comparative anatomy: "Had anatomists only been as conversant with the dissection of the lower animals as they are with that of the human body, the matters that have hitherto kept them in a perplexity of doubt would, in my opinion, have met them freed from every kind of difficulty." For the first time we see doubt cast upon the doctrine of "spirits." Says Harvey: "We are too much in the habit of worshipping names to the neglect of things. The word blood has nothing of grandiloquence about it, for it signifies a substance which we have before our eyes and can touch; but before such titles as spirit and innate heat we stand agape."

The new doctrine was at first universally rejected, especially in Italy where most of the preliminary discoveries had been made that led to Harvey's conclusions. As in the case of Vesalius, the innovator was greeted with abuse and detraction instead of demonstration and legitimate argument. Harvey received this, however, with a singularly calm and judicial spirit. He says: "To return evil speaking with evil speaking I hold to be unworthy in a philosopher and searcher after truth. I believe that I shall do better and more advisedly if I meet so many indications of ill-breeding with the light of faithful and conclusive observation." The only opponent he deigned to answer was Jean Riolan (Riolanus, Jr., 1577–1657), professor at Paris, so renowned for his acerbity in controversy that it was said of him that he would rather give up a friend than yield an opinion. Harvey's reply was judicial and complete, but failed to convince Riolan, who obtained a decree from the Faculty at Paris forbidding the teaching of the new doctrine, and opposed it up to the time of his death. Harvey lived to see his views almost universally accepted, dying in 1657, a few years before Malpighi discovered the capillaries and thus placed the anatomical basis of the circulation beyond cavil (1661).

Harvey's work called more attention to the heart, and many points in its gross anatomy were now established. Among those who worked to this end may be mentioned Richard Lower of London (1631–1691, tuberculum Loweri), Raymond Vieussens (1641–1718, fossa ovalis), professor at Montpellier, Nils Stensen (Nicholas Stenonis, 1638–1686), professor at Copenhagen, who worked at the musculature and looped fibres, and Adam Christian Thebesius (1686–1732), who discovered the foramina Thebesii.

As a consequence of the doctrine of the circulation, the distribution of blood-vessels was more accurately studied. A passage in Sylvius is sometimes cited to show that he suggested injections, but it is clear that he could not have made any effective use of them. The first to do this was Stephen Blancaard, of Middleburg, Holland (1650–1702), who, in 1675, succeeded in injecting the blood-vessels. Others obtained great success with this method, especially Frederick Ruysch (1638–1731), professor at Amsterdam, whose preparations were justly famous. It is to him we owe the demonstration of the vascular distribution in the choroid of the eye (tunica Ruyschiana = chorio-capillaris). Using fine injections he found vessels in every part of the body in such numbers that he inclined to the belief that the body was mainly composed of them, "*totum corpus ex vasculis.*"

Closely associated with the anatomy of the blood-vascular system is that of the lymphatics. These structures were probably seen in goats by Aristotle and Herophilus, but as their course and termination were not determined, the remarks of those authors concerning them were overlooked or misunderstood. Eustachius saw and described the thoracic duct in the horse, supposing it to be a vein for the nourishment of the thorax. The chyliferous lymphatics were first observed in 1622 by Gaspare Aselli (1581–1626), professor at Pavia, in the mesentery of a dog lately fed. Misled by the prevalent conceptions as to blood formation, he thought they could be traced to the liver. His discovery was not published until 1627, and the next year such vessels were demonstrated in the mesentery of a criminal two hours after death by Fabrice de Peiresc, a senator of Aix, to whom Gassendi had communicated Asellius' discovery. In 1647, Jean Pecquet (1622–1674), a student at Montpellier, accidentally discovered the thoracic duct in a dog and traced it through the diaphragm to the receptaculum chyli (reservoir of Pecquet). It was still considered a vein, though further research showed its connection with the mesenteric glands. The distinction between the lymphatics and the mesenteric veins was first made by Nathanael Highmore (1613–1684), of Shaftesbury. Jan Van Horne (1621–1670), professor at Leyden, was the first to observe the thoracic duct in man, though Olaus Rudbeck (1630–1702), professor at Upsala, noted it about the same time. The latter also discovered the general lymphatics, distinguishing them as vasa serosa in 1651, their present name being given by Thomas Bartholin (1616–1680), professor at Copenhagen, who greatly extended the knowledge of them. Finally Anton Nuck (1650–1692), professor at Leyden, invented the method of injecting these vessels with mercury and traced them to nearly all parts of the body.

It was at about this period that anatomical science obtained great assistance by the invention of the microscope. As an instrument of research the simple microscope was not used until the seventeenth century, although the magnifying power of lenses seems to have been known in remote antiquity. The greater power of the compound microscope invented about 1590 by Hans and Zacharias Janssen, of Middelburg, Holland, still further stimulated investigation and led to the discoveries of Malpighi, Leeuwenhoek, Redi and others. The imperfection of the instrument so greatly affected its utility that many anatomists distrusted the results obtained from its use. After many attempts and partial successes by others, Chevalier of Paris (1824) and Amici of Modena (1827) finally succeeded in correcting chromatic and spherical aberration, thus producing an instrument by which minute structure can be accurately investigated.

The immediate result of microscopical investigation was, on the one hand, greatly to extend the knowledge of structure, and, on the other, to introduce novel ideas regarding generation and the diffusion of animal life. Marcello Malpighi (1628–1694), professor at Bologna, Pisa, and Messina, a man of great scientific force, laid the foundations of modern botany, of histological anatomy, and of embryology. His discovery of the capillaries in the lung of the frog has already been mentioned. Molyneux (1683) and Leeuwenhoek (1688) almost immediately extended this by finding them in the extremities of lizards and tadpoles. Malpighi discovered the red corpuscles of the blood in 1665. He published the first accurate account of the consecutive development of the chick, carrying his investigations as far as the imperfect instruments and methods of his time would permit. He greatly advanced the knowledge of glands, showing the structure of acini and ducts, demonstrated the glomeruli of the kidney and the splenic corpuscles which still bear his name, and by inflating the air vesicles showed the glandular structure of the lungs and the impossibility of air passing into the vessels by mechanical means. Misled by his imperfect instruments and crude methods of preparation he endeavored to show that the brain also has a glandular character. Having cooked the organ he thought that the gray matter appeared on examination to be composed of minute spherules connected with the fibrous central portion. He assumed that these spherules secreted the nervous fluid which was distributed by the nerves. This accorded with the prevalent ideas and greatly retarded a true appreciation of the structure of the brain.

Many other anatomists added to our knowledge of glands: Francis Glisson (1597–1677), professor at Cambridge, gave a description of the liver that is the basis of our knowledge at the present day; Johann Georg Wirsung, professor at Padua in 1642, discovered in man the pancreatic duct, previously found in the fowl by his pupil Moritz Hofmann (1621–1698), afterward professor at Altorf, a discovery that retarded rather than advanced anatomical science, for the pancreas was supposed to be a lymphatic gland and the duct a lymphatic leading from the intestine to the liver, and thus confirmed erroneous views of lymphatic distribution; Thomas Wharton (1610–

1673), of London, wrote of the nature and classification of glands, and discovered the duct of the submaxillary gland that bears his name.

At Paris a remarkable advance was made by the establishment by Jean Riolan, Jr., of the Jardin du Roi, afterward the Jardin des Plantes, which was, in effect, a biological laboratory where various problems of human and comparative anatomy could be studied. Jean Guichard Duverney (1648–1730) was an able demonstrator there, so popular that noblemen flocked to hear him. He discovered the vulvo-vaginal glands (in the cow), to which Caspar Bartholin's name was afterward attached. He also confirmed the existence of the bulbo-urethral glands, first discovered by Méry (1645–1722) and named after the English anatomist Cowper.

Alexis Littré (1658–1725) described the urethral glands that bear his name, and Martin Naboth (1675–1721) the glands of the neck of the uterus and the closed follicles of the same region. Lorenzo Bellini (1643–1704), professor at Pisa, examined more carefully the structure of the kidney (uriniferous tubules). Thomas Bartholin (1616–1680), professor at Copenhagen, one of the most distinguished anatomists of the seventeenth century, discovered the duct of the sublingual gland which joins Wharton's duct, while the ducts of that gland that open separately into the mouth were found by August Quirin Bachmann (Rivinus, 1652–1753), professor at Leipsic. The duct of the parotid gland, seen and described as a ligament by Casserius, was first recognized as a duct by Walter Needham, of London, in 1655. Nils Stensen (Nicholas Stenonis, 1636–1686), professor at Copenhagen, mentioned it in his inaugural thesis in 1658, and its discovery is often assigned to him. Stensen was one of the most able thinkers of his time. He held that in order to understand the function of organs we must first determine their structure, and that no accurate knowledge of the brain can be had until we understand its conducting tracts. He declared, contrary to the prevailing opinion, that petrifactions are not mere erratic freaks of nature, but the remains of plants and animals that formerly lived. The glands of the intestinal tract were investigated by Johann Conrad Brunner (1653–1727) and Johann Conrad Peyer (1653–1712); those of the eyelids by Heinrich Meibom (1638–1700), professor at Helmstadt; while Conrad Victor Schneider (1614–1680), professor at Wittenburg, demonstrated the true nature of the lining membrane of the nasal fossæ, and thus overthrew the ancient doctrine of the secretion of mucus (pituita) by the brain and of the cerebral origin of catarrhal disorders. Antonio Pacchioni (1665–1726), professor at Rome, discovered the bodies that bear his name, situated near the superior longitudinal sinus; and the synovial fringes and so-called synovial glands were described by Clopton Havers (1692).

The Pythagorean and Galenical doctrine that the embryo is formed from two kinds of semen, generated respectively by the male and female, was generally held. Harvey, following in the footsteps of his master Fabricius, investigated the course of development not only in fowls but in mammals, and published (1651) a treatise on development in which he formulated the famous proposition that the egg is the primary stage of development for all animals. The original phrase is, "*Ovum esse primordium commune omnibus animalibus,*" afterward currently abbreviated as, "*Omne vivum ex ovo.*" According to this view the ovum is the essential element in the generative process. This belief was shaken by the discovery, in 1677, by Johann Ham, a pupil of Leeuwenhoek, at Leyden, of the spermatozoa, which were at once accepted by many as the true generative elements, and were even considered to be minute but completely formed creatures, possessing in miniature all the organs of the adult. There thus arose two schools, the Animalculists and the Ovists, that respectively maintained the efficacy of the male and female products. Nathanael Highmore (1613–1684), a physician of Shaftesbury, England, investigated the testicle, the seminal ducts, and the epididymis. His name is preserved in the corpus Highmorianum and the antrum of Highmore. Wharton described the round ligament of the uterus as the excretory duct for the female semen, but the question of the hypothetical product was finally settled by Caspar Bartholin, who correctly described the functions of the vulvo-vaginal glands. The mammalian ovum eluded research for a long time. The ovisacs (Graafian follicles) were discovered by Regnier de Graaf (1641–1673), who supposed them at first to be ova, though he seems later to have had a correct idea of their nature. When Naboth discovered the closed follicles of the neck of the uterus, he too supposed that he had found the ova (ovula Nabothi). It is said that Van Horne (1621–1670), professor at Leyden, saw the ovum in 1668, but it was not definitely and unquestionably recognized until von Baer demonstrated it in 1827. Nicolas Andry de Boisregard (1658–1742) was the first to note the entrance of a spermatozoon into an ovum, and believed that it did this in order to feed. Antonio Vallisneri (1661–1730), professor at Padua, held, on the contrary, that the ovum was necessary for generation, and supposed the spermatozoon to be unessential. Needham first showed that the fœtus was nourished by maternal blood.

In the nervous system considerable advances were made during this period. Although Harvey stated that he was unable to discover the animal spirits, yet he does not seem to have been able wholly to free himself from the influence of the prevailing doctrine. René Descartes (Cartesius, 1596–1650), the eminent mathematician, held that although the soul was immanent throughout the whole body, it must be specially centralized in the pineal gland, that being the only unpaired organ of the brain and situated so as effectually to control the animal spirits contained in the ventricles. He held that the brain is the seat of sensation, motion, and thought, sensation being due to impulses transmitted to that organ by nerves, motion to the contraction of muscles induced by impulses also transmitted by the nerves. He seems to have been aware of reflex action, noting that sensation may cause motion independently of the will. He thus anticipated discoveries made nearly two hundred years later, and was the first to attempt to explain the phenomena of life by purely physical causes. He was a warm adherent of Harvey's doctrine of the circulation. Johann Jacob Wepffer (1620–1695) was the first distinctly to deny that spirits were generated in the cavities of the brain. Pacchioni considered the dura mater as an organ for effecting the circulation of the spirits, and provided it with three muscles and four tendons.

François de le Böe (Franciscus Sylvius, 1614–1672), professor at Leyden, carefully studied the brain and gave true ideas of its interior spaces. His name is preserved in the aqueduct, fissure, fossa, and artery of Sylvius. The fifth ventricle is sometimes called the Sylvian ventricle. Raymond Vieussens (1641–1715), of Montpellier, also investigated the brain. He was the first to describe the anterior pyramids of the medulla oblongata, the olive and the centrum ovale. His name remains in the valve of Vieussens or anterior medullary velum. Duverney described the decussation of the pyramids and the connection of the jugular sinuses with the jugular vein; while Humphrey Ridley (1653–1708) described the restiform body and the circular sinus. Malpighi recognized the functional importance of the gray matter of the brain, and Burrhus (1616–1695) showed that one-fourth of the cerebral substance was a spermaceti-like fat. Much advance was made by the investigations of Thomas Willis (1622–1675), professor at Oxford, who showed that the brain gradually increases in complexity as we ascend the animal series, and considered that its anatomy could only be properly understood by comparative studies. He renamed and rearranged the cranial nerves, separating the nervus intercostalis or sympathetic from the vagus. In his enumeration he made ten pairs, including the first cervical nerve, and classing as single pairs the auditory and facial, and the glosso-pharyngeal, vagus, and spinal accessory. He described the optic thalamus and the corpus striatum.

Osteology continued to be assiduously cultivated. It is from Ole Worm (1588–1654), professor at Copenhagen, that the Wormian bones are named; and Clopton Havers (1692), an English physician, demonstrated the structure of bone (Haversian canals and systems). The structure and action of muscles were specially investigated by Stensen, by Borelli (1608–1679), the celebrated mathematician, and by Hooke (1635–1703), who was the first to recognize the primitive fibrillæ.

Knowledge of the viscera was essentially advanced by John Mayow (1645–1679), of Oxford, who was the first to recognize the true function of the lungs; by Theodor Kerkring of Amsterdam (1640–1693), who described the valvulæ conniventes of the intestine; by Jacques Benigné Winslow (1669–1760), of Paris (foramen of Winslow, posterior ligament of knee joint), and by James Douglas (1675–1742), of London (Douglas' pouch of peritoneum, semilunar fold, etc.).

The eye was specially examined by several investigators, who considered it because of its interest as an optical instrument. Among these we may mention Johann Kepler (1571–1630) the astronomer, who demonstrated the optical properties of the crystalline lens and showed that it is not the seat of vision, as was held by Hippocrates; Christoph Scheiner (1575–1650), who demonstrated the image on the retina and studied the movements of the pupil and the mechanism of accommodation; Descartes, who compared the eye to a camera obscura and suggested that accommodation for near vision was affected by changing the figure of the lens; and Edmé Mariotte (died 1684), who discovered the "blind spot" of the retina.

Another great result of the introduction of the microscope was a vast increase in the knowledge of living things. The source of life and the "vital principle" had been favorite subjects for speculation among the philosophers and poets of antiquity, and the generation of living from non-living matter was held to be demonstrated by many ordinary phenomena, such as the appearance of maggots in putrefying meat and of other insect larvæ in stagnant water. Aristotle even held that tadpoles and snakes were generated from the mud of the Nile. As the laws of development were more carefully studied this "generatio æquivoca" was controverted, especially, in the case of the chick, by Harvey and Fabricius. Francesco Redi (1626–1694), professor at Pisa, by a series of well-conducted experiments, showed that meat did not produce maggots when protected from flies by means of gauze. The doctrine, discarded for the higher forms of life, was, however, revived by the discoveries of the microscope. Antony van Leeuwenhoek (1632–1723), of Delft, discovered that stagnant water and infusions containing animal or vegetable matter swarmed in a few days with minute forms of life, the "infusoria." Nicolaas Hartsoeker (1656–1725), extended these researches and held that the air was filled with animalcula that settled upon plants and from them passed into infusions. This view, afterward conclusively demonstrated by Spallanzani, became known as "panspermatism" and is the forerunner of the modern "germ theory."

The eighteenth century was distinguished rather for its work in elaborating and defining what had previously been discovered than by any great advances in anatomical science. A few remarkable men appeared who advanced generalizations that were afterward to bear fruit, but they were in advance of their time and had but little influence upon their contemporaries. The microscope was still very defective and felt to be a wholly untrustworthy instrument when used with the higher powers. Speculation was rife, and in the absence of direct observation philosophers held the field. Of these should be mentioned Leibnitz (1646–1716), who shares with Newton the renown of inventing calculus. He supposed the universe to be composed of monads, minute, invisible, intelligent constituents of all bodies and beings, that in the human body are governed by a central monad, the soul; as the universe is governed by a central monad, God. He was a firm believer in the uniformity of action of natural causes and the author of the celebrated aphorism, "*Natura non facit saltum.*" Like Paracelsus, Georg Ernst Stahl (1660–1734) scorned anatomy and physiology, holding the soul, which eludes investigation, to be the supreme principle. This doctrine was termed "animism." Friedrich Hoffmann (1660–1742), professor at Halle, taught that the medulla oblongata is the chief reservoir of *æther*, an extremely volatile principle circulating through the vessels and nerves. David Hartley (1705–1757) considered the white medullary substance of the brain as an organ for the secretion of thought, and explained mental processes as caused by minute vibrations (vibratiuncles) of particles in the nerves. Cabanis (1757–1808) had a similar idea, which he expressed rather grossly, comparing the brain to the stomach, sense impressions to food, thought to excrement, etc. Théophile de Bordeu (1722–1776) considered the stomach, heart, and brain as the "tripod of life," regulating the other organs. Finally, there should be mentioned among these speculative philosophers Lorenzo Oken (1776–1851), who held that the entire organic world originated from sea slime formed of microscopically minute vesicles. This is apparently an adumbration of Bathybius and the cellular theory, but appears to be only a chance hit not derived from observation. Oken also independently worked out a theory of the vertebral character of the skull, but many of his speculations were wild and absurd.

It is in this century that we first see the influence of speculative ideas concerning the relation of the structure of man to that of other organisms—ideas which have had a powerful effect upon modern anatomical science. The collection of materials in the field of biology had become so vast that some system of classification became necessary. Steps toward this were first taken in the realm of plants by John Ray (1628–1705), who revived the Aristotelian idea of genera and species and established, as criteria for species, immutability of form and non-fertility with other species. Tournefort (1656–1708) gave a clear definition of a species as individuals having some distinct characteristic, and of a genus as a collection of species resembling each other in structure. It was, however, Karl von Linne (Linnæus, 1707–1778), of Rashult in Smaland, Sweden, professor at Upsala, who, by inventing the binomial nomenclature and applying it widely to all known species of animals and plants, finally established firmly the idea of the immutability of species. He even extended his system of classification to diseases, of which he described three hundred and twenty-five genera. His earlier view was that all the species of plants and animals were immutably created at the beginning of the world, but in his later works he appears to admit a certain amount of variation. In the classification of Linne man was placed at the head of the order Primates, comprising also apes, lemurs, and bats. The recently discovered orang was classified in the same genus with man as "Homo silvestris," and the great naturalist declares himself unable to discern any character by which the great apes can be made generically distinct from man. The race of man himself, *Homo sapiens*, he subdivided into six groups: H. ferus (savage); H. Americanus; H. Europæus; H. Asiaticus; H. asser (negroes); H. monstrosus (abnormal).

The great rival and contemporary of Linne was George Louis Leclerc de Buffon (1707–1788), director of the Jardin du Roi at Paris, and a very prolific writer in all domains of natural history. At first Buffon agreed with Linne as to the immutability of species, but in his studies of comparative anatomy he met with many difficulties, and soon admitted that many variations may arise through changes of climate, food, etc.; that the least perfected species disappear; and finally he even hinted at the possibility that all species of animals were derived from a common stock. While he by no means clearly worked out these ideas, they contain the germs of the doctrine of adaptation and the survival of the fittest, and it is evident that he realized that genera and species are merely human inventions made for convenience in classification.

In like manner we may discern in Maupertuis (1698–1759), president of the Berlin Academy, and a celebrated

mathematician and astronomer, an approach to some modern theories of heredity and variation. He held that all matter has psychic qualities, that the particles of the embryo retain and transmit impressions derived from their parents, chance combinations producing differences which accumulate and thus form new species. It was Charles Bonnet (1720–1793) who first advanced the view that animals can be arranged in a graded series with man at the head. His conception of the series was that it was necessarily linear. Erasmus Darwin (1731–1802), the grandfather of the great naturalist, anticipated some of the views that afterward made his grandson famous. He showed that the structure of animals changes because of their exertions, that many of these changes are transmitted to posterity (transmission of acquired characters), and that many anatomical features of man indicate that his primitive attitude was quadrupedal. Reasoning from such data, he maintained that all warm-blooded animals may have arisen from a single living filament which improved and transmitted its improvements to posterity.

The poet Goethe (1749–1832) was also famous for his morphological researches. Besides the remarkable contribution to botany in which he advanced the hypothesis of the metamorphosis of leaves into parts of the flower and fruit, he also suggested that the skull of vertebrates is composed of modified vertebræ. He recognized the importance and significance of vestigial structures and predicted that a premaxillary bone would be found in the human fœtus.

Widely different from these philosophers who sought to explain the complicated structure of man by the operation of natural forces, were the views of the eminent philosopher and metaphysician Emmanuel Kant (1724–1804), who held that a great gap necessarily exists between organic and inorganic matter, and that while in the latter natural causes prevail, the former is the product of preordained intention, beyond the power of man to comprehend.

Closely allied with these theories of the relation of the structure of man to that of other animals are others regarding his individual development. The imperfections of the microscope and of technical methods prevented an accurate determination of the earlier embryonic stages, and it was imagined that all details of the completed structure are prefigured in the impregnated ovum. This necessarily involved the conclusion that the successive generations of offspring must also be prefigured in the same manner. Bordeu accordingly declared that the semen of Adam must have contained the archetype of all mankind. The whole of the past and present organic life of the globe was held to have been contained in miniature in the first created beings, the successive individuals merely developing by growth from these preformed and structurally complete miniatures. This is the celebrated theory of preformation or encasement (*emboîtement*) which has profoundly interested biologists for the past one hundred and fifty years. It was to this unfolding that Bonnet applied the term *evolution*, a meaning widely different from that now in common use. The great weight of authority at first favored this view, and the celebrated Albrecht von Haller (1708–1777), professor at Berne and Göttingen, a most learned and acute observer, whose reputation was so great that he practically controlled the scientific thought of the latter half of the eighteenth century, even calculated the number of beings encased in the ovary of Eve, the mother of mankind, placing it at about 200,000,000,000.

In opposition to this is the theory of post-formation or epigenesis advanced by Hippocrates and Aristotle, according to which the human body develops from a structureless blastema by successive stages not necessarily resembling the adult individual. This view was revived by Caspar Friedrich Wolff (1735–1794), who published, in 1759, his now celebrated thesis, "Theoria Generationis," which contained an account of accurate observations showing that the organs of the body are not preformed in the fœtus, but developed from membranous sheets (the blastodermic membranes of later embryologists) which are themselves composed of globules or vesicles (cells). These ideas were not accepted by the anatomists of his day. Opposed to them was the great authority of Haller, who declared, "*Nulla est epigenesis*," and they were quite forgotten until fifty years later when Meckel called attention to them. Wolff's name remains to us in the Wolffian bodies or primordial kidneys.

It was from Haller that the doctrine of the vital and animal spirits finally received its *coup de grace*. By a series of most carefully conducted experiments he showed that there exists in living issues a property of motility independent of the nervous or vascular systems. This he termed irritability. Haller is often justly termed the father of physiology, which he himself loved to call living anatomy. His works abound in most excellent anatomical observations. He was an indefatigable worker, dissecting as many as four hundred bodies in the space of seventeen years. He classified structures according to their properties and thus paved the way for Bichat. Many structures have been at one time or another named after him. He was the first to describe the pes hippocampi.

The doctrine of spontaneous generation continued to be discussed. Antonio Maria Valsalva (1666–1723), professor at Bologna, a pupil of Malpighi and a teacher of Morgagni, finding that living forms still appeared in liquids that he had heated and then enclosed in vessels, concluded that they must have originated from the liquids themselves; but this was overthrown by the experiments of Lazzaro Spallanzani (1729–1799), professor at Reggio, Modena, and Pavia, who repeated the experiments with careful precautions and failed to produce life. It was to this observer that we owe the demonstration that the spermatozoa are the constituents of semen essential to fertilization. He showed that the fluid obtained by filtering semen has no effect, also that no exhalations from semen can cause impregnation. Thus were overthrown some of the more fanciful hypotheses of generation.

Throughout the eighteenth century we find isolated attempts at generalizing the complicated structures of the body under a few categories. Almost equally famous with Haller for his erudition was Hermann Boerhaave (1668–1738), professor at Leyden, a skilful anatomist who discovered the sudoriparous glands of the skin, and held that the elementary structures composing the body are vessels and fibres. In Andreas Bonn (1738–1818), professor at Amsterdam, we discern a decided advance. He endeavored to show that all structures can finally be reduced to membranes. Of these he made four classes: (1) the tectorial—skin, mucous membrane, etc.; (2) fibrous—fascia and aponeuroses; (3) synovial, and (4) serous.

The real founder of the science of general anatomy was, however, Marie François Xavier Bichat (1771–1802), who, by his philosophical insight and great energy in research, demonstrated the existence of the tissues of the body in a complete and definite manner. Distrusting the microscope, he made his distinctions by the chemical, physical, or vital properties of each tissue—*i.e.*, by its behavior with various reagents; by its color, density, etc.; or by its alterations in health and disease. Of these tissues or tissue systems he made twenty-one, such as the cellular, the osseous, the fibrous, the arterial, etc. As these tissues are everywhere the same, their diseases must be identical, hence this separation is a proper foundation for pathological anatomy. He considered life to be the composite effect of the separate interaction of the forces resident in these tissues. He died at the early age of thirty-one, from overwork and disease contracted in the putrid dissecting rooms of his day, having effected the greatest advance in anatomical knowledge made since the time of Vesalius.

The anatomy of diseased organs was, prior to Bichat, specially investigated by the illustrious Giovanni Battista Morgagni (1682–1771), who may be said to be the founder of pathological anatomy. He was likewise an ardent investigator in the normal field, as will appear from the large number of structures that bear his name; as the