# Introduction

*"It is not Nature that fails, but humans, and they often fail because they flatter either themselves or their friends."*[1] Thomas Bartholin, 1661

The century of the physician and anatomist Thomas Bartholin (1616–1680) – the 17th century – represented within the scientific world a transitional period between the Renaissance, with its cultivation of antiquity, and the era of the Enlightenment, with its focus on reason and science. The 1600s were characterized by a series of scientific breakthroughs, and it was precisely these turning points that formed the basis of the Enlightenment. Medical science was one of the areas that generated the greatest breakthroughs.

In the Renaissance, the development of printing in the first half of the 16th century had paved the way for new publications in Greek and Latin of the medical works of the ancient physicians Hippocrates (c. 460–c. 370 BC) and Galen (c.129–c. 216), and set a new focus on their medical understanding, which had already been mandatory doctrines in universities all over Europe for centuries.

## Vesalius, Harvey and Aselli

However, in the mid-1500s something happened that had a decisive influence on 17th-century medical science. With the Flemish anatomist Andreas Vesalius (1514–1564) as a pioneer (Figure 1), people began questioning the doctrines of the ancient Greek authorities. By carrying out dissections himself on human bodies, Vesalius realized that the ancient physicians' anatomical writings did not fit human beings but were based on dissections of dead animals – that is, if they were based on dissections at all.

The ancient physicians' theories about human anatomy were, in other words, just theories and guesswork, but generally not based on practical research and observations. Vesalius' courage in setting himself in opposition to the ancient authorities and his encouragement to others to perform dissections themselves and carry out their own observations generated a new culture of medical science, which did not really gain a foothold before the beginning of the 17th century.

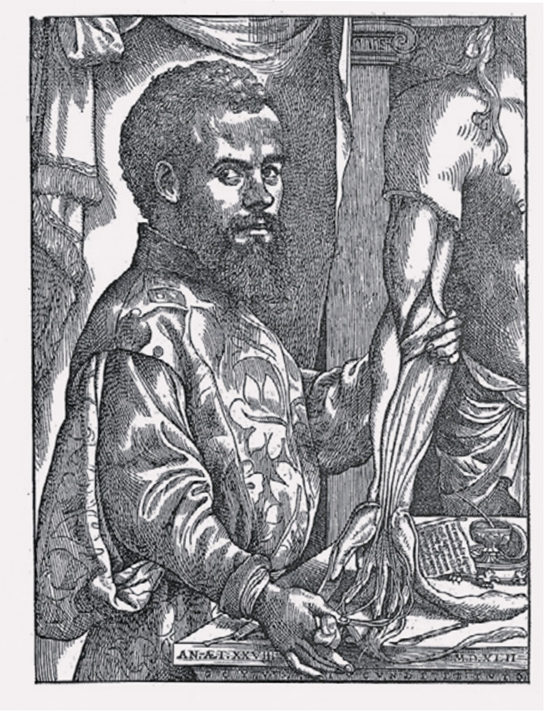

Figure 1. The 28-year-old Flemish anatomist Andreas Vesalius (1514–1564) during the dissection of an arm in 1542. Woodcut by Jan Stephan van Calcar (1499–1546) in Vesalius' epoch-making anatomical folio-work *De Humani corporis fabrica Libri septem*, Basel 1543.

Through his rejection of the doctrines of the ancient Greek physicians Hippocrates and Galen and his call for independent study of the human body, Vesalius revolutionized anatomical research and laid the foundations of modern medicine. He became a great source of inspiration for physicians of the 17th century. The Royal Library in Copenhagen.

Dissections of living creatures, so-called vivisections, making it possible to make direct observations of the functions of the organs, was a part of this development. The tradition of thinking more about structure and anatomy was, in the beginning of the 17th century, gradually replaced by a more dynamic perception. Inspired by the Italian philosopher, physicist and astronomer Galileo Galilei's (1564–1642) new mechanical observations within physics, there was a growing interest in the connection between structure and function, or, in other words, between anatomy and physiology.

Two of the 17th century's greatest discoveries in medical science took place at approximately the same time, at the beginning of the 1620s. One was the finding by the Englishman William Harvey (1578–1657) (Figure 2), that the heart pumps the blood in a circulation round the body, published in the work *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus* (An anatomical exercise on the motion of the heart and blood in animals) in Frankfurt am Main in 1628.[2] This discovery broke with the old opinion that the blood is continuously formed and broken down in large quantities in the liver, which was considered the body's blood-forming organ – an opinion that prevailed until it was found in the second half of the 1800s that the organ that generates the blood is in fact the bone marrow.


Figure 2. The English anatomist and royal physician William Harvey (1578–1657), discoverer of the blood circulation. Posthumous portrait engraving in rococo style by Jacobus Houbraken (1698–1780) from template by Willem van Bemmel (1630–1708). 36.9 × 23.3 cm. Amsterdam 1738. Published in London 1739.

The engraving shows the older Harvey. Symbolizing his profession and specialty, in front of the frame is a tablet with the large blood vessels of the chest and abdomen, the heart and the kidneys. In front of the board is a Rod of Asclepius. Harvey predicted – rightly, as it turned out – great resistance in the medical world against his theory of blood circulation. Thomas Bartholin was one of his earliest supporters. Private ownership.

Figure 3. Gaspare Aselli (1581–1625), discoverer of the lacteal veins. Engraving by Cesare Bassano (1584–1648). 20.5 × 13.6 cm. From Aselli's *De lactibus sive lacteis venis, quarto vasorum mesaraicorum genere*, Milan 1627.

The Latin text in the frame reads "GASPAR ASELLIUS CIVIS CREMONENSIS ANATOMICUS TICINENSIS ANNO ÆTATIS XLII": "Gaspare Aselli, citizen of Cremona, anatomist in Ticinum [Pavia], age 42."

With his discovery of the lacteal veins in the mesentery of a living dog in 1622, Aselli kick-started the 17th-century medical revolution. He was aware that the new vessels transported nutrients from the intestine, but he thought of them as veins and never realized that he had discovered a type of lymph vessel. His publication on the newfound vessels did not appear until two years after his death. Bibliothèque nationale de France.

The second great medical discovery in the 17th century was the finding by the Italian Gaspare Aselli (1581–1625) (Figure 3) of a new kind of vessel, namely the lacteal veins or milk veins. On the dissection of a live dog, after it had eaten, Aselli observed in the mesentery some thin white vessels which, upon intersection, emitted a milk-white fluid. He regarded these vessels as a fourth type of vessel – after arteries, veins and nerves (which at that time were also believed to be vessels – a type of veins) and called them *venæ lacteæ* (lacteal veins). Aselli believed that the lacteal veins ended their course in the liver, and that the milky-white fluid that they contained, rich in nourishment, and which originated from the food in the stomach and intestines, was conveyed directly to the liver to be

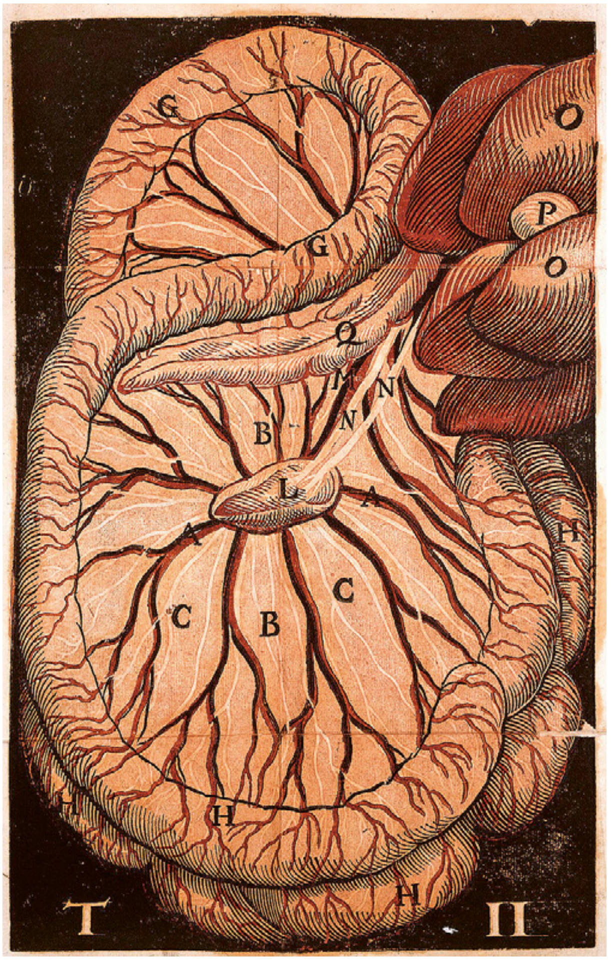


Figure 4. The mesenterial blood vessels (A) and Aselli's lacteal veins (B) on table II in his treatise about his discovery of the latter, *De lactibus sive lacteis venis, quarto vasorum mesaraicorum genere* (On the milk vessels or milk veins, a fourth kind of mesenterial vessels), published in Milano 1627. It was the first coloured anatomical illustration ever seen.

C: Mesentery.
G: Jejunum (first section of the small intestine).
H: Ileum (last section of the small intestine).
M: Vena cava.
N: Larger lacteal veins with vena cava and the liver.
O: Liver lobe.
P: Gall bladder.
Q: Pancreas.
Wellcome Collection, London.

used in the formation of blood. Aselli's discovery of the lacteal veins was published in Milan in 1627, two years after his death, in a work with the title *De lactibus sive lacteis venis, quarto vasorum mesentericorum genere* (On the lacteal vessels or lacteal veins, a fourth kind of mesenteric vessels) (Figure 4).[3]

These two major discoveries gave rise to vehement discussions and disputes between physicians and other scholars with an interest in natural science until far beyond the middle of the 17th century, but precisely for that reason they also became the area of focus for research in medical science during the same period.

One of those who played a lively part and proved decisive in this debate and research, who continuously promoted the new knowledge, and who generally played a dominant role in 17th century medical development, both in Denmark and abroad, was the main character of this book, Thomas Bartholin. With a maternal grandfather, a father and an uncle who were all highly influential physicians at the University of Copenhagen, he had the best qualifications for pursuing a career in this field. His own abilities, his insatiable curiosity and his almost inhuman capacity for work were additional factors that contributed to paving the way to his status as one of the most famous and influential physicians in Danish history.

## The legacy of Tycho Brahe

The scientific environment in Copenhagen in the 17th century, out of which Thomas Bartholin and his mentioned family members grew, was very much established by the Danish astronomer Tyge Ottesen Brahe, better known as Tycho Brahe (1546–1601) (Figure 5). Brahe was a nobleman intended for law studies, but from early childhood he was fascinated by the sky and the stars and ended up being one of the founders of modern astronomy.

In 1570, Brahe had returned to Denmark after many years of astronomical studies in different Lutheran cities in what is now Germany and Switzerland (Leipzig, Wittenberg, Rostock, Basel and Augsburg), during which time he had also learned to construct astronomical instruments. At his uncle Steen Bille's (1527–1586) estate, Herrevad Kloster in Scania (then Denmark, since 1658 Sweden), he had built an astronomical observatory. Here in the evening of 11 November 1572, when Brahe looked up at the clear sky to the north, with his naked eyes he spotted, in the constellation Cassiopeia, a new bright star clearer than Venus, which later turned out to be a supernova (Figure 6).[4] Being familiar with all the visible stars in the sky, Brahe was convinced that he had never seen this star before, and in his book about it, *De nova Stella* (About the new star),


Figure 5. Tycho Brahe (1546–1601) painted in 1596 by an unknown artist. Oil on canvas. 102 × 83 cm.

In the top-left corner is a symbolic depiction of the four elements, earth, water, air and fire. A hand from heaven holds a ladle over a burning obelisk surrounded by a ribbon with the words: STANS TEGOR IN SOLIDO VENTUS STREPAT, IGNIS ET UNDA (When I stand on solid ground, I am safe, even when wind, fire and sea roar). Two putti-like figures spit water, and two hands pour water out of jugs. In the upper right corner is the text: EFFIGIES TYCHONIS BRAHE OTTONI DANI ÆTATIS SUÆ ANNO 50. COMPLETO. QVO POST DIUTINUM IN PATRIA EXILIUM LIBERTATI DESIDERATÆ DIVINO PROVISU RESTITUTUS EST (Portrait of the Dane Tyge Ottesen Brahe painted after his 50th birthday, where after a long exile in his homeland, he regained his longed-for freedom by divine providence).

Brahe was the founder of the scientific environment in Copenhagen at the end of the 16th and the beginning of the 17th century. His empiric method resting upon experience through personal observations and measurements was adopted by later Danish scientists, including Thomas Bartholin and his famous pupil Niels Stensen (1638–1686). Skoklosters Slott. Photo: Jens Mohr. Wikimedia Commons.

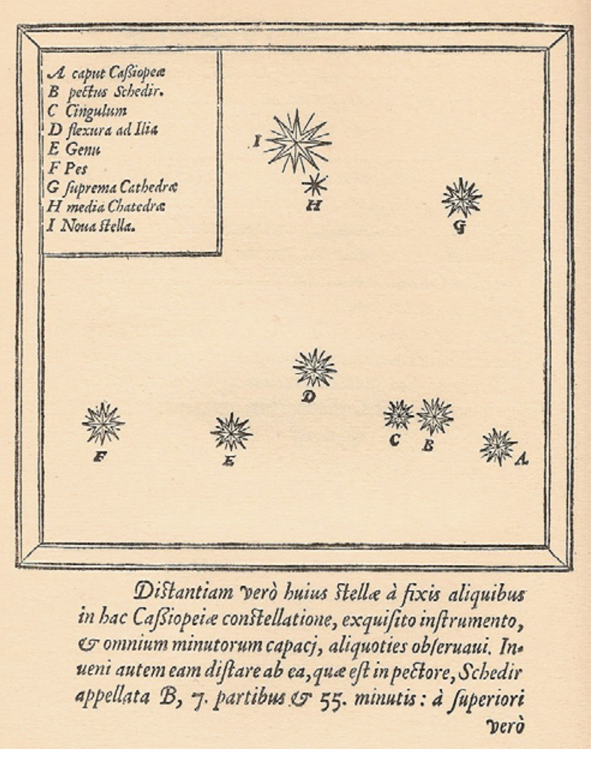


Figure 6. Tycho Brahe's depiction of the new star in Cassiopeia in his treatise about it, *De Nova Stella*, Copenhagen 1673.

The Latin text below the illustration up to the last colon reads: "I measured several times the distance between this star and various fixed stars in Cassiopeia with a specially selected instrument that records every detail. I found that its distance from the star in the chest, called Shedir (B), was 7 parts and 55 minutes." With his discovery of the new star, Brahe buried once and for all the Aristotelian doctrine that the sky beyond the Moon is unchangeable. Wikimedia Commons.

published in Copenhagen the following year, he therefore describes it as "in truth the greatest of all miracles that has occurred in Nature since the creation of the world."[5] In fact, Brahe was so surprised by his discovery that he initially did not believe his own eyes, but summoned witnesses to corroborate it: "I was surprised to such an extent that I could not believe my own eyes, but when I experienced that it could also be seen by others, when the location was pointed out for them, I was no longer in doubt that a new star had really shown itself there."

Until the disappearance of the star in the spring of 1574, Brahe continued to observe it from his observatory at Herrevad Kloster. With his self-produced astronomical instruments, he carried out exact measurements, showing that the star had no parallax,[6] but was a fixed star,[7] which did not change its position in relation to the other fixed stars, the zodiac or the Earth, and which was located much further away from the Earth than the Moon and the other planets then known in our solar system (Mercury, Venus, Mars, Jupiter and Saturn). Brahe concluded: "Therefore, this new star has neither its place in the elementary