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 was the son of Holy Roman Emperor Charles V. Scion of a Flemish family that had been medical staff of his patron, Charles V. Although Vesalius was expensive ly 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 medi eval 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 And er nach. 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, for example, 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 impa tience 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 medi eval 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 And er nach. 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, for example, 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 impa tience 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.

**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 propor tions 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 impa tience 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.

**Publishing the Visual World**

Vesalius’ generation was one that was visu ally oriented and in the process of 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 Isagae 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. He 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 ecociches 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.

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. 155) 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, then 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 pristia 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,
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 sebaceous waste brought down through its body by veins and arteries, and deposits it into the sinuses that empties into the urinary duct. To see this amazing act, 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 overlooks 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.’

At the same time, Vesalius’ illustration contains an error showing the ethmoid 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 bulb); 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.’

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. 1331) 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 or 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 there 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 orifices of ‘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 nympha’ or clitoris.

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

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 1964 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.
A Book Collector’s Astonishing Discovery

By Gerard Vogrinic
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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. I was 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, especially for the time period when these annotations were made. There were numerous corrections made to the text which I could not 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 Medieval 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. Vogrinic’s article on www.vesalius-fabrica.com. The annotated original is now at the Thomas Fisher Rare Book Library in Toronto.

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.

Batel 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 in the Renaissance 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 of the form of letters. The purpose of the redesign was not a faithful replica of the historical typeface but rather an independent 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 99 languages.
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. Using these perspectives, 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 slowly 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 unthinkably 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 handicraft. 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.

The 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 to a single source, by relating it to their basic pathological goals, 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, ethnocultural 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? Jacyln 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
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 reductionistic 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 problems area 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’ credit had 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.

What remains, however, is an intimate connection between the identity of a doctor and the knowledge of anatomy. That a TV series which focuses mainly on the fictional lives and personal relationships between hospital doctors, but has nothing to do with anatomy, is called Grey’s Anato-

my, says it all! For the last 450 years, not only the medical profession but society in general has been indoctrinated by the reason 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


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.
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.

**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 Medieval 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 within a narrower pyramid or cone, 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 optical laws were extensively used by Italian artists like Leonardo da Vinci, who never ceased to recur to the accurate description of nature, even in imaginary scenes.

In the 17th century, the French engraver Abraham Bosse illustrated the visual pyramids in a picturesquely 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.

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.

**Atmospheric Perspective**

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.

Anatomy for the Artist

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.
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 fulcrots 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 Euclidean 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 Vesalus’ De humani corporis fabrica in 1543, illustrated by Jan Stephan van Calcar who studied with Titian. Such magnificent books were of great interest to 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 painter’s scales 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 that it produced the effects they wanted. 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.

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 of 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 vision of the 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.

Fig. 4. Leonardo da Vinci, The Human Skull Sectioned, and the Oral Venues, 1499, Windsor, Royal Library, 1995 © The Majesty Queen Elizabeth II 2013.

Fig. 5. Albrecht Dürer, Iris, 1495, Kunsthalle Bremen – Der Kunstverein in Bremen, Kunsthalle Hamburg, (Photo L. Lubeck)

Fig. 6. Georges Seurat, Le Rê de l’Ile Grandscamp, 1885, © Tate, London, 2013.
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 disseminaton 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.

Vesalius deals with every bodily part, explaining where incisions are to be made and which cartilages 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 long and cleaned carefully, removing flesh, ligaments and tendons.

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 peristosed 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 disector’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.

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 excrated. 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) 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, lasting after this necklace as it had supplanted the little courtesan in his affections, pled 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 still large and sometimes also passes rather large objects.

Taken from The Fabric of the Human Body, pp. 981–982.
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. '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-medicales’. 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.

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 draftsman 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.

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, 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.

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, and their work great?

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