

# Think Microscopically

the modern life of Rudolph Virchow, part 1



**Zeiss IVa continental model  
microscope, about 1897  
Carl Zeiss, Jena. No. 28495**

**Virchow used similar  
microscopes**

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## the modern life of Rudolph Virchow

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Article finishes next month in Micscape with:

**part 2 Reformist Politician, Influencer**

**part 3 Virchow's Mistakes, Conclusions**

### Abstract

**Rudolph Virchow was the first fully modern doctor.**

**Virchow** was “the **father of pathology**” and one of the most important and remarkable physicians in all of history. Born in eastern Prussia in 1821, he went to medical school in Berlin and went on to bring medicine into the scientific era, largely via a microscopic view of human anatomy. He made medicine modern.



Virchow’s medical discoveries were almost endless, as he was one of the first to replace millennia of theories about imbalances of imaginary body fluids with a new, scientific view of bodies being made of cells, and their malfunction causing disease. His 1855 axiom “every cell arises from another cell” seeded a scientific revolution. Virchow started a medical journal, wrote textbooks and taught doctors from around the world. Among his discoveries: leukemia (blood cancer), chordoma (a spinal tumor), thrombosis and embolism (blood clots), myelin (sheath around some nerves), amyloid (an abnormal protein causing disease), chromatin (the stuff that makes chromosomes), cells inside bone, zoonoses (diseases acquired from animals), Virchow’s node (swelling above collarbone from spread of stomach cancer), how to do a proper autopsy, the lifecycle of the parasitic worm *Trichinella*, microscopic meat inspection, and numerous human skull details and diseases.

Virchow adopted the microscope from his teacher Mueller. He told his students to “think microscopically” and taught cellular pathology to a stream of visiting professors from around the world, spreading the modern way of medical thinking still used today. But Virchow was much more than a doctor and medical professor. He travelled to a typhus outbreak and investigated tuberculosis, deeming them “social diseases” because they killed the poor much more often than the rich. Advocating sewers and clean water for Berlin, he was the **father of public health**. He was the German **father of anthropology**, and dug for artifacts in Germany, Troy and Egypt. He prescribed democracy and education to improve the health of the masses and became a **reformist politician**. He claimed “politics is medicine on a grand scale”, opposing racism and high military spending. Virchow died in 1902, age 80.

Virchow wasn’t perfect. He argued against the germ theory of disease and against the theory of evolution, deeply mistaken both times. At least Virchow’s heart was in the right place. Many proponents of evolution, including his own student Ernst Haeckel, used evolution to argue for eugenics, stating undesirable peoples should be sterilized or killed. Half a century later, that pseudoscientific evil led Germany into profound catastrophe.

## Part 1: Multitalented Scientist

Born in Prussia and spending most of his career in Berlin, Professor Rudolph Virchow made numerous medical discoveries in the last half of the 19<sup>th</sup> century and introduced many bold new ideas in medicine, anthropology and politics. Virchow championed microscopes in medical care and research. He was the most important doctor of the age when medicine first became a modern science and everyday life itself became modern.



Young Virchow from CDC, older from Wikipedia, exact dates and sources unknown

Virchow wrote his parents asking for money to purchase the latest “fantasy style” clothes while a medical student in Berlin. These two photos suggest his fashion style changed little over time.

### Background and Early Career

Born in the small town of Schievelbein, in eastern Prussia (a German state, although Schievelbein is part of Poland today) Rudolf Ludwig Carl Virchow (born 13 October 1821, died 5 September 1902) rose from a middle class background to become a preeminent medical professor who helped start multiple new fields of science.

The bright only child of a farmer and town treasurer, Rudolph learned 7 languages and studied to be a pastor. He earned a Divinity Degree in 1839 with a thesis titled *A Life Full of Work and Toil is not a Burden but a Benediction*. Virchow never became a pastor, but true to his thesis he became a lifelong workaholic. Virchow said he didn't have a voice for preaching (and he was agnostic, later writing of the limits of what science knows). Virchow then accepted a scholarship to train as a military surgeon suggested by his uncle, a high ranking officer, and went to Berlin in 1840. Virchow was introduced to the microscope by professors Johannes Peter Müller and Robert Froriep. By late 1843 Virchow had defended his doctoral thesis on corneal (eye) manifestations of rheumatic disease and was a doctor. He soon went to Charité Hospital as an intern for further training. Virchow published his first scientific paper (written in Latin) in 1845, containing the first clear description of the disease he found by careful autopsy and microscopic examinations of a deceased 50 year old woman. He named the disease “leukemia” (now known to be a white blood cell cancer). Virchow started his own medical journal in 1847 which is still published today as *Virchows Archiv*. Creating the *Archiv* was in part a reaction to some practical articles he wrote being rejected by other medical journals. He and his co-founder Benno Reinhardt wrote that their journal would publish works based on observation and experiment, rather than unprovable abstract ideas. Virchow went on to write over 2000 scientific articles during his long career.





Virchow was born in a small town in the northeastern hinterlands of Prussia. He spent most of his life in the city of Berlin, at the heart of the German empire and at that time the center of worldwide science. Map Britanicca.com

## Medical Career

At the age of 27 Rudolph Virchow, then assistant prosector and junior lecturer at the Charité Hospital in Berlin, was sent by the Prussian national government to investigate a typhus epidemic ravaging Upper Silesia in 1847 and 1848. Virchow documented an appalling toll: "a devastating epidemic and a terrible famine simultaneously ravaged a poor, ignorant and apathetic population. In a single year 10% of the population died in the Pless district, 6.48% of starvation combined with the epidemic, and, according to official figures, 1.3% solely of starvation". At that time it was unknown that typhus is a group of 3 related infectious diseases (epidemic, scrub and murine varieties, caused by 3 different *Rickettsia* intracellular bacteria species). Virchow quickly saw the epidemic in social terms, which continues to be of underappreciated importance in describing disease patterns today. With the bold idealism of youth and maybe some practical wisdom, Virchow famously proclaimed in his report: "Medicine is a social science and politics is nothing else but medicine on a large scale. Medicine as a social science, as the science of human beings, has the obligation to point out problems and to attempt their theoretical solution; the politician, the practical anthropologist, must find the means for their

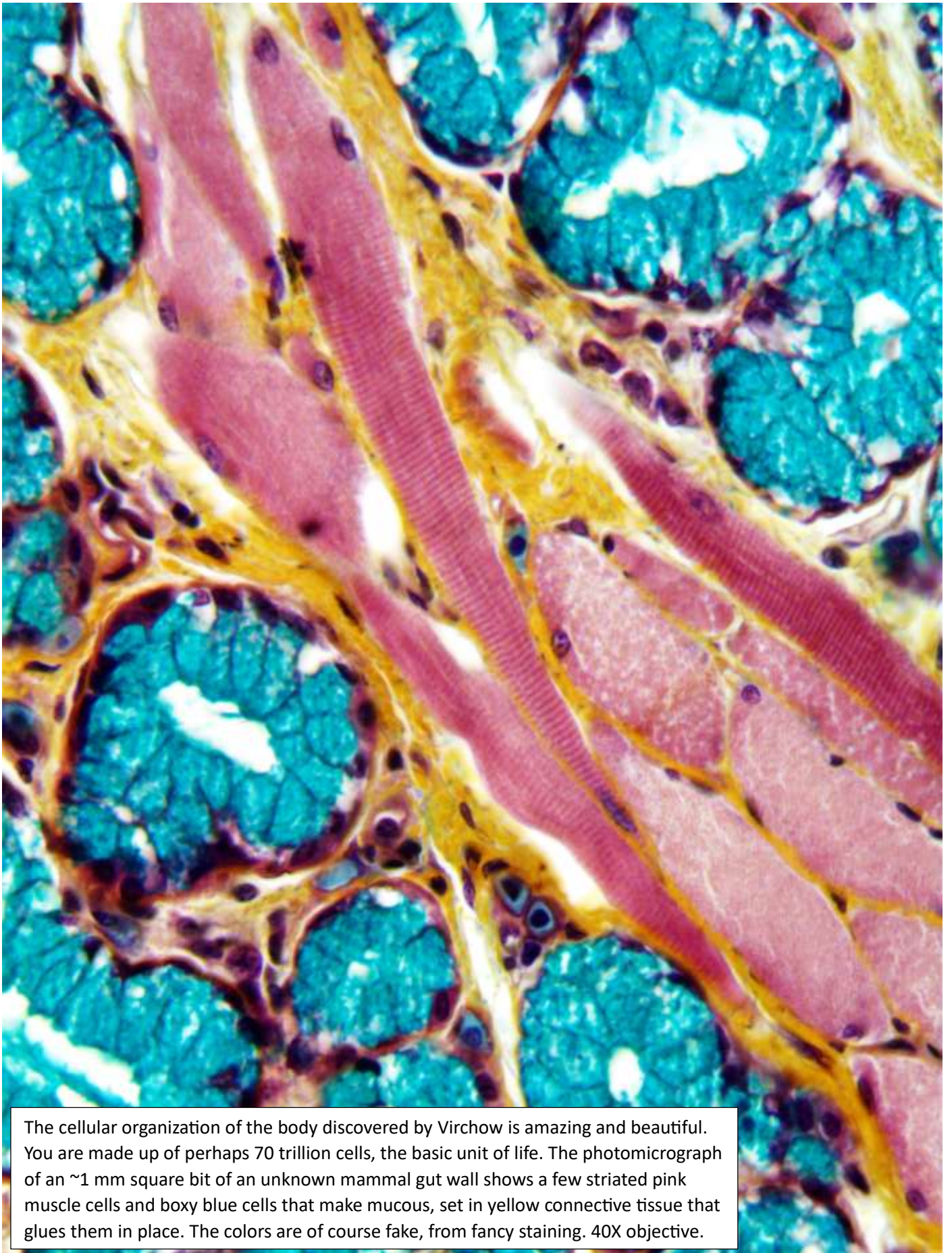
actual solution.” It’s doubtful Virchow’s 3 week visit and 133 page analysis had any good effect on the typhus epidemic, but Virchow says (and demonstrated repeatedly) that the brief investigation forever changed the way he thought about disease, and his report is the beginning of the whole field of Social Medicine.



Rudolph Virchow, date unknown from Wikipedia

One week after returning to Berlin in 1848, a democratic revolution broke out. Virchow participated by starting a liberal newspaper with the mottoes "medicine is a social science" and "the physician is the natural attorney of the poor". The revolution was unsuccessful in changing the government (although some of the liberal ideas persisted in 19<sup>th</sup> Century Germany thereafter), and Virchow lost his government paid job at Charité. He then accepted a professorship to become the first Chairman of Pathology at the University of Würzburg from 1848 to 1856. While there he worked on the science of thrombosis and cell theory. He also published his groundbreaking 6 volume *Handbook of Special Pathology and Therapeutics* while at Würzburg. Virchow married his wife, Rose, in 1850 in Berlin and they eventually had 6 children. He returned to Berlin in 1856, accepting the new Chair for Pathological Anatomy and Physiology at the Friedrich-Wilhelms-University, and was Director of a new Institute for Pathology at Charité Hospital. Virchow lived and worked as a professor, doctor, scientist and politician for the rest of his life in Berlin, the then epicenter of world science. After establishing his reputation, physician students came to Virchow from around the world to learn new science.





The cellular organization of the body discovered by Virchow is amazing and beautiful. You are made up of perhaps 70 trillion cells, the basic unit of life. The photomicrograph of an ~1 mm square bit of an unknown mammal gut wall shows a few striated pink muscle cells and boxy blue cells that make mucous, set in yellow connective tissue that glues them in place. The colors are of course fake, from fancy staining. 40X objective.

## **Father of Cellular Pathology, Medical Microscopy Advocate**

Virchow is “the Father of Modern Pathology”, which is the medical specialty dealing with the causes and diagnosis of diseases. Virchow used microscopic observations down to the level of cells to bring medical diagnosis into the modern era. Up until his time doctors often attributed disease to an imbalance in 4 purported liquid humors (blood, yellow bile, black bile, and phlegm) postulated by Hippocrates about 400 BCE. Virchow openly rejected the humors, although he did wrongly cling to the miasma theory (from Rome about 100 BCE) that bad air from rotting matter caused some infectious diseases. Virchow stated that all disease came from dysfunction of the cells which make up our bodies, which in the case of some contagions he thought was caused by bad air causing cellular damage. He often told his students to “think microscopically”.

The microscope had been around for about 250 years when Virchow went to medical school, but its use in medicine was rather new. Dutch spectacle maker Zacharias Janssen invented a compound microscope (2 lenses working together in a cardboard tube) around 1600, just before Galileo invented a similar telescope. Antonie van Leeuwenhoek used tiny single lens microscopes to discover microorganisms around 1670 (but took his lens making secrets to his grave). Microscope lenses were plagued by so much distortion of shape and color that scientists didn’t much trust what they saw in them at medium or high powers. Then about 1825 Joseph Jackson Lister (father of Joseph Lister, who later invented sterile surgery technique) invented combinations of lenses that cancelled spherical and chromatic aberrations. The 19<sup>th</sup> century was a time of fast scientific and mechanical progress, and by the time Virchow was introduced to the microscope by his medical professor Johannes Müller about 1842, the microscope had become a useful cutting edge scientific instrument. Virchow’s first microscope would have been mostly handcrafted by a small maker, but Germany was soon making improved microscopes in factories. Carl Zeiss started in Jena, Germany in 1846 and hired Ernst Abbe who by 1874 found the theoretical resolution limit of the light microscope. A few years later, some microscopes were built to that limit, showing details equal to modern standard light microscopes.

### **German microscopes**

Germans did not invent the microscope, but they perfected factory made microscopes. The first microscope may have been made by Dutch optician Zacharias Janssen, who put 2 lenses in cardboard about 1600. English scientist Robert Hooke’s simple microscope used lenses in a wooden tube in the 1660’s, and by 1800 similar simple compound microscopes with cardboard or fruitwood tubes were being made in toy factories in Nuremberg, Germany. But the work of Lister in England on lens aberrations would soon allow microscopes to become proper scientific instruments.

Virchow was educated at the time and place microscopes became modern. Carl Zeiss started his factory in 1846. Many other late 19<sup>th</sup> century German firms made microscopes including Hensoldt and Seibert in Wetzlar, and Steindorff in Berlin. Zeiss and Ernst Abbe (along with glass chemist Otto Schott) perhaps made the best microscopes of the late 19th century. Ernst Leitz started his microscope company in 1849 in Wetzlar, with mathematician Carl Kellner. Leitz’ son in law Carl Reichert founded his own microscope company in Vienna, Austria in 1876. Zeiss is owned by a Foundation set up by Abbe and makes fantastic microscopes in Jena to this day. Leitz, Wild (in Switzerland) and Reichert-Jung along with Cambridge Instruments and others merged together to become Leica in the 1990’s, and that world class company is still headquartered in Wetzlar.

The electron microscope was also a German invention, by physicists Knoll and Ruska in 1931. Additionally, German opticians Bausch and Lomb immigrated and started one of the big 2 American microscope manufacturers.



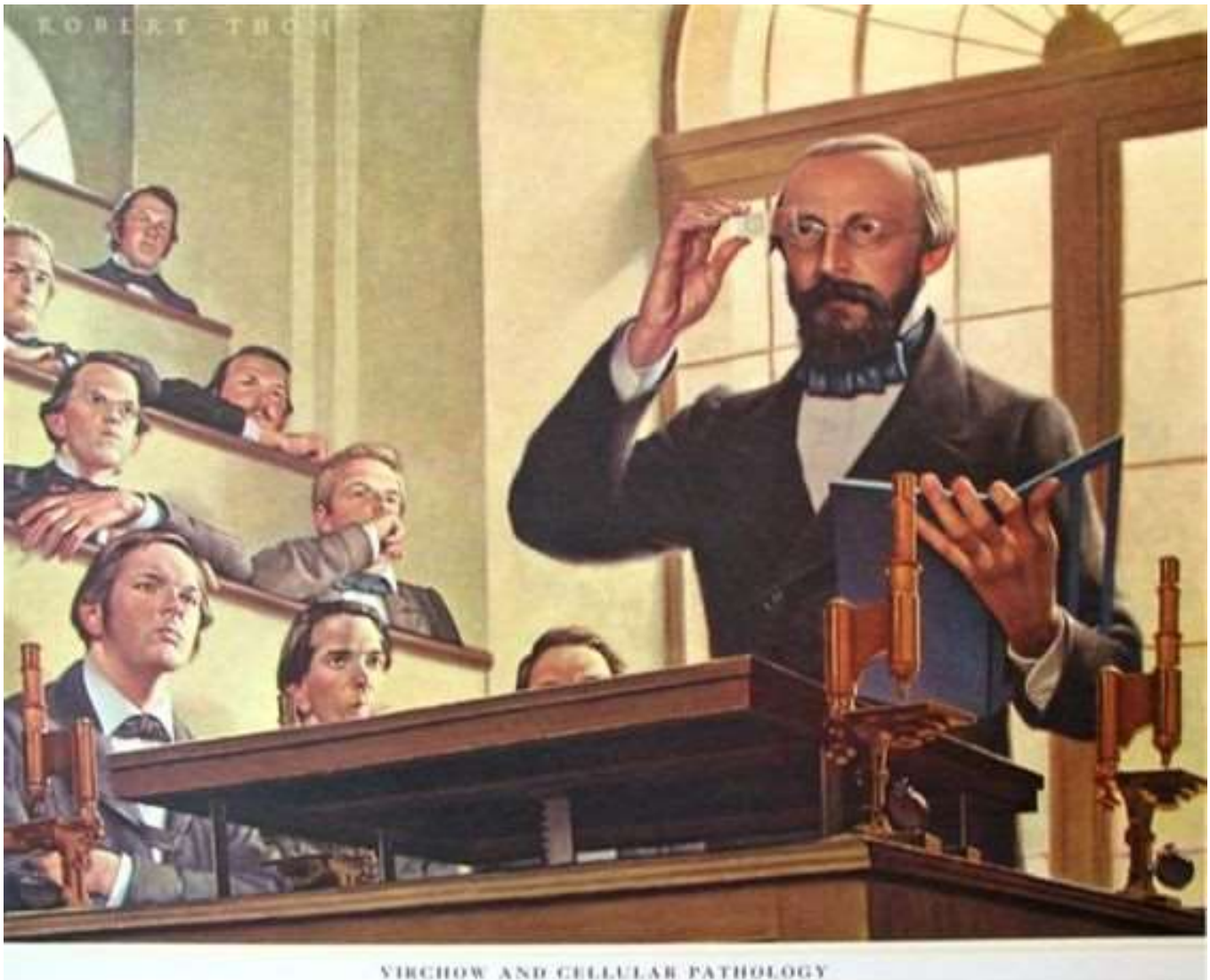


Illustration of Virchow with microscopes and slide, from [aspergillus.org.uk](http://aspergillus.org.uk)  
We know from photos and paintings Virchow did teach in amphitheater style classrooms.

Virchow went to medical school at an especially propitious time. Not only were microscopes getting better, “cell theory” was in the air. Englishman Robert Hooke had first discovered and named “cells” in a slice of cork with his low power microscope, in his book *Micrographia* in 1665. Using modern microscopes and building on recent discoveries that cells have a nucleus and protoplasm, German physiologist Theodor Schwann and botanist Matthias Jakob Schleiden proposed the Cell Theory in 1839. Their two laws were: 1. All plants and animals are composed of one or more cells, and 2. The cell is the fundamental unit of living things. Virchow rejected the old spontaneous generation belief that living cells formed naturally in nonliving rotting material, contributing the third law of Cell Theory in 1855: 3. Every cell arises from another cell (“*omne vivum ex ovo*” in Latin). Cell theory is now widely accepted as an obvious fact. But in Virchow’s day the importance of cells was newly recognized, and his new field of pathology was usually called “Cellular Pathology” to be specific. Today pathology includes some other diagnostic methods, and cellular pathology may be called histopathology.

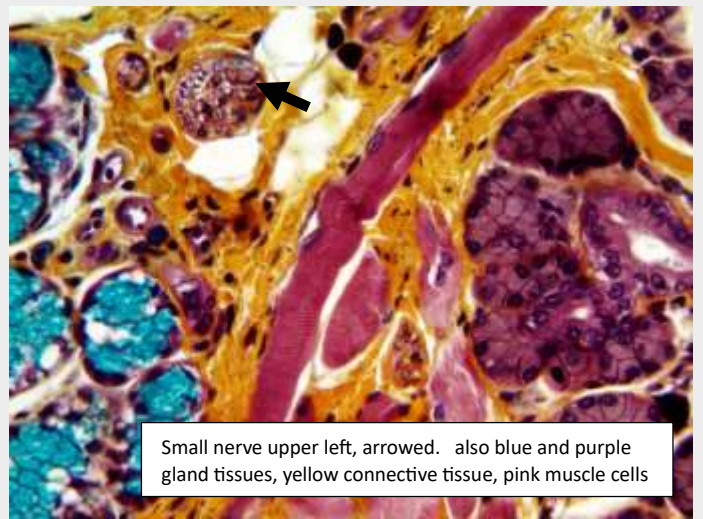
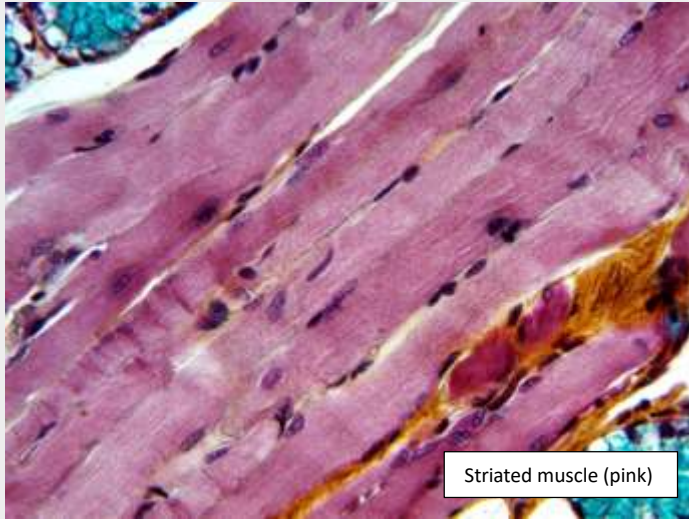
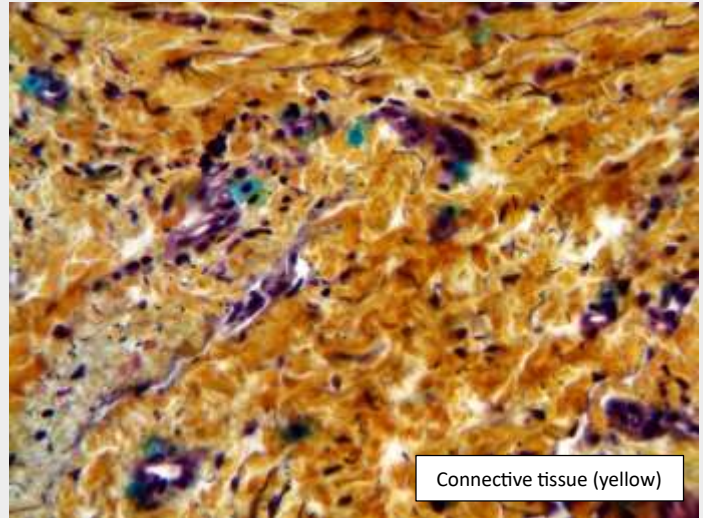
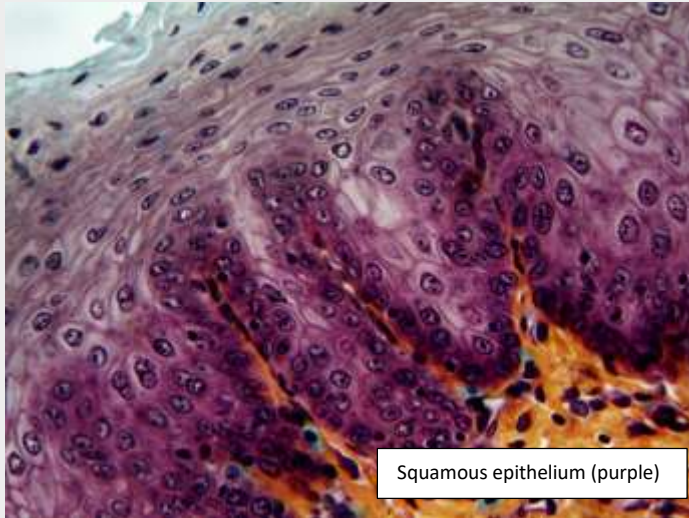


## What is histopathology?

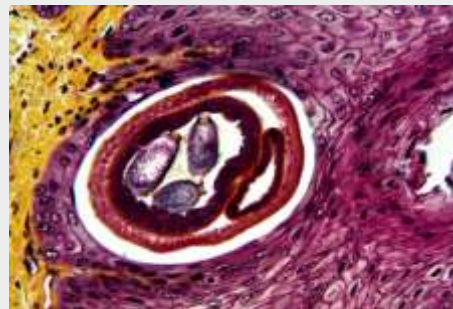
Pathology is the study of disease. "Gross" anatomy (big, what can be seen without magnification) by dissection was known before Virchow and today pathology also includes the medical lab with its myriad blood tests (the realm of molecules, ultra-small). Virchow's histopathology, the microscopic study of disease in tissue slices, links the two realms by examining cells, the building blocks of all life, under the microscope. This requires biopsy or autopsy to get a specimen, multiple treatments with chemicals to preserve and stiffen the tissue, cutting of about 10 micron (1/100 mm) slices, and various kinds of staining. The laborious highly technical process was first invented in Virchow's day.

The body is complex with many kinds of cells, which are grouped into 4 fundamental tissue types for simplicity:

1. epithelial- simple, stratified, glandular
  2. connective- general, bone, blood
  3. muscle- smooth, striated, cardiac
  4. nervous- neurons, glia
- If something not present in healthy tissues is seen, such as dying cells (necrosis), extra white blood cells (inflammation), pathogens (infection) or abnormal growths (cancer) then disease is inferred.



The example 4 basic tissue types come from a mystery slide, unknown mammal gut, beautiful stain. At first I thought it was "just" a nice histology slide, but the finding of an embedded parasitic worm (right) turned it to histopathology. Unless noted otherwise photomicrographs are by me, most with an AO Reichert 420 microscope and cheap USB camera. These 5 shots used a 40X objective and each uncropped photo shows a span about 0.3 mm (300 microns) across.



Virchow was further convinced that all healthy and unhealthy processes inside our bodies could be explained by what happened at the level of cells. He realized an illness was often just present in some cells in a body, not all. He believed that observations, often with a microscope, and experiments, often with animals and sometimes with chemicals (*in vivo* and *in vitro*), could help uncover the workings of the human body. Virchow was one of the first doctors to encourage medical students to use microscopes. He encouraged his students to “learn to see microscopically”, thinking of the body as a collection of cells. Virchow’s first job was assistant to the prosector, Robert Froriep, at Charité Hospital. Virchow was doing dissections of bodies to show human anatomy to the medical students. But his curiosity turned it into a search for disease in the bodies. Virchow would later become the first to do what we would recognize as a comprehensive autopsy to determine the cause of death. Virchow’s *Cellular Pathology* collection of lectures published in 1858 is regarded as the basis of all of modern medical science, and one 21<sup>st</sup> century medical author calls it the “greatest advance which scientific medicine had made since its beginning”. That sounds like hyperbole but it may be true. From a modern biomedical understanding, all the centuries of medical thinking about disease and health before Virchow’s time, of humoral balance and miasmas, was total bullshit. Virchow and his contemporaries began the modern scientific age of medicine, and Virchow was in the lead.

### **Most doctors used microscopes in the past, but no longer**

It took a while for “think microscopically” to make it to the US. Virchow taught cellular pathology to two of the founders of Johns Hopkins, which became the most scientific US medical school. In 1910 educator Abraham Flexnor wrote a scathing condemnation of US med schools, recommending they be shut down or reorganize to teach scientific principles along the lines of Johns Hopkins. Eventually they did. From about 1930 to the 1960’s most US medical students purchased a microscope, learned animal then human dissections, fixation of tissues, making slices with a microtome, staining and mounting the slices on slides for microscopic observations, sometimes documented by hand drawings. In the mid 20<sup>th</sup> century most doctors continued to use microscopes in their office practice for simple examinations of urine and sometimes of blood. Hence, decades ago many medical student microscope slide collections came up at estate sales or on eBay, but that is becoming rarer today. I purchased a number of these vintage doctor’s slides sets from their college and medical school histopathology training, and can tell you the young doctors varied widely in their histology skills, from awful to great. By the time I went to med school in the late 1980’s it was a different era. In pathology class we briefly looked at slides under a microscope, but we mostly looked at tissue photomicrographs taken through a microscope. In the hospital we sometimes did Gram stains, looking under the microscope for bacteria in body fluids, and at occasional Wright stained smears to examine blood cells. Some student doctors were better at this than others. I thought it was interesting, but my microscope skills were only average. We also did some other simple bedside lab tests like hematocrit, KOH testing for skin fungus, and microscopic urinalysis. Some of my peers were less interested in microscopy work than I, and it became known that practicing doctors in their offices were often doing lab testing with far less accuracy than real clinical laboratories. The Clinical Laboratory Improvement Amendments of 1988 subjected doctors to cumbersome government registration and regulations as a laboratory if they did even a single office-based test. 1988 was the end for most of the few regular doctors still using a microscope in the office. Now clinical microscopes are used daily only by lab techs and pathologists.





A small, simple mid 19<sup>th</sup> Century German microscope from Berliner Medizinhistorisches Museum der Charité

Virchow started the Medical History Museum at Charity Hospital in Berlin in 1899 as "The Pathological Museum", and filled it with 23,066 specimens by the end of 1901. The museum had about 35,00 irreplaceable pathologic-anatomical specimens, most in jars, by 1940.

This could not be a microscope Virchow actually used, as the museum was destroyed by Allied bombing during World War II and reopened in 1998 with new materials.



Great image of top end Zeiss microscope shown on title page is from [antique-microscopes.com](http://antique-microscopes.com)

A late 19<sup>th</sup> Century professional Leitz microscope About 1890. Signed: E. Leitz Wetzlar no 17327.

This is a "continental style" microscope, with a heavy horseshoe shape base, focusable Abbe substage condenser, and fine focus by turning the micrometer knob on the posterior limb.

Virchow may have used a microscope similar to this, or the cover photo scope, late in his career.

This microscope is in a collection at Moody Library, University of Texas Medical Branch Galveston



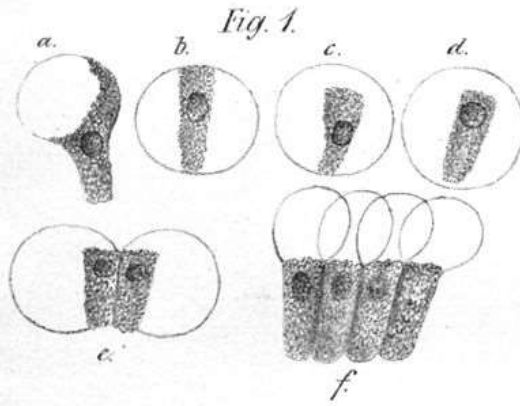


Fig. 2.

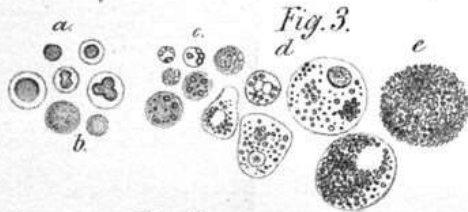
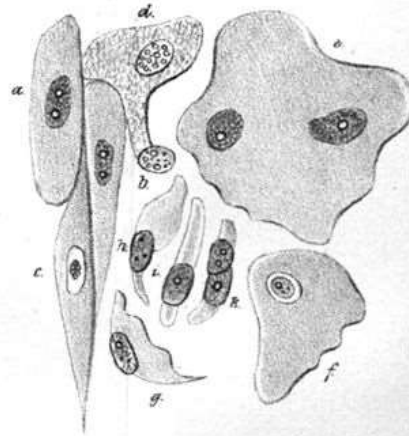


Fig. 4.

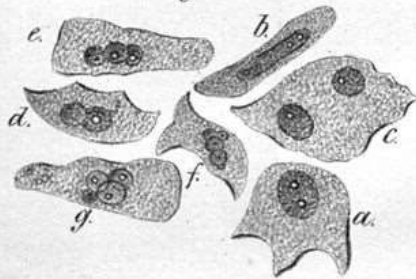


Fig. 5.

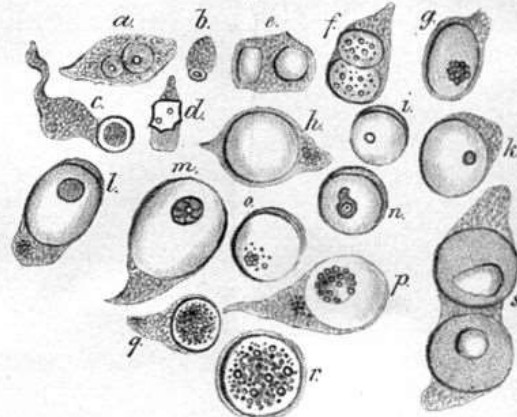


Fig. 6.

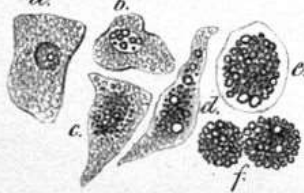


Fig. 7.



Fig. 8.

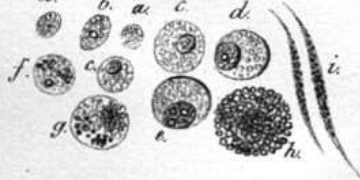
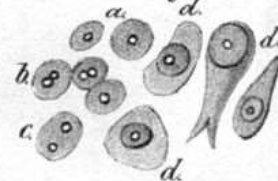


Fig. 9.



R. Virchow ad nat. del.

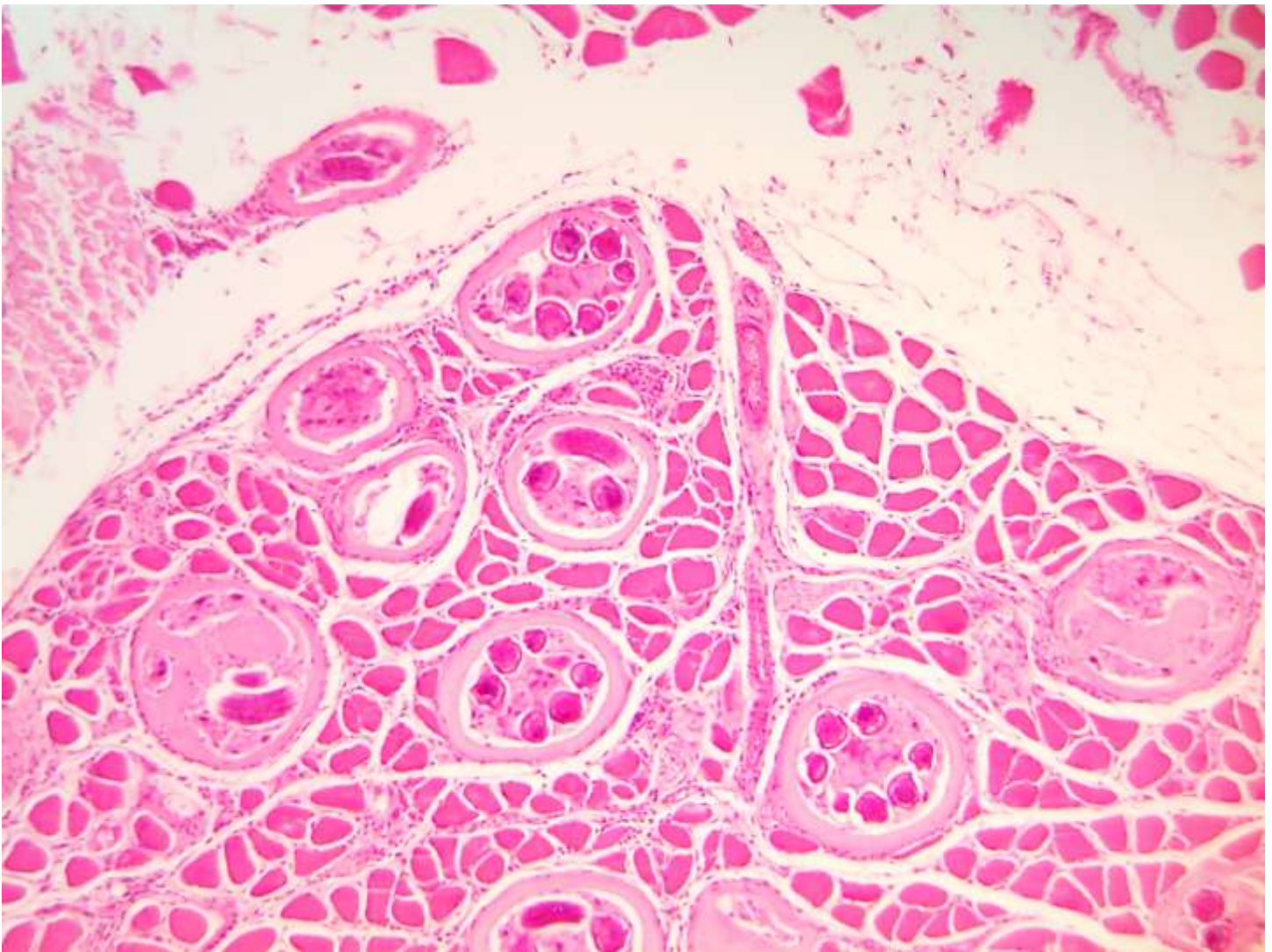
Rudolph Virchow, cell illustrations, sketched from his microscope for Archiv für Pathologische Anatomie und Physiologie (now known as "Virchow's Archives"), 1847, first issue, image from Wikipedia

Virchow had become an expert in human anatomy down to the level of cells. Trillions of tiny cells (each about 1/100 of a mm or so on average) comprise tissues which are parts of the organs that make up the body. In addition to adopting the microscope he drew on the rapidly expanding science of organic chemistry that began in 19<sup>th</sup> century Germany. He realized stains gave insights into chemical composition. It was early days, and Virchow got some details wrong. He found “waxy appearing” deposits in some brain tissue that stained with iodine, and similar looking deposits in some livers. The iodine staining made him think they were degenerative carbohydrates, and Virchow named them “amyloid” meaning starch like, although they are now known to be abnormal aggregates of an albumin like protein, associated with various diseases. His biological descriptions sometimes echoed his progressive politics. He described the human body as a “cellular democracy” and a “republic of cells.” Virchow’s medical discoveries are too numerous to list here, apart from some brief highlights. Virchow discovered and named “thrombi”, abnormal blood clots that can form in the legs then become “emboli” that move to the lungs, causing disease or death. He correctly postulated slow flow, damage to vessel linings and hypercoagulability (sticky blood) can all three contribute to dangerous blood clots (now called “Virchow’s triad” and remains clinically useful in predicting blood clots). He was an expert in human skulls, which he later extended to ancient skulls when he became an anthropologist. Virchow correctly postulated cancerous tumors arise from dormant cells in normal tissue (now suspected to be stem cells) and thought this was caused by chronic inflammation (probably true in only a few kinds of cancer). He knew tumors spread, although he wrongly thought as an inflammatory liquid rather than as metastatic cells, despite being opposed to the ancient idea of spontaneous generation of life as he expressed in his own 3<sup>rd</sup> law of cell theory. Virchow’s discoveries also applied to animals, and he found that some diseases are shared between animals and people. Virchow was right about many thousands of things, but it came at the beginnings of the modern conception of how living things function, so many tiny mistakes were inevitable. We will see later that as brilliant as he was, Virchow remained stubbornly wrong about two of the most important biomedical discoveries of the late nineteenth century.

### **Father of Public Health, Social Medicine, Parasitology**

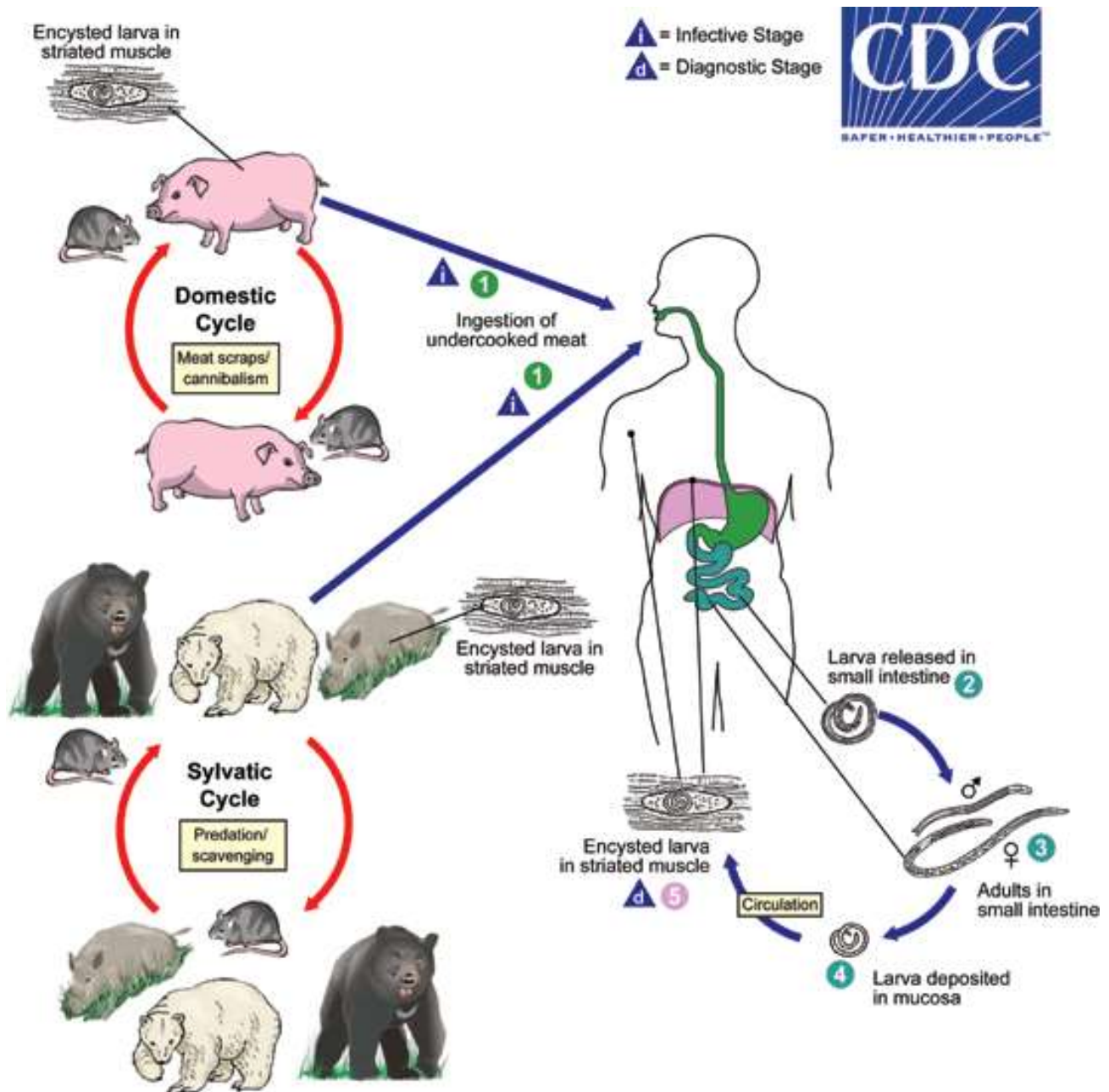
Being such a successful empiric scientist, discovering so much by observation and experiment, one might have thought Virchow would come to believe the biomedical model explained all of human health. But from the beginning, Virchow emphasized how the organization of societies explained much of their health and disease. He laid this out in detail at age 27 in his report on the typhus epidemic in Upper Silesia, stating the people of Upper Silesia were susceptible to disease because of poverty, which in turn was caused by a lack of enough democracy. His exhortation that “Medicine is a social science and politics is nothing else but medicine on a large scale” explains why we need a public health apparatus. Virchow wanted every doctor to act on the behalf of the public health, not just individual patients. Today in the US, most physicians see their responsibility as being almost exclusively to individual patients, not to the health of the whole population. 175 years ago Virchow established “social medicine” asking doctors to consider the social, cultural, economic and political causes of illness, and to act to improve overall population health. He stated that careful health statistics should be gathered and analyzed to make sure public health interventions are working. Epidemiology is another medical specialty that Virchow helped found, in this case along with physician John Snow (who linked cholera in London to the Broad street pump in 1854) and nurse Florence Nightingale (who did masterful statistical investigations of injuries and illness in soldiers during the Crimean war).

Virchow never believed bacteria caused diseases, but he did demonstrate **the parasitic disease trichinosis** was caused by a tiny nematode worm, *Trichinella spiralis*. Trichinosis can cause awful abdominal and muscle pain as the worms migrate through the human body, and in rare cases worms can go to the heart or brain. Using a microscope, Virchow showed that tiny white particles in tainted meat were the larvae of roundworms, coiled up in the muscle tissue. He posited that the worms caused human disease and found that the tiny worms in meat could develop into adult roundworms in the intestine of a dog. Virchow found trichinosis is a **zoonosis** (a disease acquired from animals) caused by eating improperly cooked pork infected with larval worms. Virchow set up regular meat inspection with “trichinoscopes” (portable low power microscopes with glass plates to squash meat samples) starting in Berlin around 1870. Virchow also demonstrated that if the infected meat is heated to 58 C (137 °F) for 10 minutes, it will not infect dogs or humans. (Pasteur had shown a similar trick for wine in 1864, but the better known Pasteurization of milk to prevent TB and brucellosis was first suggested later, by German food chemist Franz von Soxhlet in 1886).



*Trichinella spiralis* in muscle, vintage slide by NASCO, Fort Atkinson, Wisconsin, USA, 10X objective, didymium filter. The photomicrograph is about 1 mm across and the individual *Trichinella* cysts are about 120 microns across.





Trichinellosis (aka trichinosis) is caused by the ingestion of undercooked meat containing encysted larvae

- 1) after exposure to gastric acid and pepsin, larvae are released from the cysts and
- 2) invade the small bowel mucosa where they develop into adults
- 3) Females are 2.2 mm in length; males 1.2 mm. The life span in the small bowel is about four weeks.
- 4) after 1 week, females release larvae that migrate to striated muscles where they encyst
- 5) Diagnosis is usually made based on clinical symptoms, and is confirmed by serology or identification of encysted or non-encysted larvae in biopsy or autopsy specimens.

US Center for Disease Control





Women using trichinoscope microscopes to inspect fresh pork in a Chicago, USA meat packing plant in 1896

photo published 99 years later, *Science* 8 Feb 1985



Two nice early 20<sup>th</sup> century trichinoscopes from German makers in Wetzlar. photos from auction websites



Contemporary Trichinoscope microscopes from sales websites

Far left Danish Tagano digital trichinoscope

Left Russian "Steak -M" trichinoscope, Petrolaser, St. Petersburg

**Trichinoscope** microscopes were commonly used for meat inspection from about 1870's to the 1950's. Most are now antiques, but digital trichinoscopes are still sold by Taragano in Demark, and if war sanctions allowed, you could buy a simple optical trichinoscope from Petrolaser in Russia. Trichinosis is now rare in the US, some is from game meat (often bear). About 10-20 cases per year occur in the US, less than 1 in 10 million people, and even less in Europe.

Despite being a world leading city, Berlin was relatively late to get a central water supply and a sewer system. After a cholera epidemic hit the city in 1866, Virchow led a commission to investigate. He had already founded a public health and hygiene movement. In 1849 he had calculated rich residents of Berlin lived to 50 years average, while the life expectancy of the poor was 32 years. With political help from Virchow, a member of the Prussian Diet at the time, Berlin was persuaded to build a centralized sewer system between 1873 to 1893. Rudolf Virchow considered all of his political activities as being "medicine on a grand scale".



Virchow in his study at the Royal Charité in Berlin, 1895  
from Le Monde moderne at scih.org

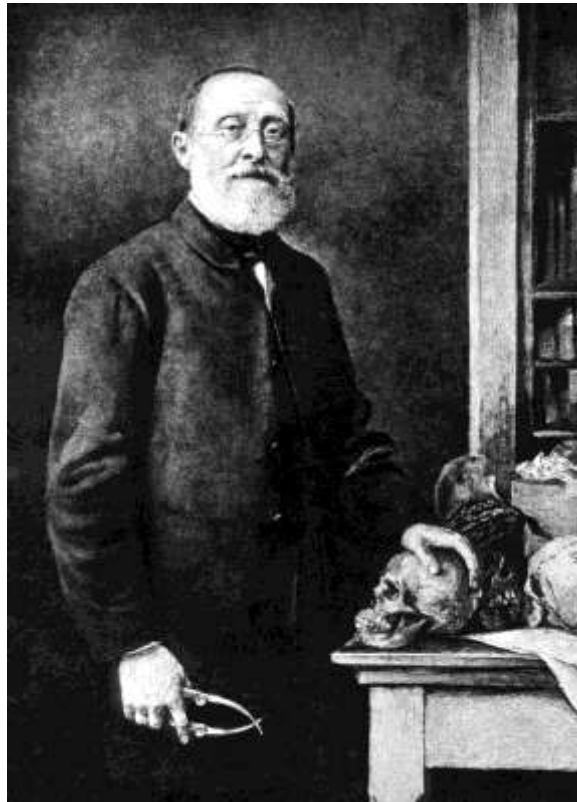
### **Anthropologist, Archeologist, Prehistorian**

Rudolph Virchow was one of the German founders of the new 19<sup>th</sup> century science of anthropology which started in France but quickly became international. Anthropology seeks to understand man and his group behaviors by applying all available scientific tools. One of anthropology's central tenets is "culture", the sum of all the learned behavior of people, including languages, beliefs, social structures, institutions, and material goods. Virchow made sure anthropology has a second central interest, physical anthropology, studying the physical body of present and past humans in detail. Interested in the history of early man, Virchow turned to archeology, discovering pile dwellings (Bronze Age ancient lake houses on stilts) in Pomerania, northern Germany in 1865 and later excavated pile dwellings and major hill forts in Germany. Virchow excavated wall mounds in Wöllstein in 1875 with Robert Koch (who later proved the germ theory of disease to the world, although never to Virchow), whose archeological journal article Virchow edited. Virchow was expert in the comparative anatomy of skulls, and found no support there for the idea of an Aryan Race, calling it "a Nordic Myth". He also steered clear of the pre-existing pseudoscience of phrenology (the now discredited 18<sup>th</sup> century belief that skull shape correlates with personality traits). Virchow founded the Berlin Society for Anthropology, Ethnology, and Prehistory in 1869 and remained its president for the rest of his life. He also helped found the German Anthropological Society in 1869.

Multiple Berlin museums emerged out of Virchow's avid anthropological and medical work. These include the Märkisches Museum, the Museum of Prehistory and Early History, the Ethnological Museum and the Museum of Medical History at Charité Hospital. Virchow also had a large private collection of anatomical specimens from numerous European and non-European populations, which today is owned by the Berlin Society for Anthropology and Prehistory.

Virchow went to the ancient city of Troy and to Egypt, the most famous of all archeological excavations. Could we expect anything less from the amazing, always curious Rudolph Virchow? In 1874 Virchow met Heinrich Schliemann, the discoverer of Troy, and went with Schliemann to excavations in Troy in 1879 and Egypt in 1888. Virchow wrote journal articles about the findings in Troy and successfully encouraged Schliemann to house his priceless collection of artifacts in Berlin. Virchow also joined archeological expeditions to the Caucasus and Nubia.

In 2020 Virchow's anthropology made news in Canada, but not in a good way. It turns out in 1884 famous American physician William Osler travelled to Berlin and gifted 4 native American skulls dug up in Ontario (but mislabeled as from British Columbia) to his old teacher Rudolph Virchow for his private collection. In 2020 two of the 4 skulls were located in the bureaucratic Prussian Cultural Heritage Foundation building in Friedrichshagen, 25 kilometers east of Berlin, along with 11,000 other human skulls. Rick Hill and other First Nations descendants are still trying to repatriate the remains.



Far left  
Rudolph  
Virchow,  
date unknown  
Britannica .com

Near left  
portrait of  
Virchow by von  
Hanns Fechner,  
1891  
wikimedia

### Forensics and Law

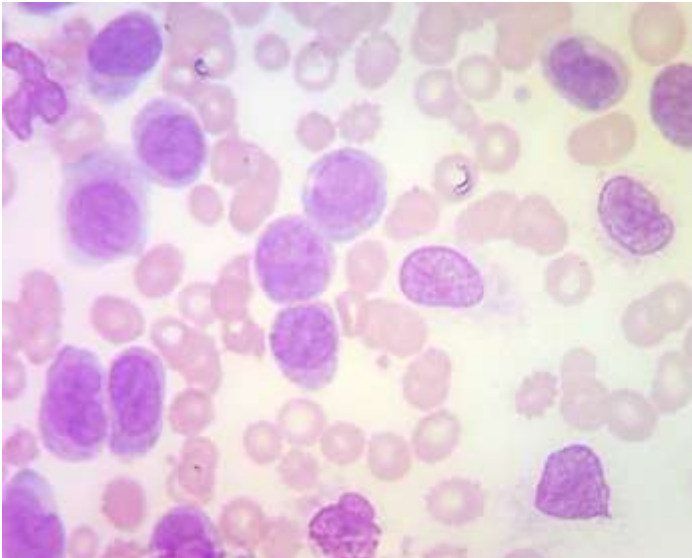
Virchow studied human hairs under a microscope for criminal investigation. His 1861 report was the first ever on the forensic use of hair. In that particular case he opined that there was not enough morphological difference to distinguish hairs of the defendant from those of the victim. Virchow also introduced and defined the concept of medical malpractice. Later, some accused him of malpractice in the case of the future Kaiser.



## Rudolph Virchow's Discoveries

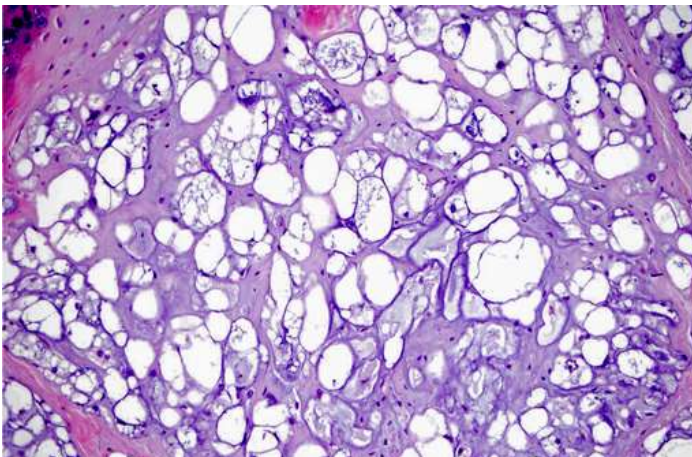
His medical achievements were legion. Among medical findings discovered and/or named by Virchow are:

“leukemia” (white blood cell cancer)



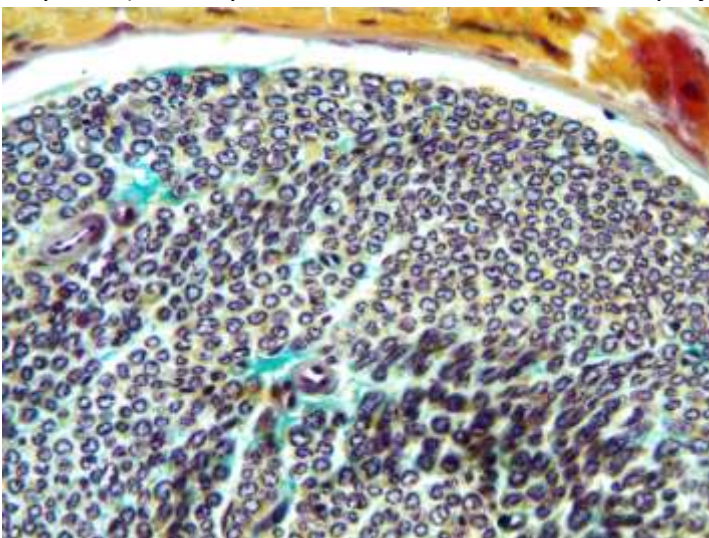
The new disease “leukemia” was the subject of Virchow’s first scientific paper in 1845. This is a Blood smear of Lymphocytic Leukemia, 1937 slide by unknown doctor, with 100X oil immersion objective and extra ~2X magnification from projection to small camera chip; RBCs are about 5 microns and the photomicrograph is about 70 microns across horizontally

“chordoma” (rare notochord remnant bone tumors, often in sacrum or at the base of the skull)



Chordoma histopathology with ‘bubbly’ cells; veterinary web image at Joint Pathology Center

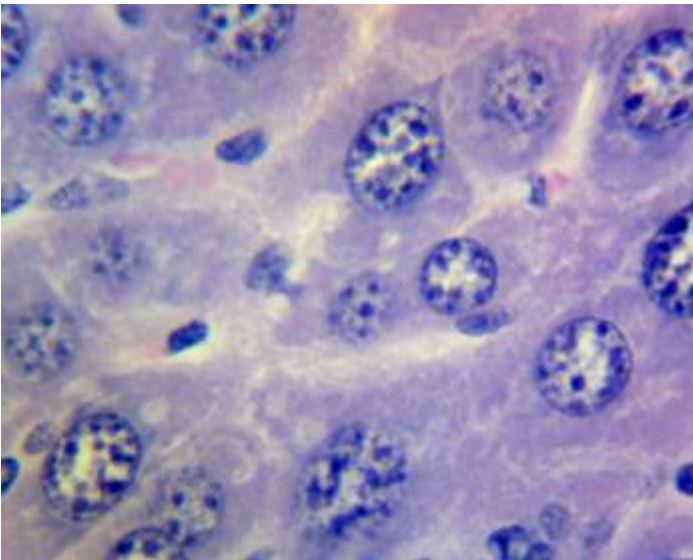
“myelin” (the fatty sheath around some nerve cell projections)



Cross section of nerve in gut tissue, small black rings are myelin around axons; 40X objective, pentachrome stain, image about 0.3mm across

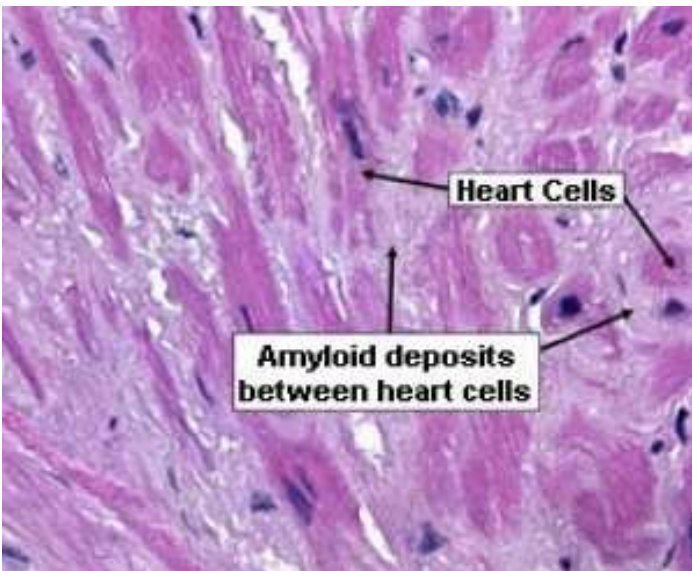


"chromatin" (the stained genetic material inside the nucleus of cells)



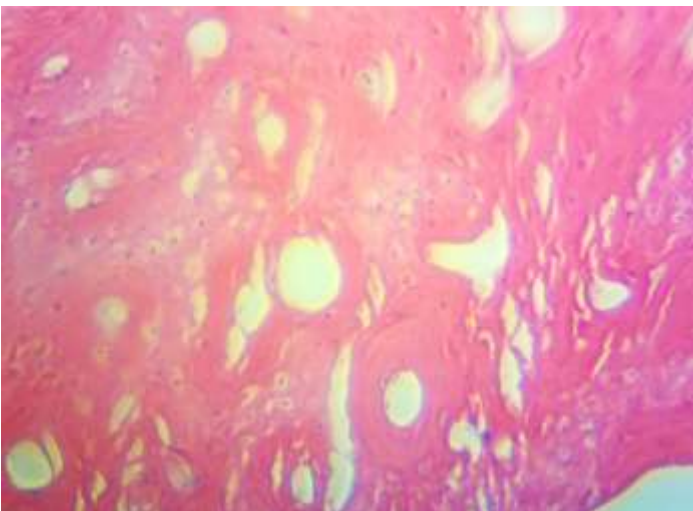
Dark blue chromatin clumps around the periphery of hepatocyte nuclei in this Boreal slide of liver tissue, 100X objective and extra ~2X magnification from projection to camera, largest nuclei are about 11 microns across

"amyloid degeneration" (abnormal buildup of the fibrous protein amyloid in organs)



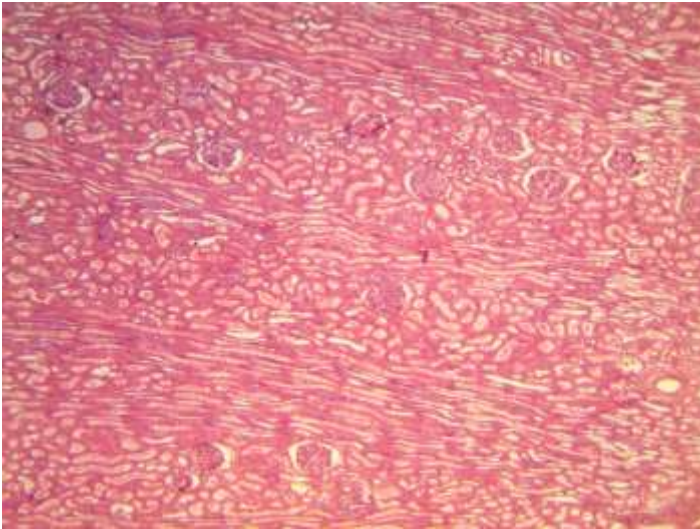
Lighter purplish amyloid clusters around the outside of cardiomyocytes in cardiac amyloidosis; image from Stanford Amyloid Center in 2016 American College of Cardiology web article by R Witteles

"osteoid" (collagen rich matrix that will become bone when mineralized)



Virchow discovered cells amid the predominate extracellular mineral and protein material (often collagen and its associated glycoproteins) that comprises bone and general connective tissue. Pictured is osteoid, collagen rich cartilage that is being remodeled into bone, vintage slide from bone pressure research, Dr. Coletti, 10X objective, area 1~ mm across

"parenchyma" (the bulky main functional tissue of an organ)



Parenchyma of human kidney, vintage or antique diamond inscribed slide; tubules and glomeruli make up most of the kidney and clean the blood, 4X objective, imaged area is about 2.4 mm across

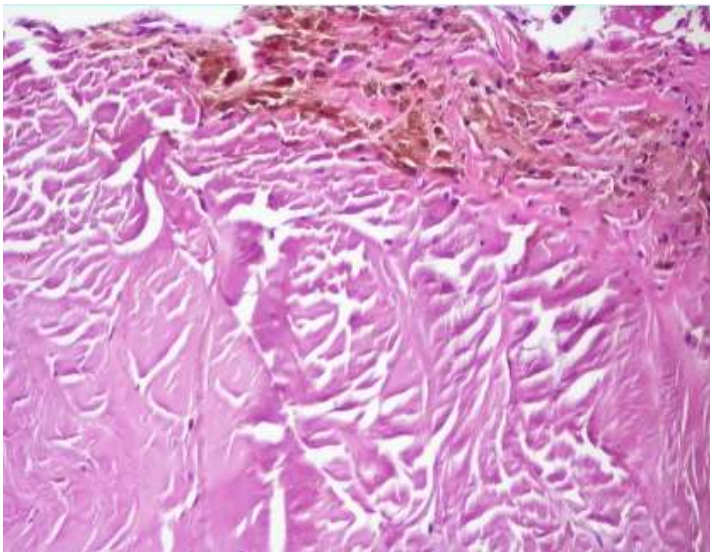
"spina bifida" (failure of the spinal canal to close before birth)

"thrombus", "embolism" (blood clots in vessels and moving elsewhere)

"agenesis" (failure of an organ to form)

"zoonoses" (human diseases acquired from animals, including trichinosis)

"ochronosis" (a metabolic disease with accumulation of brownish homogentisic acid in tissues)



Ochronosis, named by Virchow, is the tissue manifestation of alkaptonuria ("black urine disease"), a rare inherited inability to properly metabolize aromatic amino acids (phenylalanine and tyrosine) leading to staining of eyes and skin, and joint damage over time. This image shows homogentisic acid causing brown discoloration of tendon, from Groseanu, et al, A late and difficult diagnosis of ochronosis. Journal of medicine and life 2010. 40X objective stated.

## Virchow eponyms

Many medical findings or procedures Virchow discovered are named for him:

Virchow's node (a swelling above the left collarbone associated with stomach, or less often, lung cancer)

Virchow's cell (foamy macrophages in leprosy lesions)

Virchow's angle and line (help define shape of facial bones)

Virchow–Robin spaces (surround blood vessels where they enter the brain)

Virchow skull breaker (a chisel or “key” used to expose the brain in surgeries and autopsies)



Virchow's disease (leontiasis ossea, “lion face” deformity)

Virchow–Seckel syndrome (so called "bird-headed dwarfism")

Virchow's law (explains formation of skull deformities in craniosynostosis)

Virchow's metamorphosis (fatty tumors in heart or salivary glands)

Virchow's psammoma (round microcalcifications in some brain and other tumors)

Virchow's triad (3 factors promote venous thrombus: endothelial injury, stasis and hypercoagulability)

Virchow's method (a complete autopsy with organs taken out one by one for close examination)

## Titles and honors bestowed on Virchow

Virchow was “**The Pope of Medicine**” to his peers. He is also known as “Father of Pathology”, “Father of Cellular Pathology”, “Father of Modern pathology”, “Father of Veterinary Pathology”, “Father of Public Health and Social Medicine”, and one German internet wag called him “**Granddad of nowadays hipsters.**”

Rudolph Virchow earned the titles Doctor, Prosector, and Professor. When elected to the Prussian Academy of Sciences in 1873, Virchow declined an offer to be ennobled as "von Virchow."

Rudolph Virchow won numerous international prizes in science and medicine, including the 1892 Copley Medal, an English Royal Society forerunner of the Nobel Prize.



## References

(most available online)

- Adam-Tkalec, M, Why the English built Berlin's first waterworks, *Berliner Zeitung* March 30, 2021 at [berliner-zeitung.de/en/why-the-english-built-berlins-first-waterworks-li.149349](https://berliner-zeitung.de/en/why-the-english-built-berlins-first-waterworks-li.149349)
- Boak, A, Rudolf Virchow--Anthropologist and Archeologist, *The Scientific Monthly*, Vol. 13, No. 1 (Jul., 1921), pp. 40-45 <https://www.jstor.org/stable/6581>
- Bonchek, LI, 2013, How Cancer Caused WWI and Its Aftermath, *The Journal of Lancaster General Hospital*, Fall 2013 - Vol. 8, No. 3 at [jlgh.org/Past-Issues/Volume-8---Issue-3/How-Cancer-Caused-WWI.aspx](http://jlgh.org/Past-Issues/Volume-8---Issue-3/How-Cancer-Caused-WWI.aspx)
- Brown TM, Fee E. Rudolf Carl Virchow: medical scientist, social reformer, role model. *Am J Public Health*. 2006;96(12):2104-2105. doi:10.2105/AJPH.2005.078436
- Bruser, D Grill M The untold story of four Indigenous skulls given away by one of Canada's most famous doctors, and the quest to bring them home *The Toronto Star* Dec. 17 and 18, 2020
- Edwards, S., Rudolph Virchow, the father of cellular pathology at [aaas.org](http://aaas.org)
- Famous Scientists*. "Rudolf Virchow." 15 Oct. 2015. at [famousscientists.org](http://famousscientists.org).
- Gaffney, AW, 2015, The Politics of Health, *The Los Angeles Review of Books* Oct 26, 2015 at [lareviewofbooks.org/contributor/a-w-gaffney/](http://lareviewofbooks.org/contributor/a-w-gaffney/)
- Lange, K Rudolf Virchow, poverty and global health: from "politics as medicine on a grand scale" to "health in all policies" *Global Health Journal* Vol 5, Issue 3, Sept 2021, pp 149-154 at [sciencedirect.com/science/article/pii/S2414644721000646](https://www.sciencedirect.com/science/article/pii/S2414644721000646)
- Lim, A (2020, August 28). Rudolf Virchow: Father of Modern Pathology at [thoughtco.com/rudolf-virchow-4580241](https://www.thoughtco.com/rudolf-virchow-4580241)
- Popular Science Monthly*, Volume 21, October 1882, Professor Rudolf Virchow at [wikisource.org](https://en.wikisource.org/wiki/Rudolf_Virchow) (no author stated)
- Schultz, M (2008). Rudolf Virchow. *Emerging Infectious Diseases*, 14(9), 1480–1481. <https://doi.org/10.3201/eid1409.086672>
- Schulze, F "How Laryngeal Cancer Caused WW I" unknown year, photocopy provided to me by author (Micscape's Fritz Schulze, published in a Feuilleton magazine supplement, but I can't find anything on the internet)
- Silver. GA. Virchow, the heroic model in medicine: health policy by accolade. *Am J Public Health*. 1987;77(1):82-88. doi:10.2105/ajph.77.1.82
- Underwood, E. Ashworth (2022, October 9). *Rudolf Virchow*. *Encyclopedia Britannica* at [britannica.com](https://www.britannica.com)
- Unknown author, Virchow: Gargantuan Appetite for Knowledge, Battles, Causes, *Hospital Practice* 1978, 13:2, 123-140, DOI: 10.1080/21548331.1978.11707282
- Virchow, RC. Report on the typhus epidemic in Upper Silesia. 1848. *Am J Public Health*. 2006;96(12):2102-2105. doi:10.2105/ajph.96.12.2102 (translated extended excerpts of Virchow's original report that I included above)
- Walter, E, and Scott M. The life and work of Rudolf Virchow 1821–1902: "Cell theory, thrombosis and the sausage duel." *Journal of the Intensive Care Society*. 2017;18(3):234-235. doi:10.1177/1751143716663967
- Weisenberg, E (2009). "Rudolf Virchow, pathologist, anthropologist, and social thinker". *Hektoen International Journal*.
- Wikipedia contributors (accessed on-line 2023, March, April). Rudolf Virchow. In *Wikipedia, The Free Encyclopedia*.

Thank you for your reading time with my historical essay. It took a lot of space to even briefly lay out some of Virchow's many scientific accomplishments. Like Virchow, I may be mistaken about some things, and am happy to be corrected if you find an error. Next month I place Virchow more deeply into historical context and express more personal opinions. I will be happy to be challenged on those as well; changing our mind is how we grow as people.

Micscape always has lots of good information for amateur microscopists wanting to learn more about how to do it yourself.

I was inspired to think more about the big picture and to delve into German scientific history by the essays of Richard Hovey over the years and more recently by the interesting essays of G. Joseph Wilhelm on the island of Roatan.

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