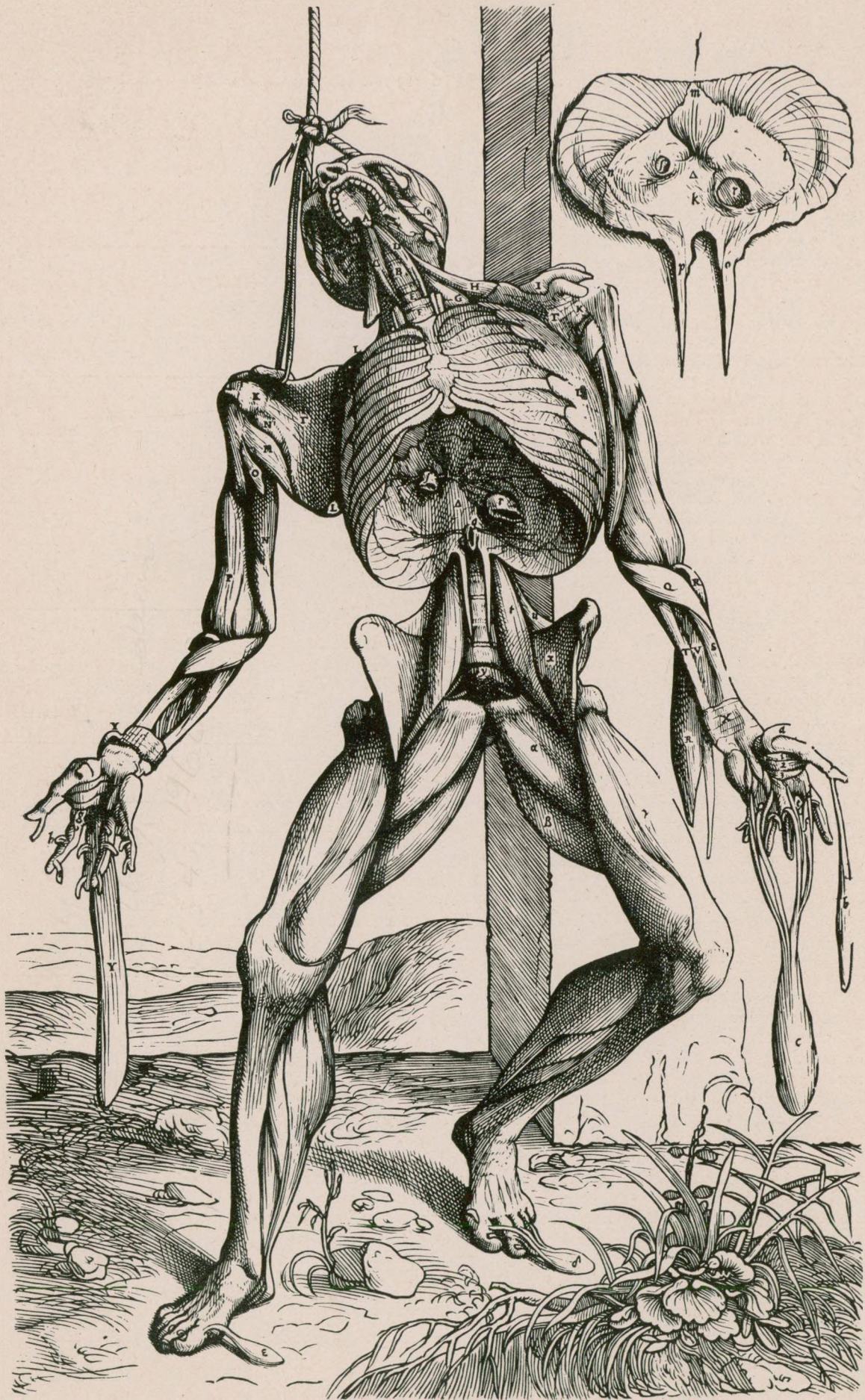




DISSECTED CORPSE in one of Jan Stephan van Calcar's woodcuts for Vesalius' *Fabrica* is hung by a rope

passing through the eye sockets and around the base of the skull. On the wall at upper right is the diaphragm.

VESALIUS: DISCOVERER OF THE HUMAN BODY

His great *De Humani Corporis Fabrica*, which founded modern anatomy, is also an unsurpassed work of scientific art

by Martin Gumpert



On July 17, 1903, in Baltimore, young Harvey Cushing received the following post card from the Isle of Guernsey: "I have bagged two 1543 *Fabricas*! 'Tis not

a work to be left on the shelves of a bookseller." The card was signed by the great physician William Osler. A week later came another message: "Besides the two '43 *Fabricas* I have just ordered a third. We cannot have too many copies in America & no medical library is complete without one."

By autumn the three copies had grown to six, among them an imperfect first edition discovered in a Rome blacksmith's shop by another of Cushing's peripatetic friends. When Osler returned to Baltimore, the two bibliophiles spread their loot on his dining room table. It was a solemn and happy moment. From the obscurity that sometimes attends greatness, the two friends had retrieved six first editions of a treatise which Osler called "the greatest medical work ever printed."

Osler distributed his precious volumes to medical libraries with missionary enthusiasm. For Cushing, the moment in Osler's dining room was the beginning of a lifelong labor of love. His copy of the *Fabrica* grew into the world's most complete collection of works by its author, Andreas Vesalius. It is now in the Historical Library of the School of Medicine at Yale University. Today one need not hunt abroad for a copy of the *Fabrica*. The New York Academy of Medicine has even sponsored the publication of a modern edition from the original Vesalius woodcuts.

This sixteenth century work, *De Humani Corporis Fabrica*, written by the founder of modern anatomy, is indeed one of the most daring, creative and beautiful adventures ever undertaken by the human spirit. No one who can be moved by genius should die without seeing it. For medical men, whose work so often leads to a final attitude of cynicism, it has the

power to turn cynicism into enthusiasm.

It is regrettable that all young doctors are not made familiar with the life and work of Vesalius. This, however, is an unhappy by-product of the fact that even the best medical schools neglect the teaching of medical history. The anatomy textbook of today is a medical Sears, Roebuck catalogue. The anatomy of Vesalius is a testament of passionate devotion to medicine. Any doctor who has made the acquaintance of this powerful book will be better prepared for the practice of medicine and its deep and dangerous beauty.

The *Fabrica* is more than a milestone in the history of medicine. It is a great work of creative art. Curiously, it is not notable for literary quality. "As a book," Cushing once observed, "the *Fabrica* has probably been more admired and less read than any publication of equal significance in the history of science." But its text, like the libretto of an opera, has become merely scaffolding for the great music of its illustrations.

These illustrations depict man's first clear and accurate knowledge of human anatomy. Even now, after four centuries, the *Fabrica*'s drawings show the freshness and enthusiasm of original discovery. In its perfect unity of format, print, picture and scholarship, the *Fabrica* is comparable to the great creations of early religious literature. Indeed, its perfection could have been achieved only through a reverence for the exquisite architecture of the human body.

The book was the joint product of a scientist—one whom Cushing ranked with Hippocrates, Galen, Harvey and Lister among the five great discoverers in medicine—and an artist, Jan Stephan van Calcar. A pupil of Titian, Calcar drew the anatomical features which Vesalius laid bare.

Great books and great discoveries are always dangerous, and the *Fabrica* was no exception. It was as daring as the later heresies of Galileo. It radically revised concepts of the structure of the human body which men had been taught for centuries. In its precise identification of all

the organs, it seemed to leave no room for the "seat of the soul"—a perilous omission. The fury of the attack launched against the *Fabrica* was not reduced by the circumstance that Vesalius was only 28 when it was published.

Vesalius was a Belgian, born in Brussels on December 31, 1514. He came of a long line of illustrious physicians. His great-grandfather was doctor to Maximilian I of Burgundy. Grandfather Eberhard wrote a commentary on a famous textbook by Rhazes, the renowned medieval Arab physician. Vesalius' father was apothecary to Emperor Charles V of the Holy Roman Empire.

Vesalius' interest in anatomy began early. As a boy he dissected mice, moles, cats and dogs. These experiences possibly are reflected in the drawings of fat little cherubs performing dissections which decorate the initial letters of the *Fabrica*'s chapters. By the time he had begun his medical studies at the University of Louvain, and soon afterward in Paris, his interest had become a passion. He obtained his first skeleton by robbing a gibbet.

VESALIUS' ardor for dissection did not please his instructors. In the sixteenth century it was regarded as indecent for a professor to take a knife in his own hand for dissection. At lectures this odious task was performed by barber surgeons. Vesalius reported of his teacher Guenther von Andernach, known as Guinterius, that he never saw him with a knife in his hand except at the dinner table.

The earnest young scientist soon became impatient with his teachers. Instruction in anatomy consisted of lectures, an occasional glimpse of a butchered dog and an annual dissection of a human corpse by the rude, ignorant hands of the barbers. Never did he see a nerve, an artery, a vein; never did he dare to take a bone in his hand.

So Vesalius began his own independent study of anatomy. He prowled about Paris churchyards and places of execution for subjects. At the cemetery of St. Innocent and at Montfaucon, dumping ground for the bodies of criminals, he was a constant

visitor. Sometimes he fought with wild dogs for the corpses he dragged home to dissect in the quiet of his room. Soon he could recognize every bone with his eyes closed, just by touching it. His skill gained him the privilege of acting as the barber at demonstrations. While he was still a student at Louvain he shocked his teachers by conducting a demonstration in which he lectured and dissected at the same time. It was the first public dissection at the university in 18 years.

At 22, Vesalius escaped this barren environment for the stimulating intellectual atmosphere of Venice. In this period Venice was the focus of the Catholic revival. Amid contrasts of luxury and pestilence, culture and filth, the serenity of Greek theology and groans of hunger, the Renaissance was drawing to a close. Vesalius threw his useful talents into the crusade of brotherly love launched by Ignatius Loyola and his new order of Jesuits. He helped the Jesuits care for the dying, the prisoners and the lepers. He bled patients, set leeches to work and tested the wonderful healing powers of quinine, recently brought from Peru by sailors.

Presently, just before his 23rd birthday, Vesalius was appointed professor of surgery and anatomy at the University of Padua. Now he had the means to realize his great dream—to get on with the science of anatomy. He began at once to reorganize the system of instruction. One

of his first ventures was a full-dress public dissection. From all over Europe, hundreds of physicians, philosophers and theologians came to see and hear his demonstration. It lasted for three weeks of all-day sessions. Vesalius dissected dogs and other animals, displayed sections of human anatomy and climaxed his lecture by exhibiting a complete human skeleton.

In the midst of the revolutionary sixteenth century, anatomy was still dominated by the second century Greek physician Galen. European medicine, emerging from the medieval spell of Arabian science, was on the crest of a surge of neo-Galenism. The revival, moreover, was led by two of Vesalius' old teachers—Guinterius and Jacobus Sylvius, the latter the most renowned medical lecturer in Europe. Vesalius himself, as he began his work at Padua, was still a loyal Galenist.

BUT already Vesalius had begun to discover errors which had been committed by the master. His dissections showed, for example, that the actual course of the azygos vein, running up through the diaphragm to the vena cava, was entirely different from Galen's description. As a result, Vesalius published a little treatise called *Letters on Vein-Cutting*, suggesting a new blood-letting procedure based on his discovery. This work was shortly followed by Vesalius' first anatomical publication, an outline of his lectures which he called *Tabulae Ana-*

tomicae. It is fascinating to study these first anatomical sketches of Vesalius—three drawn by himself and three by Calcar. The correction of Galen's errors is already under way. But some glaring ones still remain: the liver is still shown with five lobes, the breastbone still has seven parts, the uterus is shaped like a bubble, the heart is inaccurately sketched, the pelvis is falsely situated.

Vesalius did not yet dare to challenge Galen's basic anatomy. He hunted assiduously but vainly for organs which Galen had mentioned. The *plexus mirabilis*, which Galen had described in minute detail, he could find in sheep but not in man. Then, in the year 1540, Vesalius was enlisted in a project which was to become the turning point of his studies. This was the translation of Galen's collected works into a magnificent new Latin edition. Vesalius edited the parts on the dissection of the nerves and blood vessels, especially one of Galen's most important works, *De Anatomicis Administrationibus*.

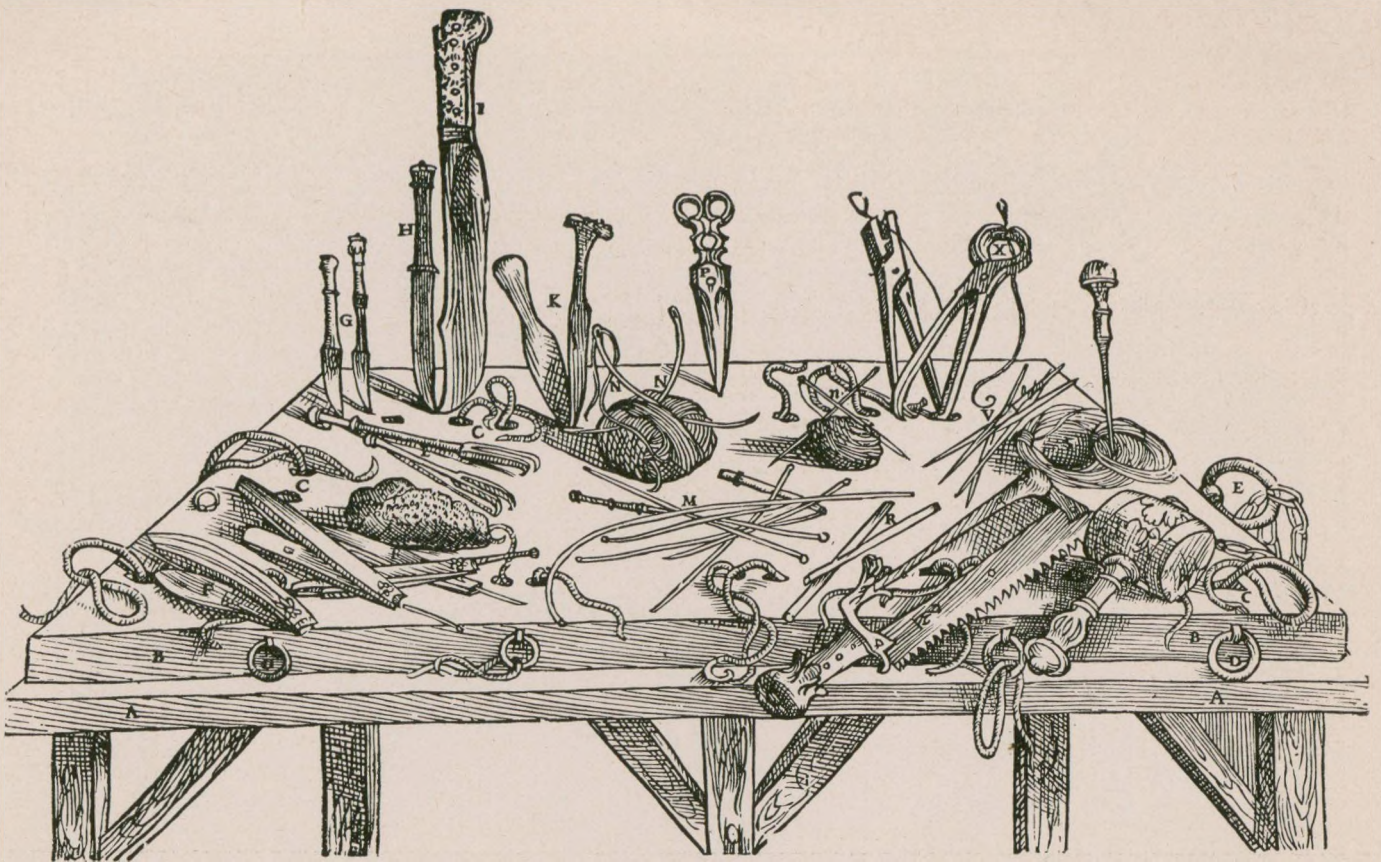
As he worked on this translation, Vesalius was delivering a course of lectures at Bologna, during which he reconstructed the skeletons of a man and a monkey. When the work was finished, he compared the two. In the monkey he found a lumbar vertebral process which was described in Galen's anatomy but which apparently did not exist in the human skeleton.

A great revelation dawned upon Vesalius. He realized, with sudden, shocking



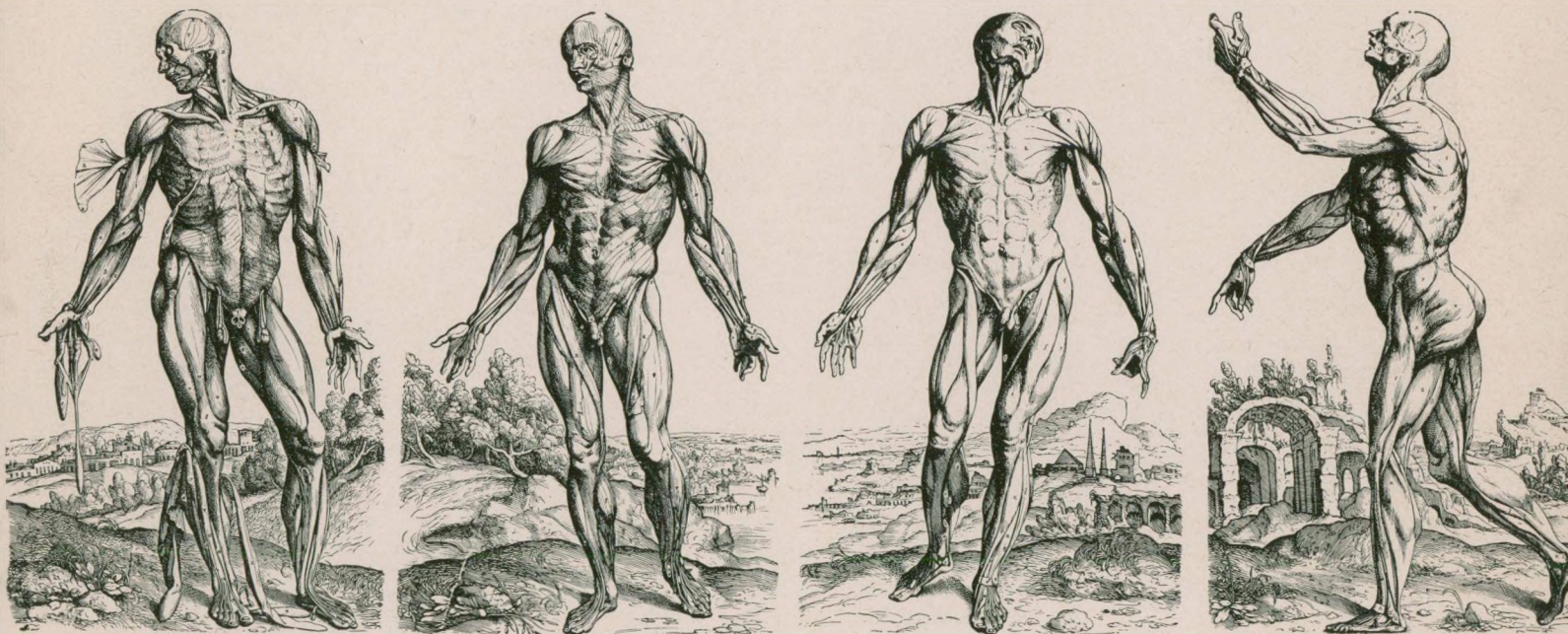
ANATOMICAL FIGURES make a monumental panorama when the *Fabrica's* folio pages are laid side by side. This series of eight tortured illustrations begins at the far right on the opposite page, proceeding through stages of dissection to the limp skeleton at the left. The illustrations are arranged in this order to show that Cal-

car placed his figures on an almost continuous landscape, identified as that of the Euganean Hills, near Padua. The figure at the far right shows the body from the side with the skin and some superficial tissue removed. Second from the right is the same figure from the front. The third figure shows the body with the mus-



THE ANATOMIST'S TOOLS were drawn by Calcar as they appeared on a table used by Vesalius to dissect living animals. Also on the table is a wooden slab fitted with holes and rings to fasten the ropes that held the animals motionless. The tools are various razors and knives (noted by Calcar with the letters F,

G, H, I and K), hooks (L), styluses and a siphon (M), needles and stout bookbinding thread (N and n), a saw, a pair of scissors (P), a wooden mallet, reeds for inflating the lungs and other organs (R), copper wire for joining bones (S), pointed instruments for piercing bones (V), pincers for tying and cutting twine (X).



cles laid bare of superficial tissue. In the fourth figure several of the muscles, mainly those controlling the tibia and the fingers, have been laid back and left to hang down. In the fifth the muscles of the thigh and other parts have been cut away. In the sixth the head is thrown back and the lower jaw split in half. The seventh, which

also appears on page 24, shows the body suspended by a rope with the viscera removed. The shoulder blade is also suspended lest, as Vesalius wrote, it fall down like a broken wing. In the eighth figure the breastbone and rib cartilages have been cut away and placed on the ground at left, leaving the skeleton almost stripped.



FABRICA'S FRONTISPIECE, discussed in the text of this article, is a symbol of the anatomical revolution begun by Vesalius. Here Vesalius stands by the cadaver

performing the dissection himself. Before it had been done by barber surgeons. Calcar drew himself as the man with the book to the left of the seated skeleton.

perception, that Galen had never dissected the human body. Galen's anatomy was that of the ape! The obscure and erroneous details that had bothered him for years were cleared up at a stroke. His long, frustrating search for the imaginary organs mentioned by Galen was at an end. Vesalius' reaction to his astonishing discovery was characteristic: he was ashamed of himself. He wrote: "Ipse meam stupiditatem et nimiam in Galeni aliorumque Anatomicorum scriptis fidem haud satis demirari possum"—"I could not get over wondering at my own stupidity and overconfidence in Galen and the writings of the other anatomists."

THAT day in 1540 marked the birth of modern anatomy. Vesalius now went to work to present the first accurate description of the structure of the human body.

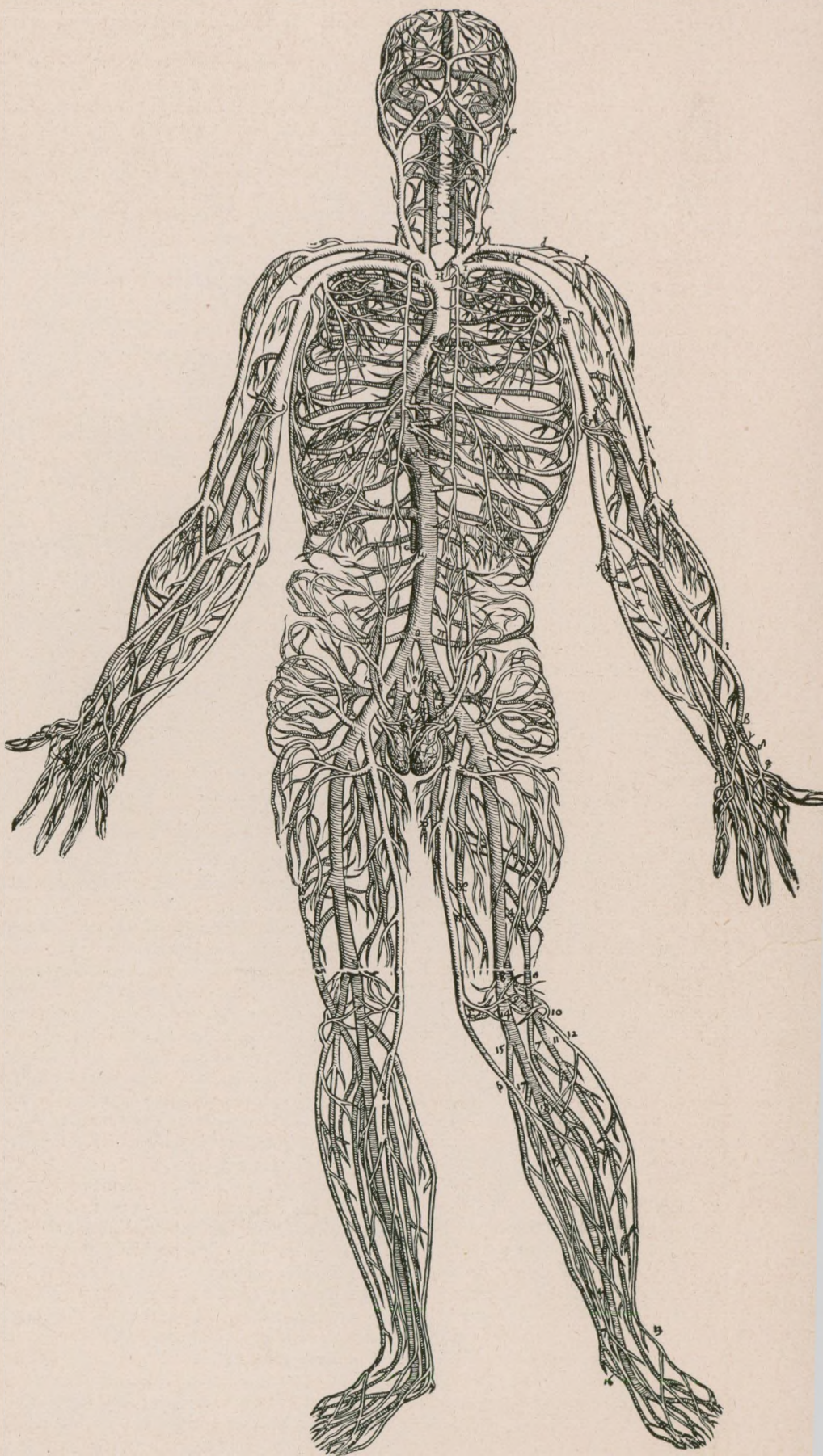
It took him only two years to complete the *Fabrica*. Meanwhile, he also undertook the dangerous task of removing Galen from his shrine in scientific opinion. His public dissections took on the character of turbulent mass meetings. He was greeted with both praise and bitterness as he destroyed the legend of Galen by citing more than 200 errors in his anatomy. "Thou, Galen," he declaimed, "who hast been betrayed by thine apes!"

On August 1, 1542 his work was finished. He took the huge manuscript to Venice and shipped it, with all the woodcuts and minutely detailed directions, to his publisher Oporinus in Basel. Vesalius soon followed to supervise the printing personally. But even while attending the birth of his masterpiece, he went on with his dissections. On May 12, 1543, a criminal named Jakob Karrer was beheaded. Vesalius promptly seized upon his body to perform the first dissection that had been witnessed in Basel in 12 years. For four centuries the skeleton Vesalius constructed from the bones has outlasted Jakob Karrer's misdeeds, whatever they were. Today it is still treasured by the Vesaliarium in Basel as the oldest preserved anatomical specimen in the world.

In June of 1543 the great book finally appeared. Actually it was two books. Besides the exhaustive *Fabrica*, Latin and German editions of an *Epitome* were published for laymen. This was an outline of the new science and a safeguard against unauthorized condensations and translations.

In the woodcut which appears on the first page of the *Fabrica* one may see a portrait of Vesalius at 28—a bold, eager man with curly hair, piercing eyes, a high forehead, an upturned nose and a small birthmark over the right eyebrow. On the table before him are the flexor muscles of a cadaver's right forearm laid bare. Vesalius, grasping the hand, is supposedly exhibiting one of Galen's errors.

The frontispiece of the *Fabrica*, a panoramic view of Vesalius' dissection theater,



THE VENOUS SYSTEM is delicately traced in another of Calcar's woodcuts. Although Vesalius knew the existence of capillaries, he did not know the circulation of the blood. This was not discovered by Harvey until 1616.

boldly symbolizes his defiance of tradition and his devotion to science. At the center, Vesalius, scalpel in hand, stands beside a table upon which lies a woman's nude body with the viscera laid open. Every detail in the picture is a deliberate rebuke to the academicians. At the conventional medical lectures of the time the professor sat high on a kind of throne, reading a chapter from Galen. Below, the demonstrator, a physician, pointed with a wooden staff at the organs to which the reading referred. Even lower, in the pit of the theater, the barbers cut up the body, or rather, hacked at it with clumsy hands. In the *Fabrica* a skeleton occupies the throne of the professor, while Vesalius stands and lectures in the midst of his students. Underneath the table two squatting barbers disconsolately brandish their razors. Flanking the picture at the bottom are an ape and a dog—the rejected subjects of traditional dissections. At the left, braced against a column, is a naked figure which illustrates the play of living muscles. The bearded figure at the right, directing a servant to quiet the dog, is believed to be Realduus Colombo, Vesalius' assistant. At the top of the picture, upheld by naked little angels of anatomy, is Vesalius' family coat of arms—three fleeing weasels. And packing the theater to the doors is a throng of fascinated students, watching the dramatic event with the taut faces of men trembling with excitement.

The frontispiece falls short of being an artistic masterpiece, but it is a masterful illustration of Vesalius' place in the history of medicine. This is the birth of anatomy, firm foundation of the art of healing and of all scientific investigation of the human body.

THE principal illustrations of the *Fabrica* are its anatomical drawings, imprinted on folio pages by woodcuts. These fall into a narrative which unfolds like a great voyage of discovery. Calcar's massive figures are almost supernatural beings, each animated by an intellect. In attitudes of monumental suffering, their giant forms rise from a continuous landscape, identified as a section of Petrarch's countryside in the Euganean Hills near Padua. From page to page the giants shed their muscles like tall trees shedding their leaves in autumn, the landscape suffering with them. The narrative proceeds with the structure of great drama: in the final pages the figures stand on naked rock, stripped of every connection with life—poor remnants of humanity sinking on their knees, leaning against a wall or hung up by cords. From this has the study of anatomy sunk to a mere pedantic exercise!

The *Fabrica* was to revolutionize surgery and to found a new era of physiology from which was to grow the discipline of modern medicine. But it broke upon its time like the first nuclear chain reaction.

Vesalius' old professor, Sylvius, called him a "madman," an unprincipled upstart who had disgraced his teaching. Guinterius turned against him. Even Vesalius' assistant, Colombo, a gifted but unscrupulous careerist, did his best to discredit him in his own stronghold of Padua.

Vesalius lacked the toughness that often accompanies genius. The attacks discouraged him. Within a year, during a fit of depression, he burned most of his notes and scientific papers and fled his university and his science. He began an entirely new life as court physician to Charles V in Madrid. He accompanied the emperor on military campaigns and to conferences



FABRICA'S ALLUSION to the legend of the Greek Poet Arion almost foretold manner of Vesalius' death.

throughout Europe. He also married Anna van Hamme, the daughter of a royal councillor in Brussels. In his bitter *Letter on China-Root* (quinine), which he wrote to a friend, he exclaimed: "Never again will I procure scientific material for myself and my pupils with such labor and danger as once I did in Paris, Louvain and Italy. In my youthful enthusiasm for science I endured this willingly and easily. Now I am through with the passion for writing." Vesalius was 31.

In 1556 his life took a minor turn. When Charles V gave his throne to his son Philip II, Vesalius entered Philip's service in Spain. This was probably the period when the portrait of Vesalius ascribed to Titian—now in Florence's Palazzo Pitti—was painted. It shows Vesalius with thinning hair and the high, pale forehead of a man growing old. A graying, slightly ruffled beard melts into the enormous breadth of his heavy body. His right hand holds a pair of spectacles. His left hand holds a book, an index finger between the pages. His wise, resigned eyes gaze past the beholder over some melancholy vista. It is Vesalius—without goals, lost in the darkness and corruption of the Spanish empire.

But the last spark had not quite been extinguished. While he was in Spain Vesalius received a book entitled *Observationes Anatomicae*, by Gabriele Falloppio, whose name is commemorated by the Falloppian tubes. Falloppio of Modena had been through an early career much like that of Vesalius. At 24 he was a professor in Ferrara, and he succeeded to Vesalius' chair in Padua after the treacherous Colombo resigned. In a clear, forthright script, every line of which breathed respect, Falloppio advised Vesalius of a few errors in the *Fabrica*, described the organs of hearing and gave an exact anatomy of the uterus, the ovaries and the clitoris.

For Vesalius, Falloppio's manuscript was a trumpet call. He read it in a fever of interest and in a few days wrote his last work, *Comment on Falloppio*. He sent the manuscript to Falloppio, but before it could be delivered Falloppio had died. Vesalius' book was published two years later in Venice.

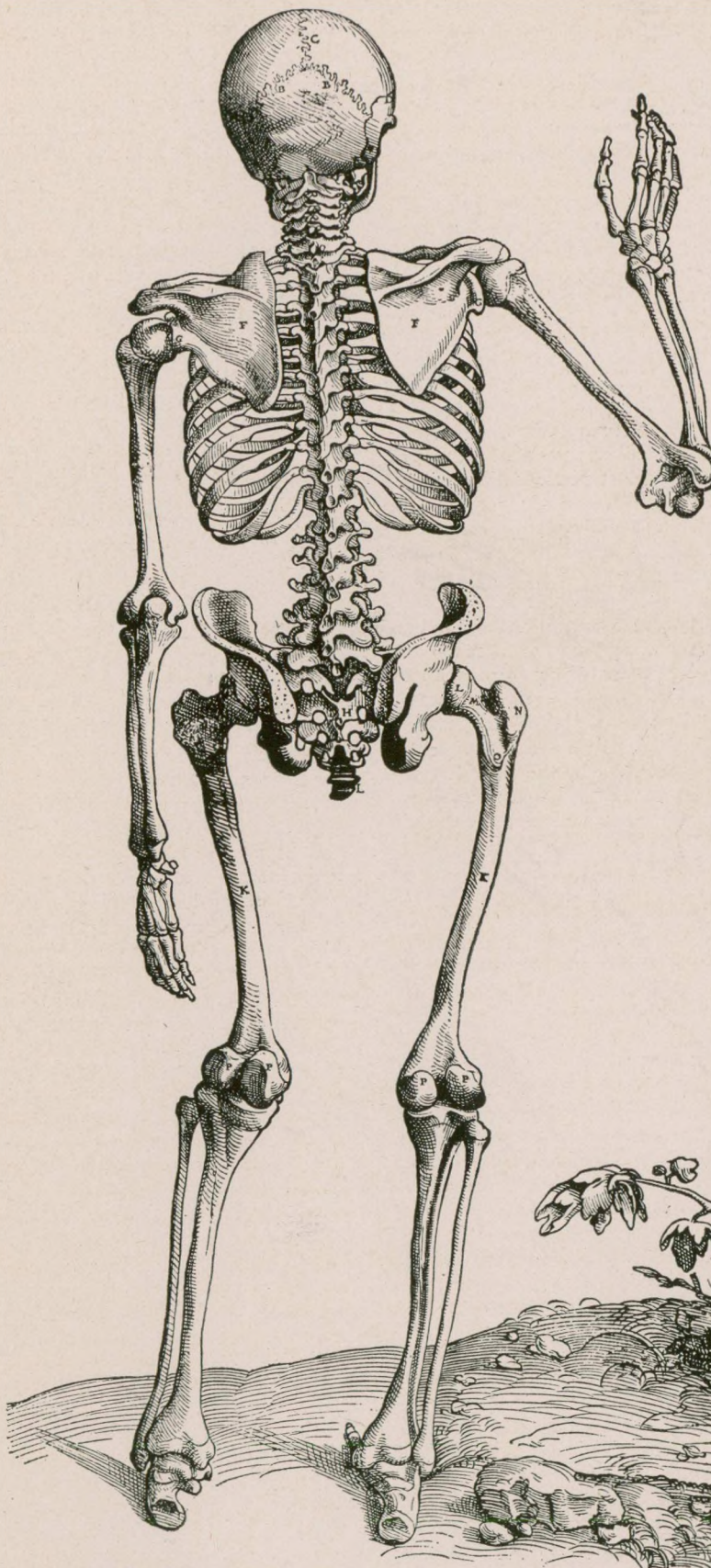
In the spring of 1564 Vesalius set out on a pilgrimage to Jerusalem, from which he was not to return alive. The reason for this journey and the circumstances of his death have never been completely clarified. According to a letter written by a Paris physician in 1565, Vesalius had a distinguished patient in Spain who died of an unknown sickness. "When he believed him dead," wrote the Parisian, "he asked the relatives for permission to perform an autopsy. This was granted, but when he opened the chest, the heart was still beating. The relatives accused Vesalius of manslaughter and Godlessness before the Inquisition. Since the killing was proved, the Inquisition wanted to sentence him to death. Only with difficulty was the king able to free him from great danger. Finally he was released on condition that for the expiation of his crime he should go on a pilgrimage to Jerusalem and Mount Sinai."

On Vesalius' return journey from Jerusalem, according to another report, his ship was wrecked on Zante, one of the Ionian Islands to the west of Greece. There he lay dying, untouched by the inhabitants because they thought he was a victim of the plague. Shortly before he died he was found on the beach by a visiting Venetian goldsmith. There, at 50, Vesalius was buried in an unmarked grave.

If this account may be accepted, there is a strange parallel between the end of Vesalius and the end of his great book. On the last page of the *Fabrica* is a concluding illustration, said to have been chosen by Vesalius himself. It is a picture of Arion, the poet and musician of Lesbos, who during a voyage was robbed and driven into the sea by Corinthian sailors. Vesalius had almost predicted his own death, and had chosen his monument

Martin Gumpert is a practicing physician and a writer on medical subjects.

ΣΚΕΛΕΤΟΝ Α ΤΕΡΓΟ ΔΕΛΙΝΕΑΤΥΜ.



Naturalis capitis figure, ad oblonge sphaere similitudinem confabratæ, ἡ ἀπὸ τῆς φύσεως, ὡς καὶ τῶν μεμβρανῶν, Complosa.

- A Per sinciput ἐν φρεσίν, coronalis quod coronari solent, ἡ τῶν οὐρανῶν : in alia figura apparet.
- B Per occiput, ἡ τῆς ἁλῆος, ἡ τῶν οὐρανῶν, Laude.
- C A medio posterioris suturæ per verticem ad anteriorem: ἡ ὁριζία, quod telum refert dila, ἡ τῶν οὐρανῶν, Sagittalis, Nervalis. Hæc aliquando frontis ipsam secans inter supercilia finitur, quod omnibus mulieribus et nullis viris accidere, falsum est.
- Hæ tres suturæ in tribus non naturalibus capitis figuris pro perditarum, aut remanentium eminentiarum ratione, variant.
- D Ad tempora due ἡ τῶν οὐρανῶν, temporales, Corticales, ἡ τῶν οὐρανῶν, squamiformes, ἡ τῶν οὐρανῶν, commissuræ potius quàm suturæ nuncupandæ.
- Reliquæ potius harmoniæ quàm suturæ sunt, vna ἡ τῶν οὐρανῶν, altera ἡ τῶν οὐρανῶν, ad os cuneiforme protensa: ab huius extremo per medias oculorum sedes ad nasi summum usque vna: ex causis temporum per inferiorem oculorum ambitum vna, ἡ qua rursus in oculi cavo tres exiguæ: tres narium ossa discernentes. Quæ verò ad caninos dentes a Galeno deferri scribitur, hæc narium parte exteriori minime visæ non sunt. Vna quæ per medium palatum procedit, aliæque transversæ eidem palati ad narium foramina secans, hic delineari nequeunt.
- E Lapidosa, petrosa, ἡ τῶν οὐρανῶν, ossa, nullâ propriam circumscriptionem habent, sed illa pars quæ ad calvarie basim est quâ spinalis medulla excidit, ita proprie nominatur: licet nonnulli temporum ossa eo nomine significaverint.
- F Scapula, ὡς ὁ πτερόν, ὡς ὁ πτερόν, Latini aliquando humerus, scapulum opertum, scapula, ἡ τῶν οὐρανῶν, Spatula.
- G Cervix seu collum, caput in acetabulum desinens.
- Pachy, spina dorsæ, ἡ τῶν οὐρανῶν, vertebrae, ἡ τῶν οὐρανῶν, vertebrae, viginti quatuor constans: ἡ τῶν οὐρανῶν, collum, ἡ τῶν οὐρανῶν, septem: vna ἡ τῶν οὐρανῶν, dorsæ, metapbreni, thoraci, ἡ τῶν οὐρανῶν, duodecim: ἡ τῶν οὐρανῶν, lumborum, ἡ τῶν οὐρανῶν, beatzæ, Reni, Albatini quinquæ. Hæc narium dorsæ undecim, non decimam vidi utrinque suscipi, et posteriores processus quas spinas et Siemenia vocant, sub decima obscure admodum, aut potius non ascendere, solumque duodecimam (quod et Arabibus placuit) transversos processus destitui.
- H Os ilion, sacrum, ἡ τῶν οὐρανῶν, latum, amplum, ἡ τῶν οὐρανῶν, Osanum, Alchais, Hægit, lumborum vertebrae subiectum, tribus vertebrae in libro de ossibus, quatuor verò in libro de visu partium Galenus conformari prodidit.
- I Coccygis, ἡ τῶν οὐρανῶν, Caudæ, Albofos, tribus Galeno ossibus constituitur, eius in li.de visu partium non meminit, sicut in lib.de administrationibus anatomicis et libro de ossibus. Verum Galeni Medicinæ principis descriptiones etiam parùm sibi constantes, his duobus ossibus non convenire subinde observavimus, reperimus enim novem ossa, paucioraque quàm scribit foramina.
- K Mucor, sternum, fœmen, ἡ τῶν οὐρανῶν, hæc ἡ τῶν οὐρανῶν, Os coxæ omnium corporis ossium maximum. L. superius caput. M. cervix. N. N. inferiora capita quibus tibis articulat. O. ἡ τῶν οὐρανῶν, magnus, quæ et γράμμιον appellant, Malum granatum testiculorum. P. ἡ τῶν οὐρανῶν, parvus et interior.



CAUTVM EST DECRETO PAV. III. PONT. MAX. ET SACRATISSIMAE CAESAREAE MAI STATIS
Illustrissimique Sena. Vene. ne quis has Andree Vuesalii Bruxellensis tabulas aut imprimat, aut alibi excessus diuendat, sub penis gravissimis in preiudicium expressis.

EARLY WORK OF VESALIUS was a lesser book called *Tabulae Sex*, also illustrated by Calcar. As indicated

by the scroll on the stump at the right, this was printed in 1538, two years before the publication of the *Fabrica*.