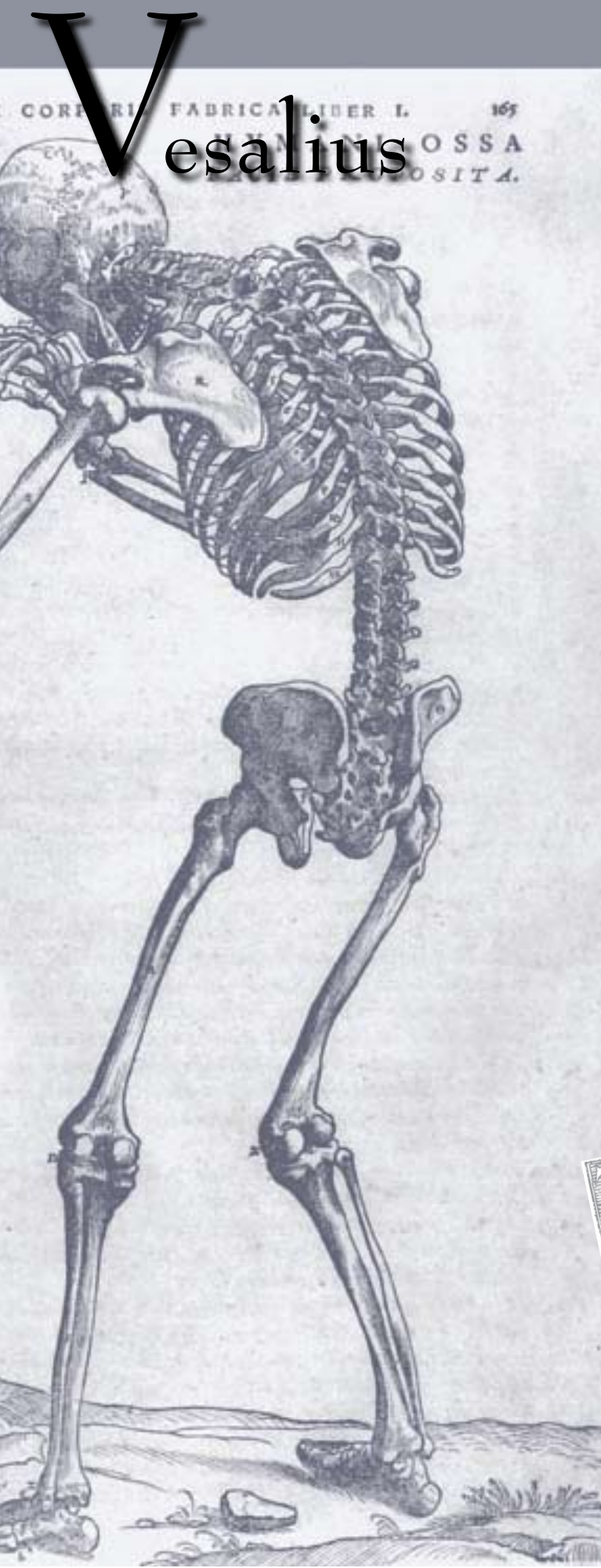


The anatomy of Andreas





Vesalius

Alison Bickford

The author is a student in the MD/PhD program at the Feinberg School of Medicine at Northwestern University. This essay won first prize in the 2005 Alpha Omega Alpha Helen H. Glaser Student Essay Competition.

It's hard to believe that skeletons can look so anguished. One mournfully contemplates a skull, one leans on a shovel and gazes wretchedly at the sky, and a third bends over his hands in sheer desolation. The muscled men appear slightly happier, though their muscles drip off their bones like Dali's clocks and one hangs by a rope through his cheekbones.

You've seen these pictures before. This is the work of Andreas Vesalius—or rather, one of the unknown artists who drew anatomical representations after his specifications. These are the anatomical illustrations of *De Humani Corporis Fabrica Libri Septem* (*On the Fabric of the Human Body*), a stunning textbook of anatomy that won Vesalius one of the best-known names in medical history. *De Humani Corporis Fabrica* (commonly called the *Fabrica*), is a rare combination of medicine, science, and art that made massive contributions to the world's understanding of human anatomy, established illustration as crucial to the study of anatomy, and emphasized the importance of observation in science. Published within a few months of Copernicus's *De Revolutionibus Orbium Coelestium* in 1543, the *Fabrica* changed our understanding of the microcosm of man as Copernicus revolutionized the science of the macrocosm of the universe.



Restoration . . . and translation

Written in the complicated humanist Latin of the Renaissance, the entire *Fabrica* of 1543 has never been fully



By and about the author

It took me a long time to decide to study medicine. But while working at a Max Planck Institute in Germany, I admired how physicians used their knowledge of the human body to make advances in science. Later, working in Siberia with the nonprofit organization Partners in Health, I admired how physicians used their knowledge of medicine to help those less fortunate. Now, as a medical student and PhD candidate at Northwestern, I find myself constantly impressed with doctors who, like Vesalius, use their medical training for more than practicing medicine.

translated into any modern language except Russian. But now, Dr. Malcolm Hast, professor emeritus of Otolaryngology at Northwestern University's Feinberg School of Medicine and Dr. Daniel Garrison, professor of Classics in the Weinberg College of Arts and Science at Northwestern have embarked on a full translation of Vesalius's *Fabrica*. Complete with annotations, modern anatomical names, historical introductions to each chapter and translations of all substantive revisions in the 1555 *Fabrica*, the translators have begun to publish the entire seven books both in print and on-line. The 272 illustrations have been restored and digitally smoothed to more precisely resemble the original woodcuttings. It is an astonishing undertaking (the first two books took eight years to complete), funded fittingly by both the National Endowment of the Humanities and the National Institutes of Health.

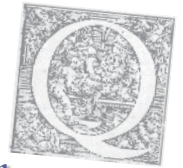
One might think a translation like this would be purely historical, with little bearing on modern medicine. But Vesalius's contributions to the science of anatomy and the principles of science, along with the artistry and beauty of his illustrations, keep his work relevant even centuries after his death. He is the Shakespeare of anatomy, influencing our lives today with works created long ago in ways we cannot even imagine.

On the fabric of the human body

The *Fabrica* was a magnum opus, both artistically beautiful and scientifically groundbreaking as the first comprehensive text of anatomy. Historically, however, Vesalian scholars tended to overestimate his academic contribution. They painted Vesalius as a heroic young visionary, breaking completely from traditional anatomy and fighting to proclaim the

truth to rabid Galenists who condemned his work the way the church condemned that of Copernicus.^{1p230} The truth is somewhat more prosaic. The humanist movement of the Renaissance was marked by a revival of interest in the classical literature and ideals of Greek and Roman culture. Vesalius, like his teachers, knew Latin and Greek and studied classical authors of philosophy and anatomy. Some of his most elegant writing simply paraphrases (or plagiarizes) these classical authors—including Galen, Aristotle, and Cicero. He assumes his readers have read Galen as closely as he has,^{2p64} and though he condemns those who follow Galen blindly, he refers to Galen as “the second leader of medicine after Hippocrates.”^{1p233} Throughout the *Fabrica* he follows Galen's teleological concept that the human body is ideally designed, a perfect instrument for carrying out the functions of the soul.^{3p10} Vesalius certainly clashed with some Galenists; in fact, his own Parisian teacher, Sylvius, protested against Vesalius, saying that Galen couldn't have been wrong—the human body had simply changed since Galen's day.^{2p86} But there is no doubt that Vesalius was, himself, a Galenist. He sought to expand upon, add to, and correct Galen, not condemn him.

Galen diminished by the young anatomist



Much of the modern glorified concept of Vesalius comes from his own writings. Vesalius was a shameless self-promoter, casually mentioning his youthful age (he was 28 when he published the *Fabrica*) and neglecting to mention both his anatomical predecessors and the contemporaries who clearly influenced his work.^{1p237} He persistently informs his audience of his corrections to Galen while giving Galen less credit for what he has taken directly from Galen's works. As a result, some scholars have tended to overly praise Vesalius, leading to a scornful backlash from critics who noted the exaggeration.^{4p299} Yet it can be argued that Vesalius deserves most of the praise he receives. Although other anatomists created texts before Vesalius, none had covered the entire human body, and no other text boasted detailed illustrations, elegant writing, and scientific advances in both anatomy and physiology (although Leonardo da Vinci's anatomical drawings, if published, might have made him the father of anatomy instead of Vesalius).^{5p18} Perhaps more importantly, no previous text of anatomy had proposed a method of hands-on instruction and a scientific principle to guide future anatomists, instructors, and researchers.

Born in Brussels in 1514, Vesalius began his study of medicine

in Paris and finished in Padua, where he graduated with highest honors. Vesalius describes his own anatomy classes in Paris in the *Fabrica*: A professor looked down on the dissection, reciting in Latin a Galenic description of animal anatomy, while a menial who understood no Latin simply hacked away at the body. “Less is presented to the spectators than a butcher in a stall could teach a physician,” Vesalius wrote.^{5p50} (One scholar points out, however, that Vesalius’s teacher Sylvius was an incredibly popular instructor, with hundreds of students at each dissection. It is unlikely he could have drawn such a crowd by simply reading Galen.^{1p233} This may be another instance of self-aggrandizing.) As a young teacher in Padua, Vesalius resolved to change the way anatomy was taught to medical students. He chose to work as both dissector and lecturer, displaying each part as he discussed it. His proximity to the cadaver allowed him to make the new anatomical discoveries that led to his *Fabrica*. He made further pedagogical advances by hanging greatly detailed anatomical charts around the dissecting arena; these are found copied in his student’s notebooks.^{5p82}



Title page of the *Fabrica*.

Courtesy of Dr. Malcolm Hast of the Vesalius Project.

On the title page of the *Fabrica*, Vesalius depicts his teaching style. A roiling mob of men is gathered around the gaping abdomen of a female cadaver. No one seems to be paying attention. Spectators read, pray, talk, and pickpocket. A naked man clings to a pillar. There’s a monkey on one side, a dog on the other—symbolic of the debts we owe animals for many anatomical and physiological advances. Vesalius, small and bearded, gestures towards the woman. A skeleton stands over her like a guardian angel with a miserable expression on its bony face. The choice of the dissecting theater for the title page does not merely give readers a historical context. The theater itself also illustrates Vesalius’s theories of anatomy and the process of scientific research. Throughout his work, Vesalius insists that the only way one can learn anatomy is by observing actual anatomies. “Swear by nobody’s words,” he writes in Book 5, Chapter 13 of the *Fabrica*. He exhorts the reader to count the teeth, count the bones, and to believe nothing, not even Vesalius, until the reader has witnessed it himself. Though perhaps not fully realized within the *Fabrica*, this spirit of objectivity and emphasis on experience and observation is perhaps Vesalius’s greatest contribution to modern science, leading the way for the codification of the scientific method and future developments in research and medicine.

Dissections with attitude

The woodcut illustrations in the *Fabrica* are detailed and stunning, some of the finest of the sixteenth century.^{4p303} Though the identity of the artists is unknown and debated among scholars,^{6p37} the quality of their art is exquisite, and they clearly received a great deal of instruction on anatomy and design from the *Fabrica*’s author. But beyond the sheer skill of the intricate illustrations, what is perhaps most striking to the modern viewer is the seeming irreverence of the *Fabrica*’s pictures. Modern anatomy texts display concise, sterile depictions of body parts and organs. Illustrations may be artistic, but they are not meant to be art: they are technical drawings to help the reader learn about the human body. Bodies in modern medical texts are inanimate: they don’t pose self-consciously, displaying their bodies to the viewers like the living corpses of the *Fabrica*.

Consider the *Fabrica*’s *putti*, fat little cherubs who play at anatomy around the first letters of each chapter. Around the letter D they saw at the skull of a beheaded criminal, they hang



A plastinated human specimen from Gunther von Hagens's Body Worlds exhibit. Kai Pfaffenbach/Reuters/Corbis.

a dog in a noose over an arm of the T, and in the middle of the Q they carve up a boar chained to an anatomy table. Nothing could be more irreverent. It is impossible to imagine such a scene in Frank Netter's books, or *Gray's Anatomy*. And yet, theoretically, anatomy was more controversial in Vesalius's time than in our own.

In 1978, German anatomist Gunther von Hagens invented a method of permanent tissue preservation by removing water and fat and replacing it under vacuum with a reactive polymer. The result is a clean, dry, nontoxic specimen preserved down

to the cellular level—a plastic tissue sample. Initially, this technique of “plastination” was used to preserve body parts and even cadavers for anatomy classes and medical research. But by the mid-'90s, von Hagens realized the fascination that human bodies hold for laypeople, and created an entire exhibit of plastinated bodies, called *Körperwelten* (*Body Worlds*).^{7p1172} You've probably seen these pictures, too, if you haven't seen the exhibit itself: a chess player whose brain buds out of an open skull, a runner with muscles flying out behind him as though blown by the wind, a man straddling a huge plastinated horse.



Body Worlds—educational exhibitionism

Body Worlds has been both hugely popular and ethically controversial. D.G. Jones, of the Department of Anatomy and Structural Biology at the University of Otago in Dunedin, New Zealand, gives three conditions under which this exhibit may be ethically acceptable: The cadavers used must represent truly informed consent; the exhibit must not exploit human beings, living or dead; and the exhibit must be educational.^{8p438} Few would argue with his first condition. The second is vague, lacking a definition of exploitation in this context. But the third and most interesting controversy surrounding von Hagens' work is essentially whether his bodies are art or anatomy. Von Hagens himself insists that his statues are not art—though he accepts and uses the term “anatomy art.”^{9p11} Jones writes, “Insertion of the adjective ‘anatomy’ [in von Hagens’ phrase Anatomy Art] has not dispelled the feeling that the plastinated displays may be serving an artistic function rather than an educational and scientific one.”^{8p438}

The distinction between art and education is an interesting one: children on a field trip to an art museum are surely getting an education. Before the *Fabrica*, illustration was an incidental part of anatomy¹⁰; since then, better and clearer illustrations have led to improved anatomical understanding. As artists work in anatomy, anatomy itself becomes art. Rembrandt's “Anatomy Lesson of Nicholas Tulp” shows men clustered around a cadaver whose hand muscles are exposed. Few would argue that anatomy cannot be beautiful or used for artistic purposes. Da Vinci's famous “Vitruvian Man” (or “Study of Proportions”) could even be called commercial art: today the image adorns posters, T-shirts, and coffee cups.

Some scholars of medieval anatomy argue that Vesalius sought to distance his audience from the actual violation of a cadaver by posing skeletons and muscle men like statues.^{11p29} Given the startlingly grotesque appearance of a rope trussed through a cadaver's zygomatic arches or the miserable expressions on his skeletons' faces, it seems unlikely that Vesalius was striving for distance. It is probable that his artists were simply more trained in art than anatomy, and wished to make their work as beautiful and interesting as possible. Vesalius's audience, primarily medical personnel who had seen dissections themselves, were unlikely to be concerned about the violation of a body. Although he intended the *Fabrica* to be a basic reference for clinicians, Vesalius presented his scientific discoveries in a way that would entertain and fascinate his audience: as art.

No one could claim that Gunther von Hagens intends to

distance his audience from violation when he poses cadavers in strange positions. Instead he seems to want to distance his audience from the textbook anatomy pictures, forcing them to look at the body in novel and surprising ways. If von Hagens's figures were actually plastic, no one would argue about the ethics of his exhibits. Even Damien Hirst's famous exhibits of animals preserved in formaldehyde did not attract the kind of visceral outrage that von Hagens's work has prompted in the medical, religious, and secular communities. But whether human material can or should be used for artistic purposes is still undecided.



Long-lasting ethical battle over dissection

Ethical controversy is not new to anatomy. The idea that the body was merely a shell for the soul and that the dead body could be objectified and even mutilated did not arrive in Western thought until the works of Socrates and Plato in 400 BC. This new attitude toward the dead took time to take hold, and both their contemporary Hippocrates and Plato's student Aristotle learned anatomy from animal dissection.^{5p2} Herophilus and Erasistratus were allowed dissection (and possibly vivisection) of criminals in 300 BC, but by the time of their deaths the spreading Roman influence had again outlawed anatomical investigation. Galen (practicing around 160 AD) was thus limited to animals (especially monkeys) and two human skeletons he had found, yet his writings more or less formed the basis of medieval European and Islamic medicine until Vesalius.^{5p6}

Once people were comfortable with the idea of dissection, debate continued over whose bodies could be used for this purpose. By the eighteenth and nineteenth centuries, executed criminals were commonly used for dissection, but a body shortage led to grave robbing by “resurrectionists” and even the famous anatomy murders by Burke and Hare. The murders finally prompted English politicians to pass the Anatomy Act of 1832, which provided donated and unclaimed bodies to anatomists.^{12p51} Even the identity of dissectors can lead to ethical dilemmas: controversy surrounds the Pernkopf anatomy atlas, published in 1943 by active members of the Nazi party, even though there is no evidence that Holocaust victims were used as models.^{13p381} In the past year, we have seen the controversial fate of donated cadavers: in 2004, seven cadavers donated to Tulane University were sold to the Army and used to test land mines, and the Willard

Body Program at UCLA was suspended after the director allegedly sold body parts for profit.

Perhaps society will become as accustomed to the use of cadavers for aesthetic purposes as we have to the use of cadavers for scientific purposes, and to the use of anatomical illustrations as art. It is certain, however, that even this evolution of thought will continue to create new areas of ethical concern and controversy.



Dr. Malcolm Hast came up with the idea of translating and publishing the *Fabrica* over 12 years before the project actually got off the ground. "I applied to the National Library of Medicine at NIH," he related. "And they said, do you have a publisher? So I then tried to get a publisher. No one was particularly interested. They said it sounds like a great idea, but it would be so expensive, so many volumes. And it died. And I forgot about it."

When the idea recurred to him many years later, Dr. Hast teamed up with Dr. Daniel Garrison, a professor of Classics at Northwestern University, who was enthusiastic about the translation. Together they began to translate everything in the *Fabrica* related to the larynx and hyoid bone, compiling pieces from various sections on the nerves, the bones, and the muscles. After Dr. Garrison translates from Vesalius's complicated Latin into English, Dr. Hast analyzes the translation to determine what Vesalius actually meant. "Vesalius didn't give names to some things," he says, "and he didn't have names for a lot of things. Vesalius says 'Now, when moving your leg, the third, fifth and eighth muscles will move. And in the thigh, the seventh and tenth muscles will move.' I've got to figure out, what is he talking about?"

In 1993, the prestigious British journal *Medical History* published their translation and analysis of Vesalius's writings about the larynx. Once they had published a scholarly article on medical history, demonstrating their own skill and the community's interest in Vesalius, people became interested in funding and publishing their complete translation. They received grants from the National Endowment of the Humanities and the National Institutes of Health. Thoemmes Press, a British publisher of rare and scholarly books on philosophy and the history of ideas, decided to make an oversized, high-quality edition of the seven volumes of the *Fabrica*.

With the exception of a Russian version published in 1950, this is the first time the 1543 *Fabrica* has ever been translated into a modern language in its entirety, complete with modern anatomical names and footnotes clarifying Vesalius's sources, his allusions to other people and events, and his anatomy. It is also the first time the revised 1555 edition of the *Fabrica* has been translated alongside the 1543 original. In his introduction to the new translation, classical scholar Vivian Nutton writes, "The 1555 revision is a major contribution to anatomical understanding in its own right, and has been unduly neglected as a result of the very success of the 1543 edition."¹⁰ Vesalius changed entire paragraphs and pages in his revised text, making the Latin more fluid and the anatomy more accurate. He revamped his notions of female anatomy and his Galenic view of the heart and replaced incorrect illustrations of fetal dissections.^{4p307} The Vesalius project will finally allow scholars to see and study the extent of Vesalius's changes.

By 2001, Garrison and Hast had finished translating the entire first book of the *Fabrica*: *The things that sustain and support the entire body and what braces and attaches them all*, the largest and arguably most innovative book of the seven that make up the *Fabrica*. They enlisted staff at Northwestern University's Galter Health Sciences Library, the University Library on the Evanston campus, and Northwestern Information Technologies to create a website that would allow all readers access to the illustrations and text of the *Fabrica*.

The oversized printed edition will be beautiful, with stunning illustrations, and text in both English and Latin. But the expense of this series limits its buyers to libraries and universities. The creation of the Vesalius Project web site means that anyone interested in Vesalius's work will be able to access it from anywhere, on-line. On March 19, 2003, the first book was finally available for viewing at vesalius.northwestern.edu. It is fitting that the translation of the book that focused so heavily on pedagogy and the importance of observation will finally be available to all readers and scholars on the internet.

Today, medical students learn anatomy as Vesalius would have wanted them to: in small groups clustered around a cadaver. But students today simply cut and memorize, without expecting to discover something new or find flaws in *Grant's Dissector*. Some medical schools are completely phasing out dissection, using prosected cadavers and computer programs to teach anatomy to their students.^{14p121} It is easy to feel that the study of gross human anatomy is dying, taking a rich and full history with it. But beyond the cadaver, the world of anatomy is spreading out into studies of development, imaging, comparative anatomy, and neuroanatomy. Anatomists today study biomechanics, evolution, fossil records, and anthropology. And behind all these new developments is

Vesalius, reminding scientists of all fields to open their eyes and to believe nothing that they have not observed themselves—perhaps even encouraging them to present their discoveries creatively, enmeshed in beauty and art.

Acknowledgment

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The author's address is:

1529½ W. Estes Avenue, Apartment 3B
Chicago, Illinois 60626
E-mail: a-bickford@md.northwestern.edu



A Lost Child

We will know your touch
When the soft, warm sand
Envelops our feet.
And when our fingers
Glide over velvet grass.

We will know your smile
When we see the reflection
Of a sunrise over the ocean.
And when we listen to the wild giggles
Of children at play.

We will see your face
In the commanding colors
Of a lazy sunset.
And in the billowy, puffed clouds
That glide through changing formations.

We will hear your voice
In the soft, rustling of leaves,
The bellowing call of the goose,
The swoosh of a winter squall,
And the quiet sigh of a sleeping child.

You will always be a part of us
As we are a part of each other,
Searching for answers we cannot find,
Daring to love and accepting the risks.
You will always be part of us.

Steven F. Isenberg, MD

Dr. Isenberg (AΩA, Indiana University, 1975) is assistant professor of Otolaryngology—Head and Neck Surgery at Indiana University School of Medicine. He is the founder of *Medals4Mettle*, a nonprofit organization that facilitates the gifting of medals earned by marathon runners and others to patients who are battling disease and handicaps with similar mettle. Physicians around the country distribute these medals to patients. His address is: 1400 North Ritter Avenue, Suite 221, Indianapolis, Indiana 46219. E-mail: sisenberg@good4docs.com.