Picturing the body : five centuries of medical images an exhibition at the Wellcome Institute for the History of Medicine / Ken Arnold.

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Picturing the body

FIVE CENTURIES OF MEDICAL IMAGES

An Exhibition
at the
Wellcome Institute for the
History of Medicine

February 1993

ACKNOWLEDGEMENTS

Exhibitions are inevitably the work of many hands. In putting on 'Picturing the Body' it has seemed like just about every member of the Institute's staff, and many others besides, have helped out. For their particular assistance I should like to thank *Alan Bird, Gerald Beasley, Tony Bish, Tim Boon, Jenni Crisp, Catherine Draycott* and her staff, *Kim Cross, Sophia Flynn, Marybeth Hamilton, Chris Lawrence, Ghislaine Lawrence, Holger Maehle, Elaine McLaren, Robin Price, Andrea Rusnock, William Schupbach, John Symons* (for his minutely attentive reading [illegible] W.I.H.M. Library Staff.

Picturing the body

Five centuries of medical images

AN EXHIBITION
AT THE
WELLCOME INSTITUTE FOR THE HISTORY OF MEDICINE

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KEN ARNOLD

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INTRODUCTION

Since the Renaissance, many different ways of representing the human form have been invented, developed and refined; some subsequently have been abandoned.

This exhibition surveys some dominant visions of the body produced during the last five centuries of Western medicine. Behind the images lie very different traditions of medical inquiry. The transitions from one set of images to another therefore also suggest ways in which the understanding of the form and function of the body has changed.

As disciplines and specializations strengthened, so traditions of representing the body became narrower in focus - from whole bodies to organs, to tissues, to cells. Only relatively recently have calls for a more holistic vision been energetically voiced again.

THE RENAISSANCE
NATURALISTIC ANATOMICAL ILLUSTRATIONS

In the Middle Ages knowledge of the body had been largely based on the descriptions of bones, vessels and organs produced by the Greek physician Galen. This book learning was sometimes supplemented by dissections of animals, usually pigs. Anatomical illustrations were not primarily used for accurate descriptions of the body, but rather as memory devices to help students recall the relationship of body parts to astrological signs, which were thought symbolically significant.

With the Renaissance came a growing conviction that knowledge of the body could best be derived from anatomical dissections of human cadavers. To this end, universities provided permanent anatomy theatres for regular lecture demonstrations. Securing bodies for the dissections, however, remained very difficult.

The most influential work in the effort to represent this new knowledge came from Andreas Vesalius (1514-1564). Even more significant than its anatomical insights, his work triumphantly incorporated the revolutionary development of naturalistic techniques of artistic representation. With printing, this style of representation gained ever wider audiences, and has remained central to Western medicine ever since.

Drawing in 15th-century Calendarium.
The carefully executed drawing of a 'Vein Man' has been done on a vellum sheet and folded to fit into a cover which is dated 1463. The work also contains the figure of an 'Astrological Man' and dates of eclipses. A vellum tag at the top of the cover would have allowed it to be suspended by a cord from a girdle. *Western MS. 40.*

Drawing in Heymandus de Veteri Busco,* Ars computistica. *1488.
The figure is of an 'Astrological Man' in which the body is surrounded by zodiacal signs which are related to their appropriate parts by a cord. The author is presumed to have been a priest from Oudenbosch in Holland. *Western MS. 349.*

Drawing in Arzneibuch, Book of medical receipts, etc. [c.1524-1550].
The figures show the veins of the head and arm. They appear in a German physician's handbook of practical medicine, with notes on medical astrology, blood-letting, uroscopy, salves and unguents. *Western MS. 93.*

Drawing in Pseudo-Galen, Anathomia. ***England, [mid-15th century].***
The image provides a general chart of various wounds. This type of figure, commonly referred to as a 'Wound Man', was sometimes used in the training of army surgeons. *Western MS. 290.*

Pen and ink drawings on paper. Attributed to circle of Bartolomeo Passarotti (1529-1592). ***Bologna.***
These drawings show the strong concern with naturalistic depiction that so characterized the Renaissance treatment of medical, as indeed many other subjects from nature. Similar compositions are known and have been attributed to Baccio Bandinelli, Michelangelo and Battista Franco.

Plate accompanying Mundinus, **Anatomia,** ***in Johannes de Ketham,*** **Fasciculus medicinae.** ***Venice, 1495.***
This dissection scene represents a pre-Vesalian anatomical lesson at Padua. While a senior student reads from Mundinus' text, and an assistant performs the dissection, the professor attempts to relate book to body.

Woodcut title-plate from Andreas Vesalius, **Sorum de humani corporis fabrica librorum epitome.** ***Basel, 1543.***
This heavily symbolic scene shows a crowded public anatomy conducted by Vesalius. The *Epitome* was first published simultaneously with the larger work *De Humani Corporis Fabrica* to be used as a more introductory work. In it, the plates were designed to be looked at in a sequence that revealed ever deeper layers of muscles eventually exposing the skeleton.

Engravings by Giulio Bonasone (c.1498-c.1574). ***Bologna.***
Bonasone worked principally in Rome. These stylized figures of his, shown stripped of their skin to illustrate the muscles, drew significantly on knowledge gained from anatomical dissections.

Plate in Juan Valverde de Hamusco, **Historia de la composicion del cuerpo humano.** ***Rome, 1556.***
Valverde's anatomical text was very popular and appeared in many editions and translations. It owed much of its success to the copper-plate illustrations which were derived from Vesalius' woodcuts.

Anatomical fugitive sheets, **Tabula foeminae membra** ***and*** **Tabula exhibens insigniora.** ***Wittenberg, 1573.***
These sheets have superimposed flaps that fold back to reveal internal organs. An accessory figure on the female sheet shows a newborn infant. Often produced in male and female pairs, these 'Adam and Eve' figures, as they are often called, became a popular instructional aid in the early 16th century, and were widely produced in France, Italy and Germany.

THE SEVENTEENTH CENTURY EXPERIMENTS AND MECHANISMS

A powerful tradition of dissection developed in sixteenth-century Italy, particularly in Padua. The anatomical work that spread and developed in the seventeenth century focused on bones, muscles and particular body organs. Its findings continued to be presented in the detailed naturalistic style developed during the Renaissance. Alongside this, other medical investigations came increasingly to be based on experiments and the measurement of body functions.

A pupil of Fabricius de Aquapendente, the English physician William Harvey (1578-1657), was one of Padua's most notable students. Supported by extensive dissections and vivisection experiments, he proposed that the heart acted like a pump and that the blood circulated.

Harvey's own investigations owed much to the works of Aristotle and Galen. The use he made of experiment and measurement was, however, pursued with equal energy by mechanical philosophers such as Descartes (1596-1650). Their radically new view of the body as brute matter with machine-like structures and functions influenced physiological research. Mechanisms also began to figure in representations of the body. And, with the use of the newly invented microscope, some inquirers actually claimed to have seen these mechanical structures on a minute scale.

Plate from Hieronymus Fabricius ab Aquapendente,* De formato foetu.*Padua, 1604.
Fabricius was Vesalius' successor in the chairs of Anatomy and Surgery in Padua. His enthusiasm for the practice of anatomy helped ensure that a permanent anatomical theatre was established in the university.

Colour plate from Gasparo Aselli,* De lactibus sive lacteis venis. *Milan, 1627.
What is remarkable about Aselli's work on the lacteal vessels is its pioneering use of colour-printed illustrations, breaking with the tradition of hand-colouring used till then.

Portrait of William Harvey by J. Houbraken, 1738, after a painting attributed to W. v. Bemmel.* *c.1657.
At the base of the figure of the great physiologist is a diagram of the heart and blood vessels - a reference to his discovery of blood circulation.

William Harvey,* Exercitatio anatomica de motu cordis et sanguinis in animalibus. *3rd edition.* *London, 1639.
These four figures are the only illustrations that appeared in Harvey's revolutionary book on the action of the heart and the circulation of the blood. Step by step, they

indicate how to do an experiment that shows how the valves in veins only allow the blood to flow in one direction.

Frontispiece to Sanctorius Sanctorius,* Medicina statica; or rules of health. *5th edition. ***London, 1737.***
The illustration shows Sanctorio's (1561-1636) metabolic balance, with which, for more than thirty years, he compared his body weight with the differences between ingested food and excreta. This was just one of the more unusual examples of how mathematics and experiments came to be used in studying the body.

Plate from 'Two epistles of Johannes Walaeus concerning the motion of the chyle and the blood...' in Thomas Bartholinus,* Bartholinus anatomy, made from the precepts of his father.** ***London, 1668.
The plate shows an experiment of Jan de Waal's, which added further evidence to support William Harvey's contention that blood passed from the arteries to the veins, and thus circulated.

Pages from René Descartes,* L'Homme... et un traité de la formation du foetus.** ***Paris, 1664.
Descartes was the most influential proponent of the mechanical philosophy. In these figures he drew a physiological analogy between sight and touch. He is known to have himself performed dissections of particular organs such as the eye, brain, lung and heart.

Orthopaedic Mannikin, from Hieronymus Fabricius ab Aquapendente,* Opera chirugica.** ***Padua, 1647.
A contrivance like this one used for correcting dislocations lent support to the notion that the human body might also perform like a machine.

Engraving after Gérard de Lairesse, from Godefridus Bidloo,* Anatomia humani corporis.** ***Amsterdam, 1685.
Along with the image of an upper arm are mechanical diagrams that show its workings. A hand-written annotation reads 'Geometriques de la disposition'.

Plate from Giovanni Alfonso Borelli,* De vi percussionis, et motionibus naturalibus a gravitate pendentibus.** ***Leyden, 1686.
In these figures, Borelli presented his attempt to analyse the action of muscles on the skeleton in terms of mechanism. His work was representative of a general attempt to solve physiological questions with mathematical and physical principles.

Plate from Marcello Malpighi,* De pulmonibus observationes anatomicae.** ***Bologna, 1661.
Malpighi's work on the lungs included microscopical observations that demonstrated the existence of the capillaries. This plate represents their earliest depiction.

THE EIGHTEENTH CENTURY
THE NATURAL HISTORY OF THE BODY

In the Renaissance, medical exploration had concentrated on large-scale anatomy. In the seventeenth century, inquirers had turned in addition to the experimental analysis of organs such as the heart. In the eighteenth century, the focus of investigative attention shifted again, this time to less immediately visible body systems. Two were particularly dominant: the nervous and the reproductive.

Both inquiries were pursued as contributions to the description and classification of the human body: its 'natural history'. In each case, the findings were recorded and published in existing representational traditions, though with progressively more elaborate and larger-scale printing techniques.

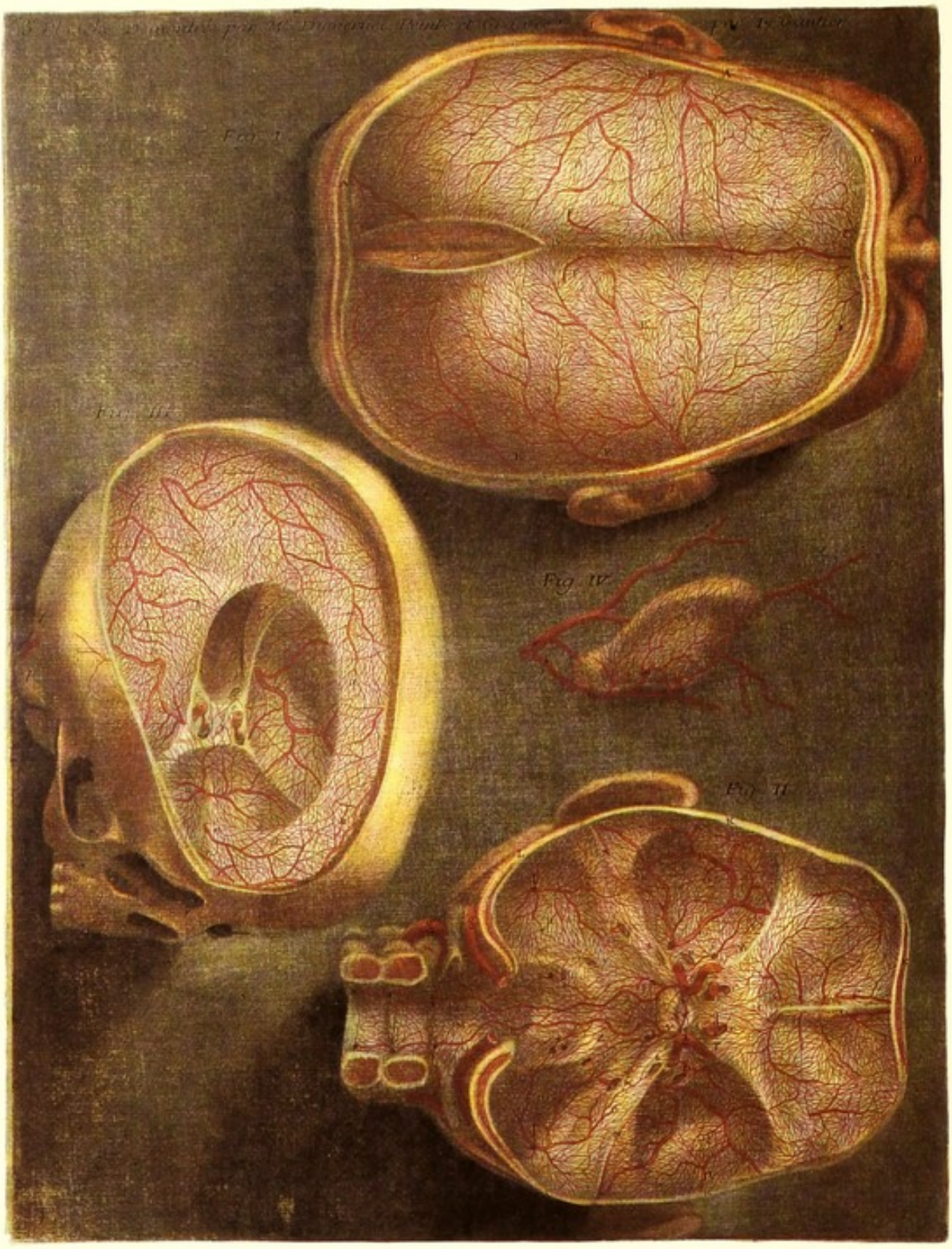
Both investigations resounded with profound philosophical implications. Tracing the fine texture of the nervous system raised the question of how the material body related to the spiritual mind. Exploring the reproductive system and the development of the foetus led to a general consideration of the nature of life itself.

Plate from Sir Charles Bell,* The anatomy of the brain explained in a series of engravings.** ***London, 1802.
A Scottish anatomist and physiologist, Bell did research in a number of areas, most significantly on the nervous system. His most influential idea was that individual nerve elements acted independently via the central system.

Plate from Alexander Monro [secundus],* Observations on the structure and functions of the nervous system.** ***Edinburgh, 1783.
After studying in Paris, Leyden and Berlin, Monro became one of the leading teachers of the Edinburgh school. In this work, his researches showed a strong inclination toward physiological concerns. In the text, he also philosophically contended that the brain acted as a medium between the mind and the body.

Plate from Félix Vicq-d'Azyr,* Traité d'anatomie et de physiologie.** ***Paris, 1786.
The early section of this volume, which was intended to be the first of a large series, was devoted to the brain. The plates, remarkable examples of the sophisticated technique of aquatinting, were much admired and often copied.

Drawings attributed to circle of Bartolomeo Passarotti. *See Section I*

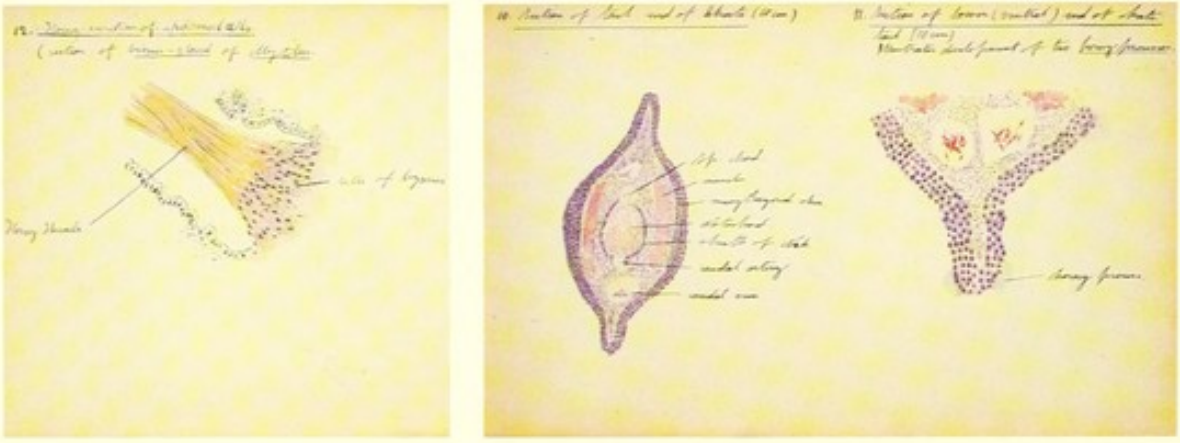


Coloured mezzotint by J.F. Gautier d'Agoty.
See Section III

Engraving from Godefridus Bidloo,
Anatomia humani corporis.
See Section II

Plate from Richard Bright,
Reports of medical cases.
See Section IV

Photograph of Lister Institute laboratory.
See Section V



Watercolour sketches from notebook of Dame Honor Bridget Fell.
See Section VI

Plate from Samuel Thomas von Soemmerring,* Abbildungen der menschlichen Organe des Geruches.** ***Frankfurt, 1809.
Soemmerring's particular concern was with the organs of sense, which he depicted especially clearly in this cross-section of the skull. He was generally interested in the anatomy of the brain and strove to represent the structure of the nervous system in scientifically exact but artistically beautiful drawings.

Coloured mezzotint made by J. F. Gautier d'Agoty, published as a plate in* Anatomie de la tête en tableaux imprimés.** ***Paris, 1748.
The image is of a dissection of the brain with a detailed record of the blood vessels. Drawn, engraved, printed and published by Gautier d'Agoty, the anatomical work was done by J.F. Duverney and Pierre Tarin. One interesting feature of his highly distinctive technique of colour mezzotinting is the use of a neutral green background.

***Engravings made by L.J.M. Daubenton for Georges Louis Leclerc, Comte de Buffon (ed.),* Histoire naturelle.**
Paris, 1749-1804, vol. 3, 'Description du cabinet du roy', (1749).
The figures, taken from wax models made by Abbé Zumbo of Syracuse, show a female foetus and a series of impressions of the head, neck and brain.

Engravings illustrating 'Anatomie' entry in D. Diderot, J. le R. d'Alembert,* Encyclopédie. *(unidentified edition).
The figures show the brain and its coronal and sagittal sections done from earlier published figures. The *Encyclopédie* helped make such images more widely known in general scientific circles.

Plate from John Burton,* An essay towards a complete new system of midwifry theoretical and practical.** ***London, 1751.
Though unsigned, the plates were drawn, etched and engraved by the artist-anatomist George Stubbs. Burton himself was educated in Cambridge and Leyden, and practised as a physician and man-midwife in York. He was satirically portrayed as 'Dr Slop' in *Tristram Shandy.*

Plate from William Smellie,* A set of anatomical tables, with explanations, and an abridgment, of the practice of midwifery.** ***London, 1754.
This plate from Smellie's obstetrical atlas shows twins *in utero* in the beginning of labour. The book's plates were, as Smellie himself pointed out, carefully produced at great expense.

NINETEENTH AND TWENTIETH CENTURIES
PATHOLOGY AND THE CONTINUING VISUAL TRADITION

The nineteenth century saw the rise of a new research tradition of pathological anatomy. Pioneered by the Frenchman Xavier Bichat (1771-1802), post-mortem investigations came to be used as a way of uncovering the anatomical causes of disease that had earlier been described and classified by their symptoms.

Physical signs of internal disease were linked to symptoms. In this way, earlier holistic notions of disease came to be challenged by a new concentration on discrete pathological changes, which were held to explain specific medical symptoms.

The records of these pathological analyses were presented within the established naturalistic illustrative tradition, which has ever since remained an essential diagnostic and educative tool. The arrival of new technologies - photography, X-rays and the more recent scanning techniques - have both widened and deepened the tradition; but as a means of conveying information, this convention has remained little changed since its development in the Renaissance.

***Plate from J.M. Bourgery and Nicolas Henri Jacob,* Traité complet de l'anatomie de l'homme comprenant la médecine opératoire... avec planches lithographiées.**
Paris, 1831-54. Volume 3.

Alongside the newer interest in pathology, large-scale publications concerning normal anatomy continued to be printed. This work with Jacob's text and Bourgery's illustrations was published in 16 volumes.

Drawing in pen and ink and watercolour by Charles Landseer (1799-1879).

This drawing was executed by the teenage Charles Landseer, when he and his brother Edwin were apprenticed to Benjamin Robert Haydon. Drawn from life, the image was done in conscious imitation of Renaissance masters such as Michelangelo and Leonardo.

Plate from Joseph Maclise,* Surgical Anatomy.** ***Philadelphia, 1851.

In this volume, Maclise published 35 lithographic anatomical plates. A strong believer in the role of anatomical illustrations as 'the best substitute for nature herself', Maclise drew from his own dissections. The figures are distinctive in their stylized poses and characterful faces.

Plate from John Bell,* Engravings explaining the anatomy of the bones, muscles and joints.** ***Edinburgh, 1794.
Instructed in art by his mother, John Bell not only drew but also etched all the engravings in this volume that accompanied his anatomical text. He also lectured extensively on midwifery, anatomy and surgery, building his own theatre in which to do so.

Plate from Jean Cruveilhier,* Anatomie pathologique du corps humain .** ***Paris, 1829-42.
Cruveilhier's book contained a vast storehouse of pathological anatomy, which, in its scale and beauty, represents one of the most lavish pathological atlases ever published.

Plate from Pierre François Olive Rayer,* Traité théorique et pratique des maladies de la peau, fondé sur de nouvelles recherches d'anatomie et de physiologie pathologiques.** ***Paris, 1826-27.
Rayer was associated first with the Hôpital Saint Antoine and then with the Charité. One of the foremost dermatologists of the first half of the nineteenth century, he worked extensively on the classification of skin diseases. Another much larger work of his concerned diseases of the kidney.

Line engraved portrait of Xavier Bichat by Wacqua, after E. Béranger. ***n.d.***
On the table behind Bichat (1771-1802) is a female cadaver covered with a cloth. For Bichat, anatomy was the science of the body's simple organic elements and structures. Since diseases arose from alterations in their vital properties, pathology was to be based on the study of the tissue structure that made up organs.

Plate from Richard Bright,* Reports of medical cases selected with a view of illustrating the symptoms and cure of diseases by a reference to morbid anatomy.** ***London, 1827. Volume I.
A champion of exact observation and description, Bright closely supervised the illustration of this book. The work contains important research on kidney disease. This plate is one of several dealing with the subject.

Pages from Henry Gray,* Anatomy, descriptive and surgical.** ***London, 1858.
Since its publication in this first edition of 1858, Gray's name has become synonymous with anatomy itself. Gray did not picture an 'ideal' or 'perfected' anatomy, nor did he emphasize anomalies and variations. His was instead a practical anatomy. The semi-diagrammatic wood-engravings were anatomically accurate without trying to represent what was actually seen in the dissecting room.

Clinical drawing and photograph by L. Haase of Berlin, 1850s - 1860s.
Most of the images in Haase's collection show patients with orthopaedic problems. The mixture of drawings and photographs may indicate a shift from the former to the latter. In the 1850s a number of physicians heralded the potential of photography to fix objective medical records; while some also expected this new technique for visualizing pathology to be accompanied by advances in medical understanding.

Photographs relating to early X-rays.

a) Print taken from 'Neg taken by Mr Sidney Rowland in 1896 '.
One of the earliest X-rays taken in Britain. Rowland (d.1917) was later on the staff of the Lister Institute.

b) Early photograph of man holding cathode-ray tube.

c) Early photograph of man wearing protective suit.

d) Early print of negative taken of two hands with broken and malformed digits.

After the announcement of Roentgen's experiments in 1894, many physicians were excited by the possibilities offered by X-rays. Seen as a transcendent instrument of visualization, X-rays challenged the use of touch, especially in diagnosing fractures and the nature of material lodged in tissue. By 1900 they were also being used in malpractice suits against surgeons.

Pages from Frank Henry Netter,* The Ciba Collection of Medical Illustrations. *Volume 4, 'A compilation of paintings on the anatomy and pathology of the endocrine system and selected metabolic diseases'. New York, 1965.
Netter's paintings that fill this multi-volume work form a composite of pathological and anatomical subjects. They are characterized by a high density of information, many incorporating microscopical images, highly schematized diagrams, quantitative charts and graphs.

NINETEENTH AND TWENTIETH CENTURIES

LABORATORY SCIENCE AND THE GRAPHIC TRADITION

Nineteenth-century Germany and France saw the rise of laboratory-based medical science. Experiments in organic chemistry and physiology allowed a variety of the body's activities to be systematically measured.

Justus Liebig (1803-1873) and others chemically analysed blood sugars, digestive juices and fats, research which in turn opened the way for further work on nutrition and immunology. A similar quantitative and experimental approach was championed in physiology by the likes of Carl Ludwig (1816-1895). An enormously important element of these latter inquiries was the development of nearly all the basic laboratory instruments of modern physiology.

The emblematic instrument in this trend was Ludwig's kymograph. What it enabled was the automatic translation of bodily functions into quantitative records, a process that symbolized a radically new, non-naturalistic representation of the body that perfectly fitted the new methods of laboratory medicine. The graphic tradition it unleashed has continued ever since, throwing up a dizzying variety of information content and types of presentation.

Charles Bonnet's book of notes taken during Claude Bernard's lecture series 'Cours de physiologie'. ***Paris, 1849-50.***

MS1303-1315 no.6.

Bernard's reputation as a teacher attracted large numbers of students to Paris. His teaching style was characterized by the performance of inspiring demonstrations. His approach to research was practical and required relatively few instruments. These lectures that Bonnet attended were given at a period when Bernard was at his most productive.

Claude Bernard, **Introduction a l'étude de la médecine expérimental.** ***Paris, 1865.***

Bernard was a highly influential physiological researcher and teacher. In his opinion the laboratory was the 'temple of medical science'. In this work he discussed methodological questions about the practice and value of physiological observations and experiments.

Pages from Carl Ludwig, **Lehrbuch der Physiologie des Menschen.**
Heidelberg, 1852-56.

In this work Ludwig set out his pioneering approach to physiology, which was based on precise, quantitative researches into isolated phenomena. Amongst other instruments, he invented the kymograph for recording variations in fluid pressure. From 1869 he also directed a physiological institute founded on his principles.

Plate in Justus von Liebig, **Chemische Briefe.** ***Hamburg, 1913.***

First published in 1844, this work of Liebig's was a popularization of his discoveries that went through many editions. The thrust of his life's work was the application of chemical ideas and methods to the understanding of various life processes. At Giessen, where he was Professor of Chemistry for 28 years from 1824, he erected the basic workshop of his enterprise - a chemical laboratory.

Photographs of laboratory. ***c. 1900.***

These particularly fine photographs are possibly of the Wellcome Chemical Research Laboratories in King Street, London. Housed initially at 42 Snow Hill, the Wellcome Laboratories moved to King Street in 1899.

Photographs of laboratories in the Lister Institute of Preventive Medicine.
[late nineteenth and early twentieth century].

Founded in 1891, the Lister Institute was for 20 years or more the most important medical research institution in the UK. Work there significantly contributed to many fields including bacteriology, immunology, biochemistry and medical statistics. It was also a pioneer in the development of many vaccines and sera.

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Pages from Augustus D. Waller, 'Introductory address on the electromotive properties of the human heart,' **British Medical Journal,** ***2:751, 1888.***

This is one of the very early papers on the subject of electrocardiography. In it Waller described his experiments to produce transcriptions of the heart's electrical impulses using Gabriel Lippmann's electrometer. This new representation of the behaviour of the heart reflected the growing medical appetite for precisely expressed evidence in the form of graphs.

Leo Schamroth, **An introduction to electrocardiography.** ***Johannesburg, 1957.***

The electrocardiograph, a machine that graphically tracks and records the electrical behaviour of the heart, was developed at the end of the nineteenth century. Initially only found in large hospitals and research laboratories, during the twentieth century it has become more and more widely used. Leo Schamroth's book attempted to be a clear and concise introduction to a subject often given to bewilderingly complicated forms of presentation.

NINETEENTH AND TWENTIETH CENTURIES
THE CELL AND THE BIOLOGICAL BODY

The development of the notion of the cell as the fundamental living unit of the body, and indeed of the living world, in the 1830s and 1840s led to profound changes in the concept of the nature of the body.

In the 1870s and 1880s Louis Pasteur's and Robert Koch's researches into the microbiological causes of disease extended the study of cells into a theory of germs, and thus founded the science of bacteriology. Diseases were re-interpreted as the abnormal behaviour and structure of cells.

The study of cells captured both the descriptive approach of anatomy and the explanatory approach of physiology. Cells were portrayed naturalistically through the use of ever more sophisticated microscopic observation, while their functions were depicted in graphs.

Today, cell theory dominates biomedical thought and research. The rise of cell and molecular biology, and the discovery and investigation of DNA, have further dissolved the body into yet finer parts. However, the more that is learned of cell functions, the more bodily systems are shown to be interdependent. While different disciplines have fragmented the study and representation of the body, many researchers now argue for a return to a more holistic vision.

Plate from Louis Pasteur,* Oeuvre de Pasteur.** ***Paris, 1922-39.
Tome III , 'Etudes sur le vinaigre et sur le vin'. (Originally published 1866 and 1868.)
Pasteur's discoveries fundamentally linked illness to the activity of micro-organisms. From studying various 'diseases' of French agricultural products, such as this work on the fermentation of wine and vinegar, he was able to argue that they never occurred in the absence of micro-organisms. Rather than being generated spontaneously by a chemical process, these organisms, said Pasteur, arrived from external environments.

Table from Robert Koch,* Gesammelte Werke.** ***Leipzig, 1912.
'Die Aetiologie der Tuberkulose'. (Originally published 1882.)
At the time that Koch worked on it, tuberculosis was the predominant endemic disease in Europe. His pioneering bacteriological work enabled him in 1882 to announce his discovery of 'the parasitic nature of a human infective disease', reinforcing the idea that micro-organisms were the starting-point of diseases. He was also responsible for developing a number of crucial procedures in the study of bacteria and disease, most notably techniques for staining and cultivating organisms and the use of photographs in microscopic observations.

Rudolf Virchow,* Die Cellularpathologie.** ***Berlin, 1858.

This ground-breaking work in the history of pathology systematized a body of facts into a theory of health and disease based on the cell. The basis of disease, argued Virchow, was the disruption of cellular functions. The book became a foundational text for microscopists, whose instrument was an essential tool in the study of this ultimate unit of living beings.

Plates from Arthur Hill Hassall,* The microscopic anatomy of the human body, in health and disease.** ***London, [1849].

In Hassall's own words, this is the 'first complete book' on the subject in the English language. In upwards of 400 illustrations, it attempted systematically to examine with a microscope 'all the fluids, tissues and organs of the body'. Work on the book involved many visits to autopsies at St George's Hospital. The microscope illustrations were drawn from Hassall's own preparations by Henry Miller, who he had personally trained.

Plate from Sir Edward Sharpey-Schafer,* Schafer's essentials of histology. *16th edition. ***London, 1954.***

It was under the influence of William Sharpey, the teacher whose name he later added to his own, that Edward Schafer took up the study of histology. Schafer's considerable number of investigative contributions included work on internal secretions, later called hormones, and the discovery of adrenaline.

Pages from Sir Edward Sharpey-Schafer,* A course of practical histology.** ***London, 1877.

Sharpey-Schafer helped to promote physiology in England at a time when the science was far more energetically pursued in France and Germany. The figure from this book for students shows the operation of a simple warming apparatus, by which the blood of warm-blooded animals and humans could be kept near body temperature while under microscopical observation.

Pages from Dame Honor Bridget Fell, 'Notebooks and drawings'.

a) 'Embryology and Cytology Drawings'

b) 'Embryology of Organs'

From 1929 to 1970 Honor Fell was Director of Strangeways Research Laboratory. Much of the research pursued there was devoted to cell biology. Fell herself made a very significant contribution to the development and application of organ culture techniques, in particular to the study of cells in bone, cartilage and associated tissue.

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