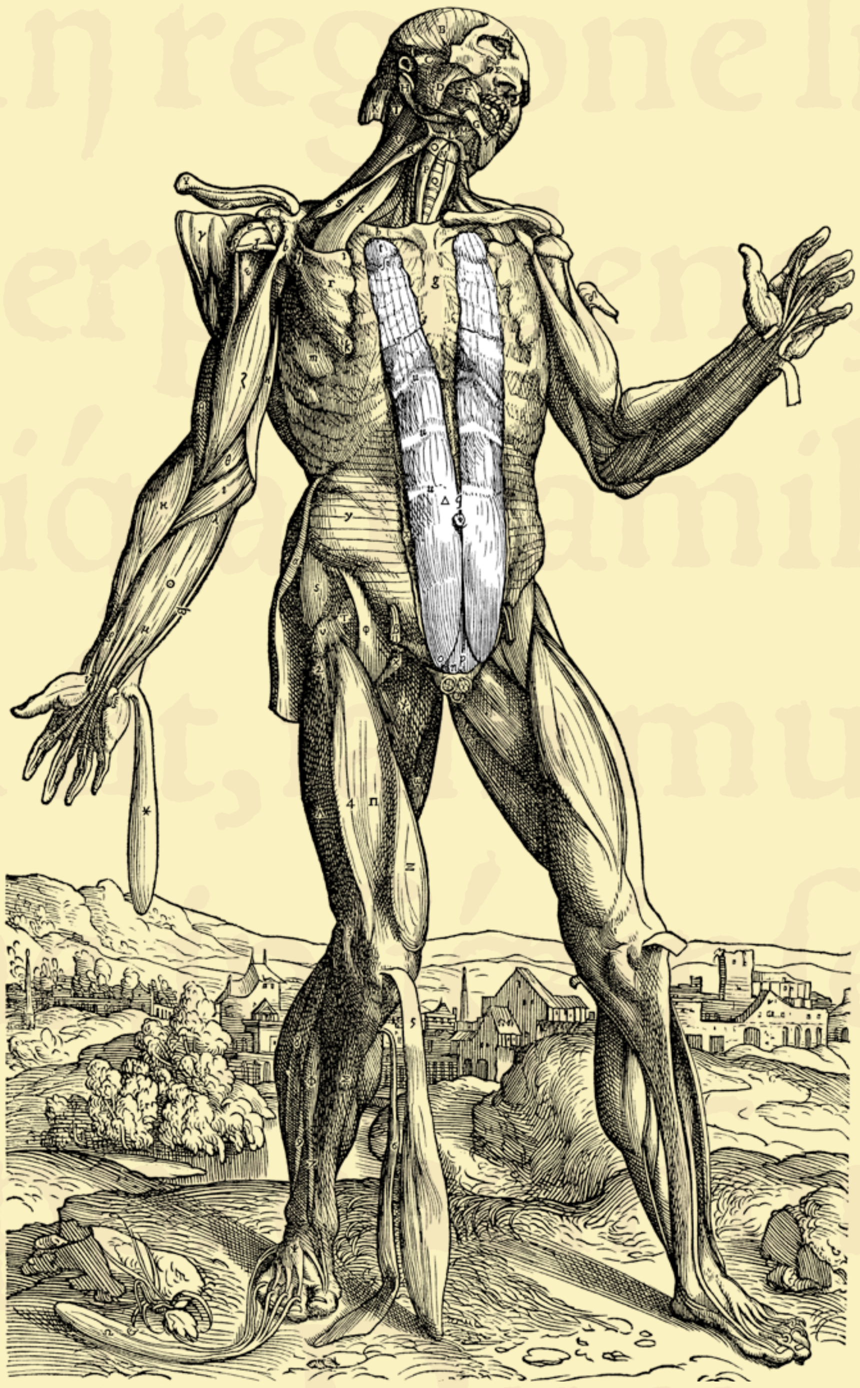


Fig. 2. Fifth muscle man, displaying the rectus abdominis muscle as it is seen in dogs and caudate apes.

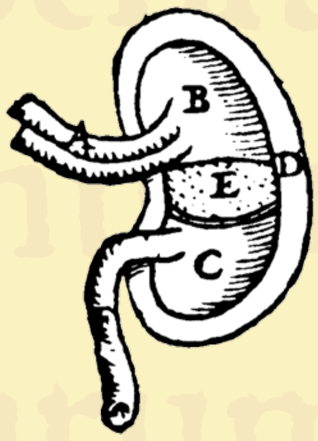


Fig. 3. Kidney showing an imaginary filtering membrane perforated like a sieve.

Fig. 4. Vena cava as postulated by Galen.

Vesalius believed that the human body was the supreme work of Nature's art, and he often reminds his readers of this conviction, which he shared with his ancient predecessor Galen: 'Nature did not depart wrongly or idly from her accustomed craft with muscles, and for this she deserves your praises' (New Fabrica [1], p. 502). As a rule, he intended his illustrations to demonstrate 'the signal craft of Nature' (New Fabrica, p. 153) in the various systems of the body, but he was not above using several figures scattered around the *Fabrica* to demonstrate errors by other anatomists that are not borne out by dissection. The rectus abdominis muscle, for example, begins no higher than the fifth, sixth and seventh ribs and descends to the pubis in man. But Vesalius' fifth muscle man shows it originating much higher, just beneath the clavicle as it does in dogs and caudate apes (fig. 2). His purpose was to show Galen's error in its description: 'it is not to be seen in humans as it is in caudate apes and dogs. We have nevertheless drawn it here so that Galen can be understood' (New Fabrica, p. 373).

The Quarrel with Galen

This brings us to the other important side of Vesalius' achievement. From his earliest days as a professor of surgery and anatomy at Padua, if not even earlier when working as a demonstrator at Paris, Vesalius was becoming ever more aware of the widening gap between the anatomy described in the ancient works of Galen (2nd century AD) and the directly observable *anatomia sensata* recommended by Berengario and by Niccolò Massa, who wrote an introductory book of anatomy in 1536. Although he remained essentially a Galenist to his dying day, he increasingly emphasized his growing belief that Galen had never dissected a human body. This was certainly true, as Galen adhered to the Greek belief going back to Homer that opening the 'black box' of the human cadaver incurred pollution.

This taboo had long been forgotten in late medieval Europe, and in the 16th century human dissection had become a universal feature of medical education and dissections were regularly attended by art students and others with an amateur interest in the fabric of the human body.

But medical humanism, the dominant ideology of European intellectuals in Vesalius' lifetime, was also dedicated to the revival of *prisca medicina*, the pristine medical teachings of ancient scholars including the Hippocratics, Aristotle, Galen, and others whose works were being re-edited, re-translated, and employed as textbooks and references with unquestioned authority. This school of thought placed little stress on personal observation of anatomy as long as the classical authorities were closely studied.

It was to this clash between these two perspectives that Vesalius and a growing number of university anatomists devoted their attention. Galen himself had compared bookish anatomists to navigators who sailed their ships with only a book to guide them. Following in Galen's footsteps,

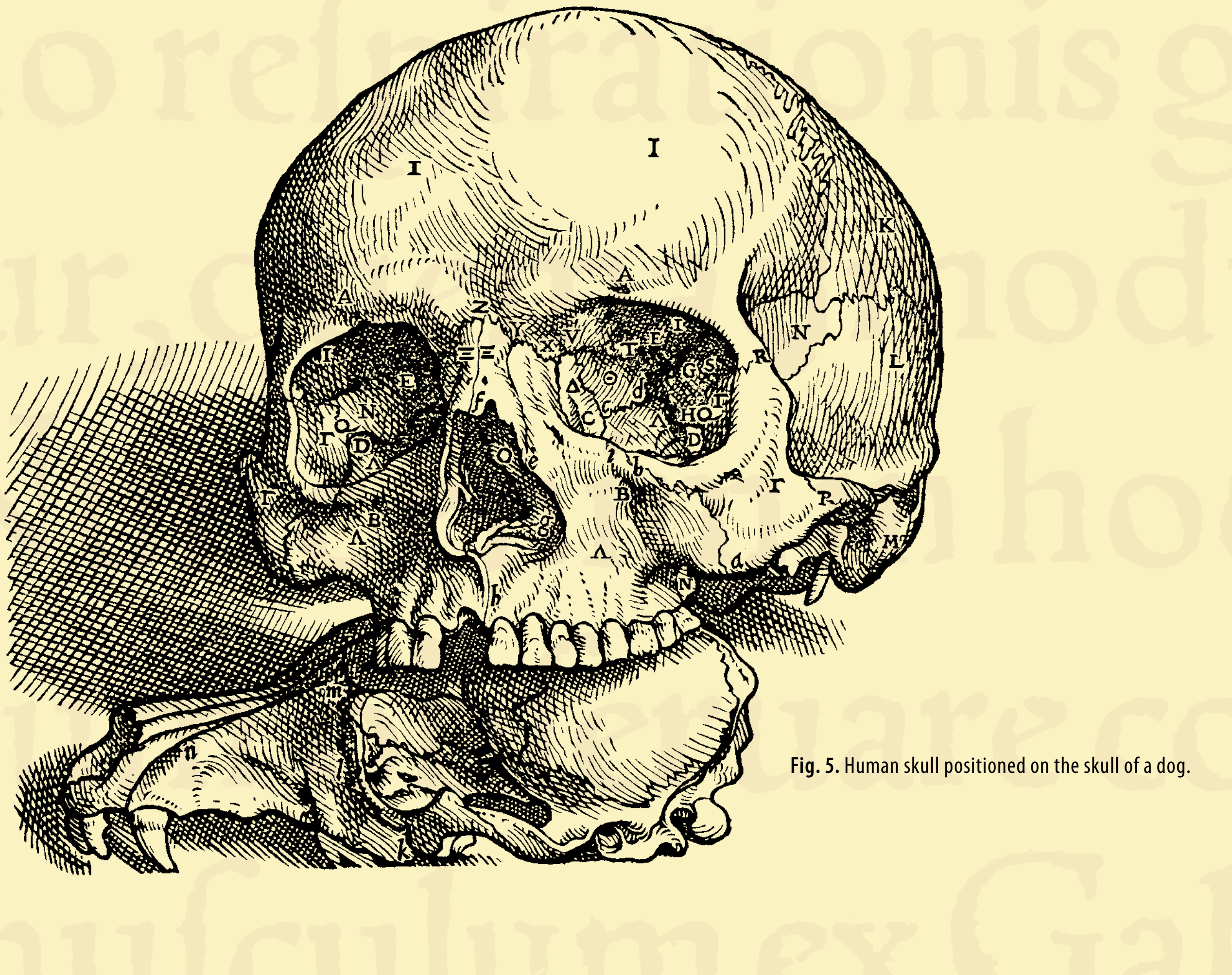


Fig. 5. Human skull positioned on the skull of a dog.

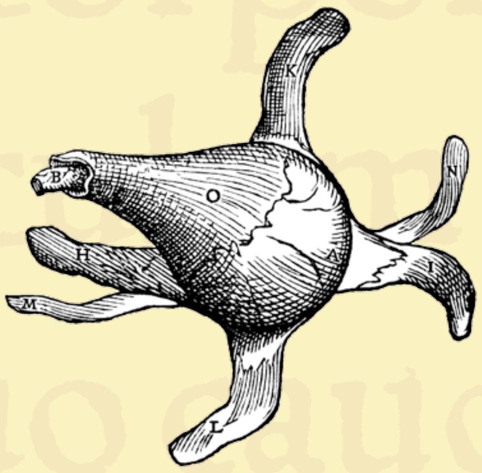


Fig. 6. Faulty illustration of an eye muscle that can be found in cattle only (see character O).

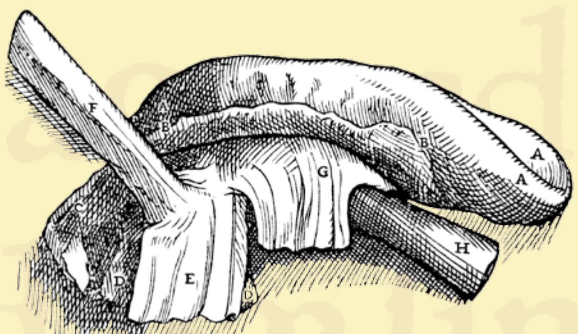


Fig. 7. Tongue, suspected to be canine.

Fig. 8. Hyoid bone with doggy features.

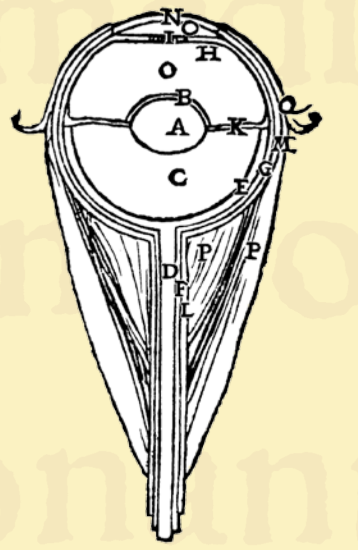


Fig. 9. Eye drawn in a perfectly spherical way.

Vesalius based his description of anatomy on direct observation, but always comparing human to animal anatomy.

Illustrating Galen's Errors

We have seen that Vesalius sometimes altered his woodcuts to show a feature that Galen had described but that does not exist in human anatomy. Likewise, he created illustrations that were totally wrong to illustrate other errors.

Most pre-Vesalian anatomists imagined the kidney to contain a filtering membrane that removed urine from the blood and passed it out through the ureter. 'Surely', Vesalius argued,

> *the supremely wise Maker of things did not assign so great a task to one little membrane perforated like a sieve, nor did he construct such a thing in the kidneys. In fact, by a faculty native to it and its own tendency to justice, the substance of the kidneys filters out the serous waste brought down through its body by veins and arteries, and deposits it into the sinus that empties into the urinary duct. To see this amazing artifice, I would like you to have at hand a canine kidney.* (New Fabrica, p. 1039)

He then added an illustration to picture the imaginary membrane perforated like a sieve inside the kidney (fig. 3, p. 3). The actual human kidney works in another way, but as Vesalius was more an observer of form than a student of processes, he evades the question with a grand-sounding 'faculty native to it and its own tendency to justice'.

In another illustration (fig. 4, p. 3), Vesalius asks his readers to imagine what the Galenic vena cava would look like if it existed in the human body.

> *In this figure I have drawn the arrangement of the vena cava that would inevitably result if it were split into two trunks at the right side of the heart. To observe more precisely Galen's argument, which he repeats so often and uses instead of the best demonstration, compare the present figure with some of those in the sixth book.* (New Fabrica, p. 739)

One of the most arresting woodcuts in the *Fabrica* shows a human skull propped up on the skull of a dog (fig. 5, p. 3). Vesalius used it twice in Book I, as the first figure in chapters 9 and 12. As Saunders and O'Malley remarked:

> *The primary purpose of the illustration was to reveal that Galen had described the premaxillary bone and suture of the dog as though present in man and thus could not have been familiar with human anatomy. Vesalius thus opened a great controversy of singular importance in comparative morphology which was to rage with bitter polemics for nearly four centuries and to be settled only in recent times. … His discovery, from which he made the correct deduction, was one of the major factors leading to the overthrow of Galenical anatomy.* [2]

At the same time, Vesalius' illustration contains an error showing the ethmoidal labyrinth as a separate bone – an error that would be corrected within a few years by Fallopio.

Notable Errors in the *Fabrica*

Although he was in some ways a radical critic of the prevailing orthodoxy, Vesalius was a young man in a hurry who remained tethered to prevailing views and lacunae in anatomical knowledge.

This led him into numerous faulty illustrations like that of the eye muscle (fig. 6) that can be found only in cattle (O in the illustration is the bovine retractor bulbi), as his critics must have quickly pointed out, for in his *Epistle on the China Root* he explained:

> *I hear that some people are putting it about that I am describing bovine eyes rather than human because they have seen that I always bring bovine eyes to dissections and because the eyes illustrated in my book appear much larger than human. I have certainly always displayed bovine eyes in classes because human eyes outside the order of dissection were too flabby and small.* [3]

But he added that he saw no difference in the muscles. Realdo Colombo remarked in *De re anatomica* (1559) that both Galen and Vesalius had dissected an animal eye instead of a human eye.

Similarly, his illustration of the tongue in Book II looks suspiciously canine (fig. 7). Later in the *Fabrica* Vesalius admits: 'to tell the truth, [the tongue] is not as well known to me' (New Fabrica, p. 1313) as other parts of the body.

Because they are distinctly human, Vesalius would have hoped to provide accurate illustrations of the larynx and hyoid bone. But nearly all of the human specimens provided to him by the civil authorities in Padua were from people who had been executed by hanging or decapitation, which crushed or otherwise mangled these parts. His illustrations of the laryngeal cartilages are therefore a composite with doggy features, and his pictures of the hyoid bone (fig. 8) bear little resemblance to the human hyoid. The string of ossicles in the left illustration extending to the styloid bone is distinctly canine: in humans, this connection is made by the stylohyoid ligament.

In at least one instance, Vesalius was unable to resist an old anatomical metaphor. The medieval notion that the eye was created in imitation of a perfectly spherical, geocentric cosmos led him to render its structure to fit the ideology (fig. 9). Hence, he makes the eye perfectly spherical, ignoring the conical anterior protrusion formed by the iris and cornea, and he locates the lens (A) posteriorly, near the center of the vitreous cavity rather than beyond its anterior limit. In addition, the optic nerve (D) is implanted more or less on the posterior pole rather than slightly medial to it, where it is found in real life. It is not clear from his illustrations that Vesalius had ever examined the human eye. The unworthy thought has sometimes come to me when reading the *Fabrica* that he was squeamish about certain parts of the body such as the eye and the tongue.

Another structure where he made various mistakes is the female reproductive anatomy. This could be understood in part by the relative scarcity of female cadavers of reproductive age, although he mentions a few that came his way before he wrote the *Fabrica*, and in the title page of both editions he has himself shown performing a pelvic dissection of a woman. The subject had been prestigious since the Hippocratic writers of the late 5th century BC, who devoted no fewer than ten of their sixty surviving works to gynecology and obstetrics. It is therefore something of a surprise that Vesalius did not show a better understanding. His large woodcut of the female pudenda, vagina and uterus (fig. 10) follows the popular belief that these parts are an internal reflection of the male penis – about which he had a much better understanding. He left it for his younger contemporary Colombo to claim discovery of the clitoris and for Fallopio to detail the oviducts or 'Fallopian tubes'. Still more surprising is his placement of the urethra to discharge inside the vagina, a curious error for a normally observant anatomist like Vesalius, especially as Soranus, writing in Rome about a generation before Galen, had placed the end of the female urethra accurately 'beneath the nymphe' or clitoris.

Fig. 10. Female reproductive organs.

It is not my purpose here to give an account of everything Vesalius got wrong, or to sneer at his mistaken attitudes. Coming as he did from a family of distinguished physicians going back generations, Vesalius was a conservative anatomist who respected everything about Galen except for his dependence on animal instead of human anatomy and his inexperience in human dissection. Like Galen, Vesalius did not introduce any paradigm changes in medicine comparable to William Harvey's discovery of blood circulation in 1628. But his introduction of detailed illustration and his insistence that medical students perform their own dissections instead of 'swearing by the words of a master' placed him at the forefront of a new scientific era.

References

1 Vesalius A: The Fabric of the Human Body: An Annotated Translation of the 1543 and 1555 Editions of *De humani corporis fabrica libri septem* by DH Garrison and MH Hast. Basel, Karger, 2014 [= New Fabrica].
2 Saunders JB de CM, O'Malley CD: The Illustrations from the Works of Andreas Vesalius of Brussels. Cleveland, World Publishing, 1950, p 58.
3 Vesalius A: Vesalius: The China Root Epistle. A New Translation and Critical Edition. Cambridge, Cambridge UP, in press; quoted in New Fabrica, p 489, note 20.

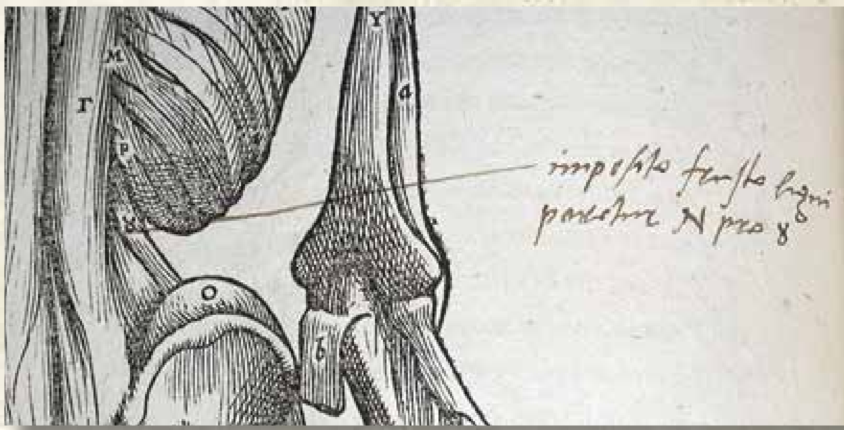
Daniel H. Garrison

Daniel H. Garrison received his degrees from Harvard (A.B. Classics, 1959) and Berkeley (PhD Comparative Literature, 1968). He was a member of the Classics Department at Northwestern University from 1966 until his retirement in 2010. His publications have dealt chiefly with the understanding of Greek and Latin lyrics. He continues to write on 16th-century anatomy. Dr. Garrison is one of the translators, together with Dr. Malcolm H. Hast, of *The Fabric of the Human Body*, published by Karger in 2013.

Vesalius Vignettes

A Book Collector's Astonishing Discovery

By Gerard Vogrincic
Lions Gate Hospital, North Vancouver



Vesalius' handwriting

As a collector of rare books, I have always been attracted to books with annotations. I am fascinated by the handwritten notes of past readers, some of them written hundreds of years ago. Who were they? Where were they and what were they doing when they wrote them? Why did they write them? Lastly, there is always the highly unlikely possibility that they were written by a significant figure, someone we would still know about today.

Fortunately for me, most collectors seem to view annotations as defects and put more value on non-annotated copies. This was certainly the case with the 1555 edition of *De humani corporis fabrica* that I purchased at auction in 2007, and I am convinced that the extensive annotations throughout this particular copy made it unattractive to other collectors.

Soon after acquiring the book, I began to examine it. Initially, it was the extent of the annotations that intrigued me the most. The 1555 edition of *De humani corporis fabrica* is a large folio containing over 800 pages, and the annotations kept cropping up throughout the entire book. I soon realized that the nature of the annotations was very unusual. In many cases sentences and even whole paragraphs had been crossed out and rewritten in the margin. Although I personally could not read them, I could see that they were written in Latin. The person who made the annotations must have perused the entire book very carefully. There were numerous corrections down to the smallest details throughout… spelling errors, commas to periods, colons to semicolons. I also noticed that the name of Vesalius' father, Andreas, was crossed out in the introduction… curious indeed!

These annotations were clearly not those of a typical student or casual reader and, to me, raised the possibility that they were made by Vesalius himself. But how should one go about determining if they were really written by Vesalius? An obvious place to start would be to compare the handwriting of the annotations with known specimens of Vesalius' handwriting. Examples of handwriting by Vesalius are extremely rare, largely because he burned his early books and papers. There are fewer than ten known existing letters by Vesalius, and after an extensive search on the internet, I was able to get hold of excellent photocopies of two of his letters from the Waller Manuscript Collection at Uppsala University.

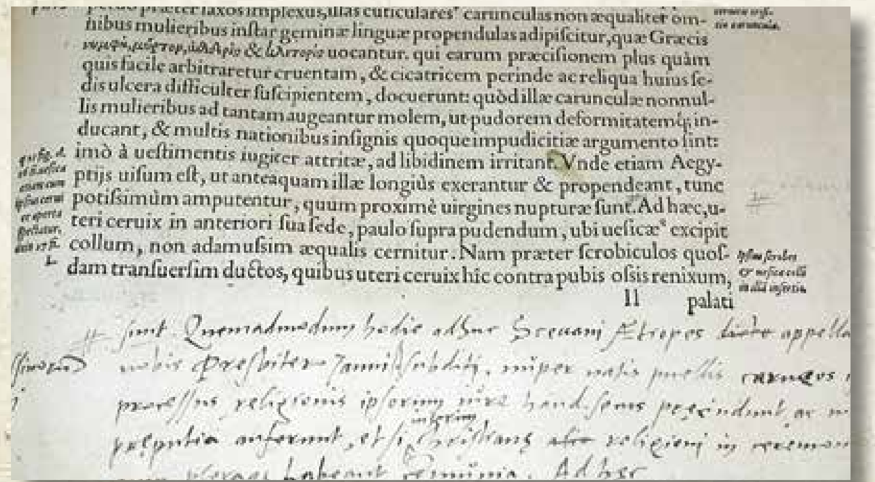
Whilst comparing them with the annotations, I had by far my most exciting experience ever as a collector. The handwriting was absolutely identical to that in the letters. There was match after match… between words, letters, spacing, flourishes at the end of words… everything matched! Even though I could neither read nor understand the annotations, I knew that this was a book of great significance and value, not just to collectors, but also to scholars and historians. What was Vesalius writing, and why? The annotations had to be translated.

It was clear to me that a discovery of such great importance would require a world class scholar in medical history to interpret the contents, but who? One name I was very familiar with was Dr. Vivian Nutton, Emeritus Professor at the UCL Center for the History of Medicine. When I emailed Dr. Nutton and told him what I thought I had, he responded with interest, but also cautioned that I should not set my hopes too high. He asked me to send him some images of the annotated pages, and he would then get back to me with his opinion.

It was only after Dr. Nutton saw the images and began translating the annotations that he got as excited as I had become. It was also clear to him that they could only have been written by Vesalius himself and he confirmed his opinion when he came to me to look at the book in person. In the first scholarly discussion of these annotations, Dr. Nutton presented the view that they were most likely meant for a third edition of the *Fabrica*, which had never been published (see his article in *Medical History*, Vol. 56, No. 4, 2012).

Andreas Vesalius' own copy of *De humani corporis fabrica*… one of the most important books in history, extensively annotated by its own author, undiscovered for centuries. Incredible doesn't even begin to describe it!

This is a shortened version of Dr. Vogrincic's article on www.vesalius-fabrica.com. *The annotated original is now at the Thomas Fisher Rare Book Library in Toronto.*


nibus mulieribus inſtar geminæ linguæ propendulas adipiſcitur, quæ Græcis
uocantur. qui earum præciſionem plus quàm
quis facile arbitraretur cruentam, & cicatricem perinde ac reliqua huius ſe-
dis ulcera difficulter ſuſcipientem, docuerunt: quòd illæ carunculæ nonnul-
lis mulieribus ad tantam augeantur molem, ut pudorem deformitatemq́; in-
ducant, & multis nationibus inſignis quoque impudicitiæ argumento ſint:
imò à ueſtimentis iugiter attritæ, ad libidinem irritant. Vnde etiam Aegy-
ptijs uiſum eſt, ut anteaquam illæ longiùs exerantur & propendeant, tunc
potiſsimùm amputentur, quum proximè uirgines nupturæ ſunt. Ad hæc, u-
teri ceruix in anteriori ſua ſede, paulo ſupra pudendum, ubi ueſicæ excipit
collum, non adamuſsim æqualis cernitur. Nam præter ſcrobiculos quoſ-
dam tranſuerſim ductos, quibus uteri ceruix hic contra pubis oſsis renixum,
palati

Vesalius own notes in the 1555 edition of the *Fabrica*

Printing of the *Fabrica*

Vesalius' fixation with perfection did not end with his manuscript. By 1543, new technology and distribution channels made it possible to print a work of this size in quantities that permitted broader dissemination than had been possible before.

Vesalius sought out one of the most accomplished printers of the time, Johannes Oporinus of Basel, Switzerland, even though this involved transporting the 273 folio-sized woodblocks over the Alps. Basel was a mecca of the modern publishing world, and Vesalius stayed for months in the town on the Rhine to carefully steer each stage of the production process until the printing was complete.

By a fortunate twist of fate *The Fabric of the Human Body* was again printed in Basel, 470 years after its first publication.

Basel Antiqua – The new design of a historical typeface

Inspired by the font used in the 1543 edition of *De humani corporis fabrica*, the Swiss graphic designer Christian Mengelt created a new and modern typeface called *Basel Antiqua* especially for *The Fabric of the Human Body*. The original was distinctive of the 16th-century printing of Basel and can be found in many publications printed at that time. They belong typographically to the most beautiful publications of their time. The Antiqua font used in Basel was based on the Venetian Renaissance Antiqua, one of the most commonly used fonts in the 16th century. However, the second edition (1555) of *De humani corporis fabrica* was printed in the Garamond typeface which originated in France.

The newly designed Basel Antiqua is compatible with 21st century digital technology. Computer programs are used today for the technical transformation of the historical type into a modern typeface. Nevertheless, this is still a complex task requiring knowledge of the historical development of printing types and a deep understanding for the form of letters. The purpose of the redesign was not a faithful replica of the historical typeface but rather an independent type design reflecting the stylistic features of the historical model. To fulfill the requirements of a modern font, *Basel Antiqua* encompasses all the characters of the Greek and Cyrillic alphabets and can therefore be applied in 89 languages.

Why History of Medicine Matters

Hubert Steinke

Medicine is increasingly becoming a subject of public discussion and decision-making. We are in need of physicians who have seriously reflected on the foundations of their profession and are able to make well-founded contributions to these debates. Careful analysis of history helps us understand the current situation of medicine. In contrast to earlier periods, modern historians of medicine have adopted a critical but constructive approach and developed new areas and methods of enquiry.

Unity of the Ars Medica

The title page of *De humani corporis fabrica* depicts the public area of a classical anatomical theatre (fig. 1). We can see the anatomist and author Vesalius standing in the center next to the opened cadaver that is being dissected. To his left and on the other side of the dissection table there are three larger-than-life figures in classical attire. These have been identified to symbolize Hippocrates, Galen and Aristotle. The picture not only shows Vesalius' endeavors to be accepted by the authorities of antiquity, but is also a statement as to the general relationship between contemporary medicine and its history. The four men have been placed together in one picture, forming a unit. Galen and Hippocrates are not merely a part of history but are also maintaining their place in current medicine. With such a perspective, a true historiography was not possible: the old medicine was still a part of the new, and history making was more a project of unification.

Whoever takes a deeper look into the medical literature of the Renaissance will find themselves continuously faced with this process of unification. Both modern authors and those from antiquity were cited; it was natural to supplement the accumulated knowledge of 2,000 years with the latest findings, a process that was taken for granted until the age of enlightenment, when scholars first began to question the teachings of the classics. The old, traditional knowledge including the doctrine of the equilibrium of bodily fluids (humoral pathology) was slowly becoming obsolete; a new knowledge based on modern principles was now called for. However, as a new solid scientific basis had not yet been achieved, these demands were met only to a limited extent. So, one alternated between a purely empirical collection of knowledge based on experience and the establishment of a new form of natural science. This reorientation soon led to the destruction of the unquestioned historical unity of medical science. As a consequence, a true historiography became possible and medical history steadily began to establish itself as a field in medical training. The field of medicine profited greatly from medical history: it offered guidance in the complex and changing medical landscape, encouraged openness towards all things foreign as well as humility and self-criticism, and protected against repeating old mistakes.

Instrumentalization of History

Radical changes took place in the mid-19th century. Medicine had established itself and increasingly began to understand its role as a natural science – the break with the old ways had definitely taken place. With the discovery of cells, the chemical analysis of blood, germ-free operations as well as numerous quantitative diagnostic methods, medical doctors were convinced that they possessed the basic tools needed for fast and continuous progress. A hitherto unthinkable trust in the natural sciences developed and reached its peak at the turn of the century. In 1905, the clinician Bernhard Naunyn stated: 'There is no doubt in my mind that the words 'Medicine will be a science, or it will not be' should also be, and is, applicable for therapy. The art of healing will become a science or it will not be! It is absolutely clear to me that where science stops, it is not art that appears but rather raw empiricism and handcraft.' Such an attitude implied that the art of medical practice and experience was only a crutch on which medicine in its growing scientification would soon no longer have to lean on for support. Consequently, the history of medicine lost its place as an integral component of medical science. As the objectives were defined in such a clear and uncompromising way, there was no longer any need for an instance that provided guidance and self-criticism. Medical history came under pressure and took a fatal course, with consequences that can still be felt today. It gave up its function as a critical authority, and its mission was to support and confirm the beliefs and goals of modern medical science by identifying precursors of current thinking in their struggle against traditional beliefs.

Fig. 1. Title page of Vesalius' *Fabrica*. The highlighted figures represent Galen, Hippocrates and Aristotle (from left to right).

This positivist medical history was mainly written by doctors, for doctors and about doctors. It legitimized medicine, procuring historical proof of the accuracy of a purely naturalistic scientific approach. As a reward, after the turn of the century, the field became more and more institutionalized: new chairs were introduced and new institutes founded. Together, doctors and historians of medicine celebrated the milestones and the outstanding figures of this field.

The 'New' History of Medicine

Since the middle of the 20th century, and even more pronounced since the 1970s, professional medical historians began to abandon this one-dimensional approach, heralding in a new era – the so-called 'new' history of medicine. Representatives of this new direction are open towards any questions and new approaches from other historical disciplines; they follow and even contribute to the linguistic, visual, cultural and practical turns in scientific research. Using these methodologically matured tools, they are striving to understand historical events within their individual context. They do not, for example, reduce the revolution in anatomy that took place in the Renaissance to the works of an individual genius in the midst of stubborn followers of an outdated, irrational ideology, but try to understand under which conditions various academic and intellectual milieus could be formed to either prevent or allow change. The new history of medicine is not only interested in great doctors or medical discoveries, but also in patients, hospitals, health care, physical ideals, gender-specific and general social conditions, cultures of medical knowledge, demographics, political changes, ethnological medicine, medical ethics, complementary medicine and much more.

The traditional, positivistic historiography no longer exists in academic history of medicine, even though it is still popular with many doctors. Erwin Ackerknecht – one of the leading medical historians of the 20th century – described these doctors as 'the Sunday drivers of medical history'. But why is this view still so widespread among doctors and medical students? Jacalyn Duffin stresses that doctors and historians of medicine are in the same basic predicament. Both must treat each case, be it an individual patient or a specific historical source, by relating it to their basic pathophysiological knowledge or general historical context. At the same time, both know that it is impossible to draw conclusions from the general to the specific and vice versa with absolute certainty and mathematical precision; there is always room for some uncertainty or accident. I suppose this is where we are one step nearer the mark: historians are in the comfortable position of being able to ignore the area of uncertainty, describe it, problematize it or even use it heuristically. Doctors, on the other hand, have to act decisively in each individual case; even today, in the age

Fig. 2. Students handling plastinate specimens. (© Nanyang Technological University, Singapore; reprinted with permission).

of 'informed consent' when uncertainties can be discussed with the patient, they have to make the ultimate decision and come up with a therapy. From the doctors' perspective, the need for clear answers and simple explanations is much greater than it is for historians. And these simple explanations are provided by a kind of medicine that is focused on its scientific aspects.

Teaching Medical History

Today's doctors are well aware that medicine is not purely a natural science and that a reductionist viewpoint leads them astray. Apart from basic scientific research, medicine also relies on statistical-empirical clinical research and doctors' experience and skills. The quality and nature of medicine as a practical science is seen only with the treatment of each individual patient. We could agree with Kathryn Montgomery, who says medicine 'is neither a science nor an art. It is a distinctive, practical endeavor whose particular way of knowing … qualifies it to be that impossible thing, a science of individuals.' Only when we have such a holistic view of medicine, will there be a purpose for medical history. This distinguishes it from the history of science, which is primarily concerned with scientific knowledge and not with patients, hospitals or health care issues. Medical history, like any other historical specialty, provides a specific contribution to understanding our history, and as such has a specific task in the medical curriculum. Its main goal cannot be to transmit historical knowledge, but rather to use the historical background as a heuristic tool to better understand today's medicine. This means explaining and critically reflecting the fundamental structures, conditions, self-conceptions and problem areas in medical science and practice from a historical perspective, and it involves questions such as: Of what kind is the knowledge that doctors possess, how does it evolve, what are the fundamental notions on which it is based, how is it applied? What is an illness and how do concepts of disease change? How has the doctor-patient relationship developed? Based on this, we can enter into a dialogue with medical students and doctors about the general and fundamental questions of their profession. This is illustrated by the following example.

Locating Medicine

For over 10 years now medical students have been confronted with a new question. In their teaching of anatomy, an increasing number of medical colleges are now replacing hands-on dissection with work using 3D images, CT scans, plastinate specimens, etc.; for example, the Nanyang Technological University in Singapore – one of Asia's top-ranked universities (fig. 2). This is not an unexpected development as working with cadavers is time-consuming and costly, and no study exists which proves that dissection is the best and most efficient method of studying anatomy. However, the majority of medical students as well as doctors are convinced that hands-on dissection is an indispensable component of their training. Should students then only study at universities that are offering such courses?

In this case, medical history can be of help in locating the problem zones. Hands-on dissection was not commonplace in the pre-Vesalian era. At around 1300 AD, the anatomist Mondino de Luzzi from Bologna was the first to introduce anatomical teaching with human cadavers. The professor stood at the pulpit, reading out instructions from his textbook, while a demonstrator (or prosector) pointed to the parts in question on a cadaver (fig. 3). The students were not expected to actively take part in the dissections. Vesalius broke away from this traditional form of teaching. By touching the cadaver on the title page (fig. 1), he made it clear – in line with Renaissance thinking – that one has to get hands-on oneself in order to fully comprehend the anatomy. And since Vesalius this credo has been a fixed component of medical education. Anatomy had been the main discipline in medicine and the basis of a doctor's identity for centuries. A physician's reputation in the highly competitive market of the early Renaissance was based on the respect he attained from his exclusive studies of the human body. Broad anatomical studies were still highly regarded even after the concept of disease had long since shifted from the macroscopic descriptions of organs and structures to the microscopic levels of cells and bacteria. Only during the 20th century was the number of teaching hours for gross anatomy radically reduced from around 500 to 100 hours.

Fig. 3. Mondino's anatomy lecture. From Johannes de Ketham's *Fasciculus medicinae*, Venice, 1493, p. 64.

What remains, however, is an intimate connection between the identity of a doctor and the knowledge of anatomy. That a TV series which focusses mainly on the fictional lives and personal relationships between hospital doctors, but has nothing to do with anatomy, is called *Grey's Anatomy*, says it all! For the last 450 years, not only the medical profession but society in general has been indoctrinated by the reasoning that a good doctor is a doctor who has a profound knowledge of anatomy. Anatomical work in the laboratory not only serves in the acquisition of anatomical knowledge, but also works as a rite of passage into the medical profession. If we are fully aware of this background, we may find it easier to decide whether or not we want to give up this 450-year-old tradition.

In this, as in many other questions, taking history into consideration can help us to better understand the situation in which the medical profession currently finds itself. Critical reflection is as essential in medicine as it is in any other academic field. Without it, we will not be educating academic physicians, but merely medical workmen and workwomen.

Further Reading

Bröer R (ed): Eine Wissenschaft emanzipiert sich. Die Medizinhistoriographie von der Aufklärung bis zur Postmoderne. Pfaffenweiler, Centaurus-Verlagsgesellschaft, 1999.

Burnham J: What Is Medical History? Cambridge, Polity Press, 2005.

Bynum WF: History of Medicine. A Very Short Introduction. Oxford, Oxford University Press, 2008.

Frewer A, Roelcke V (eds): Die Institutionalisierung der Medizinhistoriographie. Entwicklungslinien vom 19. ins 20. Jahrhundert. Stuttgart, Steiner Verlag, 2001.

Huisman F, Warner JH (eds): Locating Medical History: The Stories and Their Meanings. Baltimore, Johns Hopkins University Press, 2004.

Montgomery K: How Doctors Think: Clinical Judgment and the Practice of Medicine. Oxford, Oxford University Press, 2005.

Hubert Steinke

Hubert Steinke is Professor of History of Medicine at the University of Bern. He has published widely on Albrecht von Haller, the Republic of Letters and on medical theory and practice from the 16th to the 19th century.

Karger Gazette

The Karger Gazette, highlighting a specially selected topic in biomedicine, is provided free to the biomedical community. To subscribe to the print edition please write to

S. Karger AG
P.O. Box
CH - 4009 Basel (Switzerland)
Email: gazette@karger.com

PDF available at: www.karger.com/gazette

Published by S. Karger AG, Basel.
Edited by Dagmar Horn, Beth Reigber and Franziska Suter, design by Gerri Schmid.

The views expressed in the articles are those of the authors and do not necessarily reflect those of Karger Publishers.

Art
and the Science of Appearance

Martin Kemp

The hugely productive relationship between art and science in the 15th century Renaissance and over the following four centuries was predicated upon the definition of painting as the imitation of natural appearance as seen by a spectator from a specific viewpoint. Once this definition had been formulated, not least by Leon Battista Alberti in his little book *On Painting* in the mid-1430s, the accurate description of nature, even in imaginary scenes, came to involve aspects of optics and the varied sciences of nature, especially those concerned with the structure and actions of the human body.

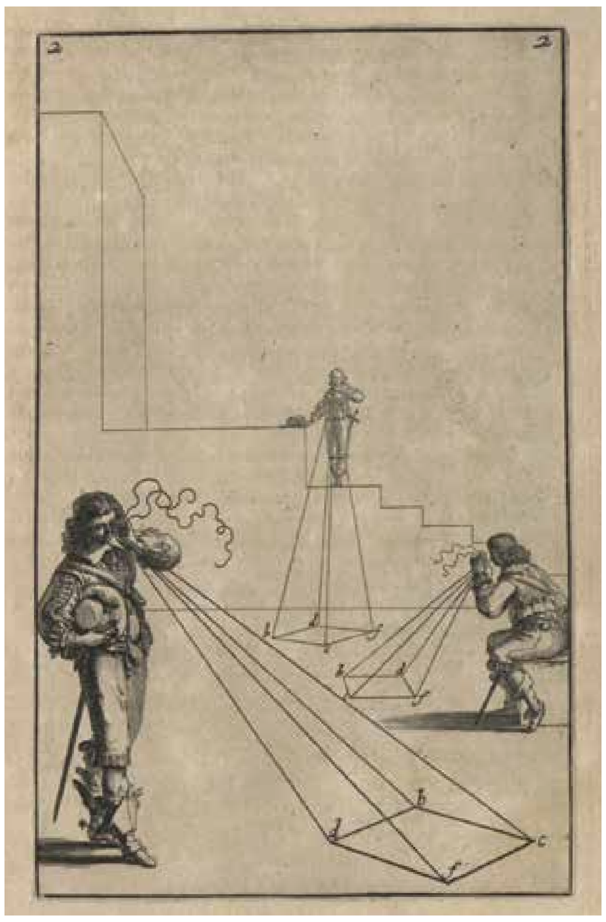
Fig. 2. Piero della Francesca, *Flagellation of Christ*, ca. 1460, Urbino, Galleria Nazionale delle Marche.

Optical Science

Alberti formulated the optical basis of Renaissance painting, explaining that the eye sees with a pyramid or cone of rays, the apex of which is within the eye. In this, he was drawing upon Mediaeval optical science. An object that is further away is seen within a narrower pyramid or cone, and thus appears smaller according to a precise mathematical rule. That is to say, if it is twice as far away it will appear to be half its previous size. And something that is seen at an angle will be foreshortened, i.e. larger at its nearer than at its furthest part.

In the 17th century, the French engraver Abraham Bosse illustrated the visual pyramid in a picturesque manner by showing elegantly dressed men gathering together the visual rays from squares on the ground like a collection of threads (fig. 1). If we imagine the pyramid of rays intersected on the surface of a window placed between the square and the observer, the resulting configuration shows what the squares look like to the men's eyes.

Fig. 1. Abraham Bosse, *Demonstration of Visual Pyramids with Squares Viewed from Varied Positions,* from *Manière Universelle de Monsieur Desargues* pour *Pratiquer Perspective,* Paris, 1648.



The optics of the pyramid is expressed in the painter's technique of linear perspective, in which lines that are parallel and set at right angles to the plane of the picture or 'window' run to a point of convergence, later known as the 'vanishing point'. The distances between equally spaced lines parallel to the picture plane also diminish according to due mathematical proportion, enabling the construction of a grid, like a tiled floor. The foreshortened grid can act as the measurement scale of everything in the depth of the picture. The first of the three books in Alberti's treatise takes the reader step-by-step through the construction of such a tiled ground plane and shows how objects can be placed on it.

A supreme example of this technique is the relatively small picture depicting the *Flagellation of Christ* by Piero della Francesca, painted in around 1460 (fig. 2). Piero sets the prime incident in the scourging of Christ deep in an architectural space defined by the tiled floors and beams of the roof, while representative figures in the foreground are tacitly conspiring in the events that will lead to his Crucifixion. The tiled floor in the zone occupied by Christ and the column to which he is tied relies upon an elaborate geometric pattern, which has been meticulously foreshortened. The figures are all scaled according to their position in the depth of the picture. It will not be surprising to learn that he produced his own intricate treatise on the geometry of perspective and also wrote a book on the geometry of the five regular or 'Platonic' solids as well as a basic manual of practical mathematics.

Other optical methods are involved in the description of natural appearance. Shadows are cast geometrically in relation to the source of light and the shape of the illuminated body, as we can see on the ground beside the three figures in Piero della Francesca's painting. Within this highly rational framework, a miraculous light seen only by Christ floods the coffers under which he stands, catching the pagan statue from below. The greatest Renaissance artists did not use perspective simply as an illusionistic trick but integrated it into the meaning of the picture.

Atmospheric Perspective

Leonardo da Vinci, in the generation immediately after Piero della Francesca, defined the systematic diminution of colour over distance, and the loss of clarity that resulted from the intervening atmosphere, later called 'atmospheric perspective'. This can be seen to perfection in his *Mona Lisa*, in which the painter embeds many aspects of his concept of painting as the supreme science of the visual appearance of nature. This involves not only the optics of appearance but also the structures and functioning of natural things. The landscape, depicting what he called the 'body of the earth', represents geological processes in which the rocks serve as 'bones', the soil as 'flesh' and the rivers as 'veins' – in line with the ancient theory of the microcosm, according to which the human body is seen as a miniature world. The two lakes at different heights reflect his ideas about the dynamic instability of water in the body of the earth over long periods of time. The sinuous flow of water is echoed in the cascades of her hair and in the rivulets of drapery that descend from the gathered neckline of her dress – more readily appreciated in a digitally restored version (fig. 3) than in the painting hanging in the Louvre.

Anatomy for the Artist

Leonardo was also the supreme advocate of anatomy for the artist, which was necessary if the human body was to be portrayed in expressive action in the most convincing manner. Thus, he studied its bony and muscular structures to an unprecedented

Fig. 3. Leonardo da Vinci, *The Mona Lisa,* ca. 1503–1513, Paris, Louvre, digitally restored by Pascal Cotte of Lumière Technology.

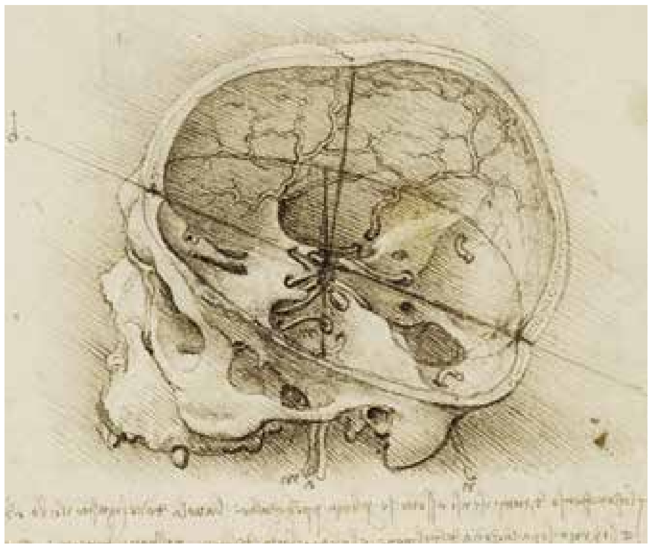


Fig. 4. Leonardo da Vinci, *The Human Skull Sectioned, and the Cranial Nerves*, 1489, Windsor, Royal Library, 19058r. Royal Collection Trust/© Her Majesty Queen Elizabeth II 2013.

degree, in order to comprehend the forms that underlie the skin and to understand the mechanisms of human motion in terms of the levers and fulcrums of the limbs. But, he also went deeper than we might expect an artist to do. He questioned the workings of the brain within the bony cranium, defining how the nerves converge on the geometrical centre of the head at a location called the sensus communis (fig. 4). This is where the senses converge, producing a coordinated set of impressions of the world around us. Leonardo needed not only to know *what* things look like but also *how* we see and *how* we understand what we see. The central core of the brain is also the region where judgement and imagination are located, and where the commands of voluntary motion originate. Leonardo thus aimed to develop a complete system for understanding perception, intellect, imagination, motion and emotion.

Academies of Art

Beginning in the 16th century, academies of art were founded, and they institutionalised the intellectual disciplines that were considered necessary for the learned artist, as distinct from someone who was merely a skilled craftsman. Formal teaching was offered in the optics of perspective and the science of the human body. Abraham Bosse, whose image of visual pyramids can be seen above, was employed to teach perspective in the Academy in Paris, using advanced techniques of projective geometry, and, like other theoretically minded artists, he published treatises based on his teachings. By the mid-17th century no ambitious artist would dare boast of their ignorance of the Euclidian geometry that lay at the heart of perspective. Equally, a grasp of anatomy was considered essential for any aspiring artist.

Anatomical and Naturalistic Illustration

Artists were employed by medical doctors to create great picture books of anatomy, beginning with Andreas Vesalius' *De humani corporis fabrica* in 1543, illustrated by Jan Stefan van Calcar who studied with Titian. Such magnificent books were of little practical use in actual medical procedures but demonstrated the divine 'architecture' of the body and promoted the anatomists' status. In turn, the anatomical pictures served to educate generations of artists, as did specially designed *écorché* (flayed) statuettes that were produced as demonstration pieces.

Animals and plants also played their roles, with artists concerned to depict fauna and flora in an authoritative way, and being employed by zoologists and botanists to illustrate comparably magnificent picture books, which were much prized by patrons and collectors. The study of a lily by Albrecht Dürer, the great German contemporary of Leonardo da Vinci, could potentially function equally well as symbolic detail in an image of the Virgin and as an illustration in a book of plants (fig. 5). The successors of Leonardo and Dürer fully realised the scientific potential of this type of naturalistic illustration over the course of the next three centuries.

The Science of Colour

The science of colour proved more problematic in art. The ancient Greek theory of Aristotle saw colours as resulting from proportional mixtures of lightness and darkness, and worked relatively well with the painters' scale of colours. Yellow, which stood close to the light end of the range, was naturally brighter than blue, which stood towards the darker end. Red, the most powerful colour was located in the middle, composed of equal amounts of lightness and darkness. Between yellow and red was orange, while purple was located between blue and red. Mixing yellow and blue produced green. This scale of three 'primaries' and three 'secondaries' corresponded reasonably well to the painter's experience of mixing actual pigments. The 'colour scale' even proved amenable to the formation of a kind of colour music, in which colours resulting from the proportional mixtures were equated with particular notes. In 1740, the Jesuit Louis-Bertrand Castel recounted his invention of a colour organ, which involved lights from candles passing through small shuttered windows of coloured glass in response to the keyboard of a clavichord. However, these concepts, attractive as they may have been, provided painters with limited detailed guidance when they actually needed to produce a portrait, landscape or narrative picture.

Isaac Newton's colour theory, first formulated in 1666, stated that white light was composed from a series of rays that could be refracted to different degrees. It gave painters a great deal of trouble. Newton relied on the *addition* of coloured lights to make white, while the painters' pigments, as we now know, operate by the *subtraction* of certain colours from the impinging illumination. Newton's coloured mixtures produce white light, while the more painters mix their various pigments, the darker and muddier the result. The difference between additive and subtractive primary colours was not adequately defined until the mathematician Hermann von Helmholtz published his theory on colour vision in the mid-19th century. The popular transmission of Helmholtz's definitions occasioned some artists' attempts to 'paint with coloured light', encouraged not least by the writings of the American physicist Ogden Rood.

The idea was that bright colours could be laid down side-by-side and that the resulting reflections of coloured light would mingle as they passed to and inside the eye, creating a vivid and natural effect. The separate touches of pigment used by the Impressionists relied to some degree on the notion of optical mixing, but it was the 'Divisionists', led by Georges Seurat, who aspired to exploit the technique in a scientific manner. During his brief career, Seurat developed a method of painting from small, juxtaposed points of colour, in which, for example, an optical green might be composed from adjacent patches of yellow and blue (fig. 6). In reality, Seurat's actual way of painting was less doctrinaire than the theory required – just as painters had only followed perspective to the extent that it produced the effects they wanted. This reflects a general rule in the application of scientific theories to works of art. If the rigid adoption of science led to results that were unsatisfying, artists were generally willing to bend the rules.

Fig. 6. Georges Seurat, *Le Bec du Hoc Grandcamp*, 1885, © Tate, London, 2013.

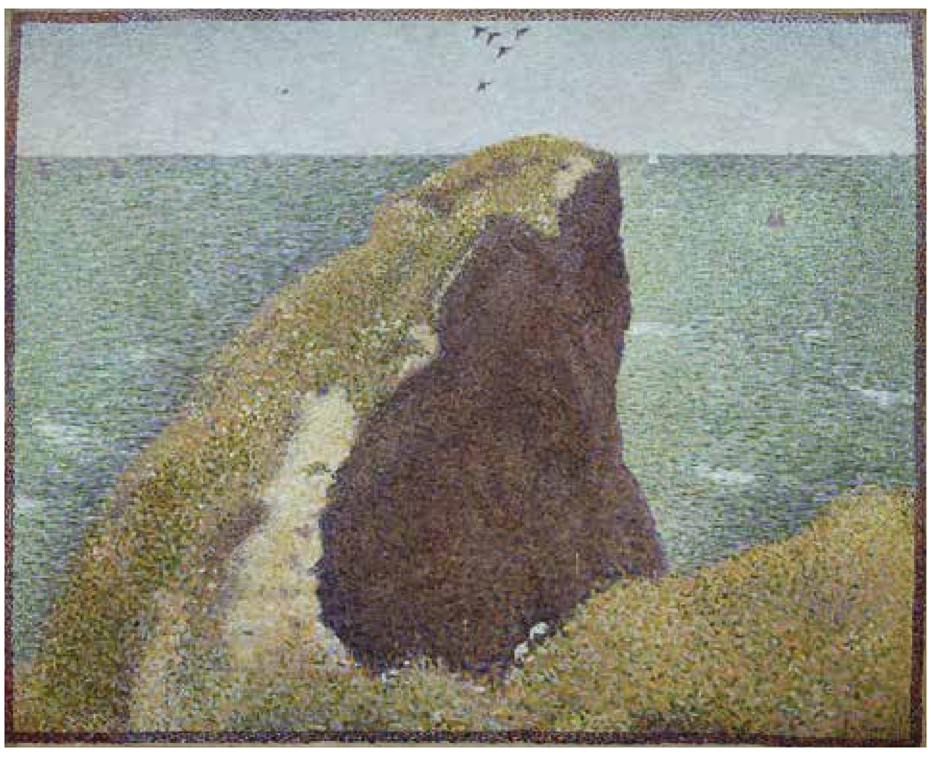


Fig. 5. Albrecht Dürer, *Iris*, 1495, Kunsthalle Bremen – Der Kunstverein in Bremen, Kupferstichkabinett. (Photo: L. Lohrisch).

Dialogue between Art and Science

When, partly under the influence of photography, the goal of painting was progressively redefined as being other than the systematic imitation of nature, the 'science of art' necessarily had to shift on to other foundations, concentrating on structures beneath the surface of appearance, whether they were the hidden laws of nature or the inner rules of the human mind.

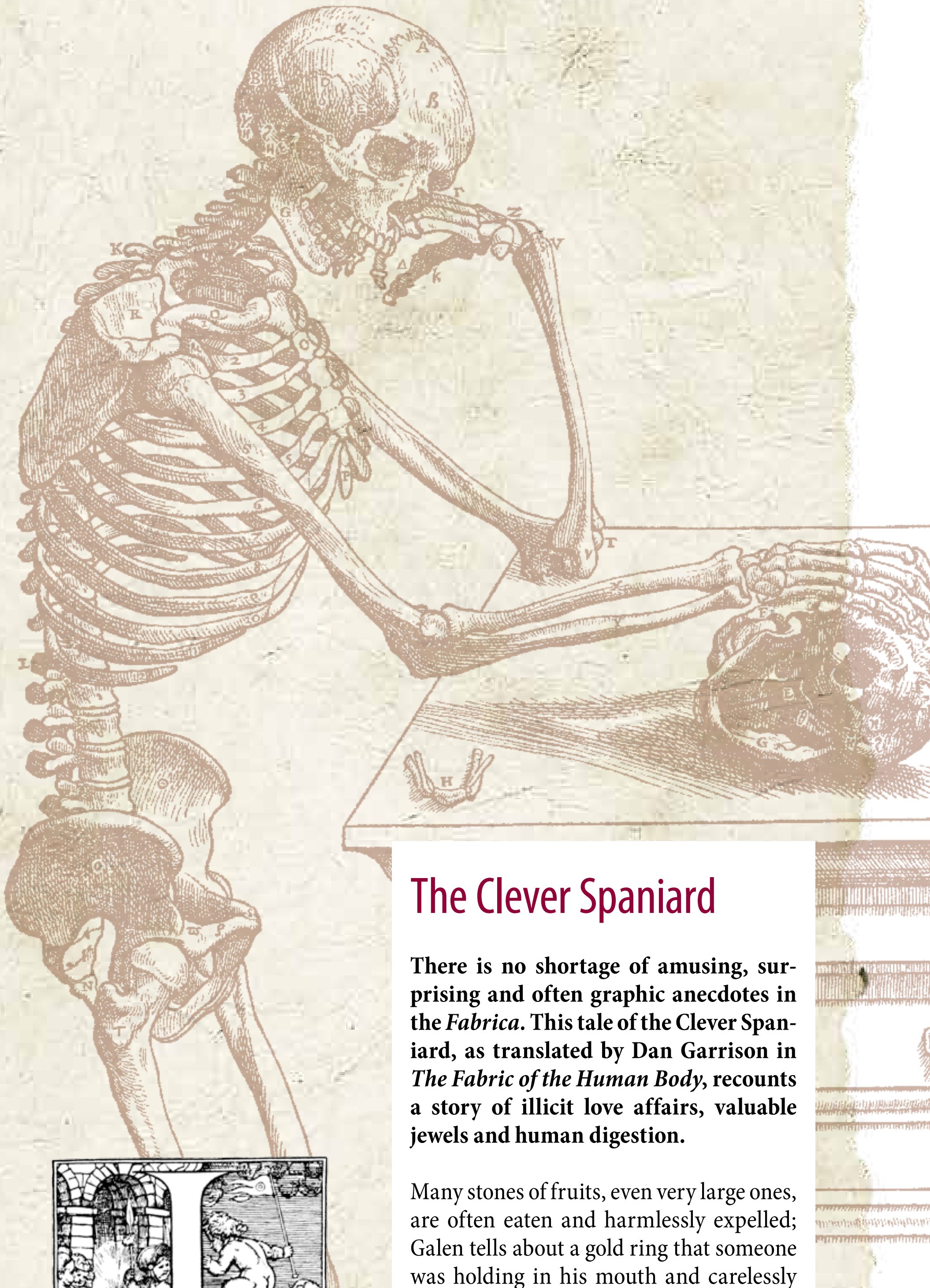
The most radical break was made towards the end the first decade of the 20th century by Pablo Picasso and Georges Braque, the founders of Cubism. They abandoned the notion of the picture as a naturalistic window on the seen world in favour of fragmented, elusive and intersecting contours that suggested a more dynamic interaction between form, space and the viewer. Although the plotting of direct influence is difficult, there is little doubt that their forging of a new vision of space in art was affected by the popular transmission of contemporary physics, above all the revolutionary theories of Albert Einstein.

During the course of the 20th century, art and science remained in intermittent and varied dialogue, as for instance when the Surrealists invented their illogical visual world partly as a response to Freudian psychology. The relationship between the arts and sciences became more exceptional, more complex and less obvious than during the previous five centuries of optically based naturalism.

Martin Kemp

Martin Kemp is Emeritus Professor in the History of Art at Oxford University. He was trained in Natural Sciences and Art History at Cambridge University and the Courtauld Institute of Art, University of London. Dr. Kemp has written and broadcast extensively on imagery in art and in the sciences of anatomy, natural history and optics from the Renaissance to the present day. Leonardo da Vinci has been a major focus of his research and the subject of several books written by him and of exhibitions that he curated.

Vesalius Vignettes



Andreas Vesalius' Instructions for the Preparation of Bones

By Sachiko Kusukawa
Trinity College, University of Cambridge

One of the lesser known points about the *Fabrica* is the role it took in the dissemination of important practical information; for instance, the intricate detail put into the instructions on how to clean and articulate bones. Vesalius claimed his method to be new – traditionally, maceration in lime followed by cleansing in a fast-flowing river had been the usual method (see Historiated Capital C). Vesalius described this method as being 'dirty and difficult', with the process hiding certain features of the bones.

Vesalius set out his own 'easy' two-step method – the first step instructs how to extract the bones and cartilages from a cadaver by boiling, and the second explains how to articulate the bones. Instructions for the first step draw on analogies with cooking, while those for the second resemble a complex DIY manual. His instructions run roughly like this: first, find a corpse (any corpse will do, though a cadaver emaciated from disease is the best), a tub, and a large cauldron (see Historiated Capital O). Put a sheet of paper on a table on which the cartilages can be laid out. Next, take a sharp knife and make an incision around the head, saw through the skull along the incision and dispose of the brain into the tub. Cut away the ears, eyelids and tip of the nose for cartilages and place them on the paper.

A civic official hands down the recently severed head of a condemned man to a *putto* who prepares to receive it in a basin.

Vesalius deals with every bodily part, explaining where incisions are to be made and which cartilage should be removed and set aside. He also suggests that some structures should be boiled together so that the bones do not get separated and mixed up. Use a sponge to soak up the blood and squeeze it out into the tub. Remove the contents of the peritoneum in no particular order like 'a butcher'. Once all the bones are placed in the cauldron, pour in enough water so that the bones are covered at all times, and keep the liquid clear by removing the scum and fat that rise to the surface as one normally does in cooking. The bones should be picked out with a tong and cleaned carefully, removing flesh, ligaments and tendons.

In the decorative initial C a perforated casket containing a cadaver is about to be placed in a stream. Note the holes covering the box. Vesalius explained that small holes were bored all over the box in order to wash away the lime and flesh, but not the bones.

Immediately after the cleaning process, the bones need to be assembled before they start to harden. Starting from the feet upwards, Vesalius provides detailed instructions of how to use awls, fine and coarse copper wire, and forceps to pierce the bones and join them together.

It is noteworthy that throughout the description of his method, Vesalius insists that the dissector uses his own hands. The task of cleaning the bones should not be delegated, not only because special care must be taken in order to preserve the cartilages, processes, heads and depressions while discarding the flesh, ligaments, tendons and periosteal membranes, but also because the process of cleaning each bone is an opportunity to study it in detail. He also emphasized that the success of articulation would depend on the dissector's manual dexterity and his knowledge of how the bones fit together. The ability to articulate a skeleton, then, was a manual demonstration of his mastery of anatomical knowledge.

One of the skeletons articulated by Vesalius has survived time – it is now kept at the Anatomical Museum of the University of Basel, and is the oldest existing example of an articulated skeleton in Europe. These are the remains of a criminal who had been sentenced to death by beheading for killing his wife. Vesalius was in Basel at the time supervising the printing of the *Fabrica* and was able to obtain the body for dissection.

This article is adapted from www.vesalius-fabrica.com, *where the full version can be read online.*

'Resurrectionist' *putti* unearthing a buried cadaver under cover of darkness.

This character shows a group of men removing the body of an executed criminal from the gallows for transport to a dissection. A hooded figure on the right holding a cross suggests that this is an officially sanctioned removal and that the remains will be given a Christian burial after the dissection.

The Clever Spaniard

There is no shortage of amusing, surprising and often graphic anecdotes in the *Fabrica*. This tale of the Clever Spaniard, as translated by Dan Garrison in *The Fabric of the Human Body*, recounts a story of illicit love affairs, valuable jewels and human digestion.

Many stones of fruits, even very large ones, are often eaten and harmlessly expelled; Galen tells about a gold ring that someone was holding in his mouth and carelessly swallowed, but readily excreted. The clever Spaniard who last year stole from a certain Bacchis of Cluny forty pearls of the sort that noble matrons here wear on their neck, together with a gold cross beautifully ornamented with five gems and the string on which they were threaded, showed that he was not unaware of the size of this orifice. When she refused to spend the night with him until he had paid out fifty gold pieces in advance and he had finally agreed, she obtained from her patrician lover in Venice his wife's supremely elegant necklace (often a significant part of a dowry there) so she would be better adorned, more beautified, and more pleasing. To keep it from being stolen, she kept it still hanging on her neck while in bed. The Spaniard, lusting after this necklace as it had supplanted the little courtesan in his affections, plied her with all the lust he could muster so that she would sleep more pleasantly afterward; finally he undid the necklace and swallowed the pearls one at a time, then the cross, and finally (so that nothing would impede his theft) the string. It is therefore clear that although the lower orifice of the stomach is narrower than the upper, it is still large and sometimes also passes rather large objects.

Taken from The Fabric of the Human Body, *pp. 991–992.*

Minds Wide Open: **Art Meets Science**

Art and science might, at first glance, seem to represent two opposing worlds. ‘Science’ may evoke visions of disciplined experiments and rational thought within carefully controlled environments. ‘Art,’ for its part, stereotypically may conjure images of free-wheeling creativity with few limitations. At their heart, however, the two disciplines and their practitioners have more in common than meets the eye, according to medical artist Pascale Pollier.

Pollier’s work bridges the worlds of art and science, building on their common values, particularly the necessity of direct, open-minded observation and scientific integrity in the pursuit of advancing human knowledge and understanding. In medical art as in science, Pollier said in an interview with the *Karger Gazette*: ‘The open mind is the greatest tool of all faculties’.

Pollier, a Belgian national who has spent much of her adult life in London, has been steeped in both art and medicine since she was a teenager. She chose to attend art school rather than study science, but medical conditions were frequently the inspiration and subject of her paintings. After completing postgraduate studies in medical art, she held diverse jobs, from portrait painter at the Belgian embassy to medical illustrator for a pharmaceutical company.

Besides creating her own art, she began organizing exhibitions, classes, conferences and other collaborative art/science projects. For over 10 years now, Pollier has been a self-employed artist whose work is found under ‘artem-medicalis’. In addition, she is president of the Association Européenne des Illustrateurs Médicaux et Scientifiques. Pollier mainly focuses on sculpture in wax, clay, silicone and resin. Her work covers film, digital media and the writing of poetry, but she is also interested in traditional media such as oil painting, watercolor and drawing.

The following is a summary of the *Gazette’s* interview with Pascale Pollier.

What are the origins of medical illustration and how has it evolved?

Medical illustration for instructional purposes first appeared in Hellenic Alexandria during the early 3rd century BC. On sheets of papyrus, graceful anatomical figures were often posed dramatically in landscapes amid pieces of classical architecture, in startling contrast to the bare backgrounds of earlier and later illustrations.

The Renaissance gave us Leonardo da Vinci, the first medical illustrator in the contemporary sense. Stunningly inventive, he melded a scientific understanding of anatomy and great artistic skill. A generation after da Vinci’s death, Andreas Vesalius published *De humani corporis fabrica*, the most well-known book of anatomy. The techniques of the past included woodblock cutting, lithography, etching and wax sculpting. It was much more difficult to edit an artwork and to preserve the different stages of the illustrations. In the 19th century, new printing techniques allowed illustrators to work in a variety of media. Color printing became readily available. In the 20th century, publishing became much easier and more direct, with digital files and editing programs. Now one can enlarge and reduce artworks with ease, work in layers and press the undo button when a mistake has been made. With the Internet, research is now at our fingertips. In the future, 3D printing will be an incredible new tool. Holographic projections and Google Glass might also be an asset in the fields of art and science.

Please explain the difference between a medical artist and a medical illustrator.

It is a very fine line, as they originate from the same source, but it is the difference of intention that distinguishes the one from the other. As medical illustration is seen as a functional educational art form, the artistic expressive freedom is sometimes a little limited – the main aim is to be precise and clear and explanatory. A medical artist would seek to capture a more philosophical, sometimes even political communication, and must feel free to express these findings in any way found to be suitable.

What skills are necessary for a medical illustrator?

A great passion for medicine, an understanding of complex scientific concepts, and the talent for translating these concepts in a visual manner. Of course one has to be a talented draftsperson and be creative in executing artwork, but the main requirement is to be able to communicate and depict the anatomically and scientifically correct information.

What advice would you give someone who wants to become a medical illustrator or artist?

Make direct observations at the source, study from cadavers, go to dissection rooms and attend operations, get reference materials and take notes, talk to scientists and get the facts right.

Does your work require more of a scientific or an artistic background?

It is a perfect mixture of both, really a meld of art, science, philosophy and technology.

What do you hope to achieve with your work by bridging art and science?

That’s a very big question; in answering it, you must excuse me if I go a bit over the top. I believe that only by breaking down the boundaries between all faculties is man going to move forward. Science on its own would become so abstract that the people would be left behind. There is a new Renaissance happening. Collaboration, open-mindedness, a passion for understanding and having the energy to learn from each other is the way.

Autopsy in a Nutshell (2006)

‘The inspiration for my sculptures always comes from direct observation, never compromising my scientific integrity for artistic effect. Anatomical correctness is of the utmost importance to me, joined with the desire to capture complex life issues. Then comes the attempt to communicate these philosophical debates in a visual manner.

An example is *Autopsy in a Nutshell* (mixed media, 30 × 30 cm, 2006). This work was created after witnessing an autopsy. I watched a brain being removed from the skull and it was placed into my hands for observation. This experience made a profound impression on me. Holding this young man’s brain, which contained all the experiences of his life, was very humbling.

The magnifying glass in this sculpture represents the observer. The size of the brain and the reference to the walnut was dictated by the desire to highlight its link with nature and the idea of micro- and macrocosm.’

How closely do you as an artist collaborate with scientists?

I work directly with scientists most of the time. I have access to medical laboratories, dissection and autopsy rooms, hospitals, operating theaters as well as medical anatomy and pathology museums. I discuss my concepts and ideas for new works with as many relevant scientists as I can, and in many cases we collaborate on these projects.

Some might see a contradiction between science and art. What is your view on this?

I see more common ground between art and science than contradiction. Artists and scientists share a common drive to observe, explore, question and innovate, and they have a similar mindset in approaching their work: the artist and the scientist must begin their day without preconceptions about the possible outcome of their research. They must be open to all ideas, including the supposedly ridiculous and impossible. They must empty their head of all previous knowledge and journey forth with the innocent vision of a child. If the outcome of research is preempted in any way, it will be subservient to expectation and therefore flawed.

Do you ever have to sacrifice scientific accuracy for art? How does this affect your work?

My artwork always stems from direct observation and research. I try not to compromise my scientific integrity for an artistic effect. Medical illustrators sometimes have to emphasize certain structures to clarify complicated scientific concepts, and thus they have to take things out of context. The same is true of medical art: in order to map out the essence of the human body, an abstraction is sometimes needed. This is true of all maps, including geographical ones. An example that springs to mind is the simplified map of the London underground system, which was designed by Harry Beck in 1933. A clever abstraction of a complex reality, it is an image we all accept and use every day.

Cardiovascular System, water color, finished in Photoshop® (2003)

Whom of the medical illustrators and/or artists do you admire most?

Leonardo da Vinci and Vesalius and Jan Stephan van Calcar [a student of Titian's, credited with some of the illustrations in Vesalius' *Fabrica* – ed.] are my all-time favorites – pioneers, geniuses and great visionaries. They have been a great inspiration to medics and artists alike, widening our understanding of the human body and the physical world. There are a number of other artists: Bernhard Siegfried Albinus, Jan Wandelaar, Govert Bidloo, Jan van Rymsdyk, Frederik Ruysch, Albrecht Dürer, Ernst Haeckel, Joseph Towne and all the wax sculptors whose work is exhibited in the Museo di Storia Naturale 'La Specola' in Florence.

What do you think makes these illustrators and artists and their work great?

They were pioneers in that they looked at life with an open mind, free from all preconceptions. They observed the world and physical life in all its wonder and splendor, ever questioning all previous knowledge. They were inquisitive and possessed with the art and talent of communicating their visions. Their passion for finding answers and recording their views shines through.

What position does medical art have within contemporary art in general? Do you have a vision of how the field of medical art will progress?

Medical art is one of the ways out of the 'cul de sac' that modern art found itself in at the turn of the century. By returning to serious scientific and anatomical study, doors have opened to a new discipline altogether. This is enhanced by the arrival of new technologies, breakthroughs in physical science and the wealth of new materials now available. The future is once again very exciting. It is a great time to be an artist, and nobody has much of an idea of where this will lead.

The full interview, including details on Pollier's Vesalius-related projects, is available at www.vesalius-fabrica.com.

To see further works by Pascale Pollier, visit her website www.artem-medicalis.com.

International Conference

Vesalius Continuum

Zakynthos, Sept. 4–8, 2014

Under the auspices of The Municipality of Zakynthos and the Embassy of the Kingdom of Belgium in Athens, the Ionian Island will host a number of events commemorating the 500th anniversary of the birth of Andreas Vesalius in Brussels, who died on Zakynthos in 1564 while returning from a pilgrimage to Jerusalem. Co-organized by Pascale Pollier and others, it will also host an exhibition of contemporary medical art, *Fabricae Vitae.*