
Fundamentals—Rudolf Virchow and Modern Medicine

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The 19th century pathologist Rudolf Virchow was a physician, scientist, and revolutionary. The preeminent medical investigator of his day, Virchow remains best-known for his theory of cellular pathology, which laid the conceptual foundation for modern scientific medicine. Less appreciated are Virchow's numerous accomplishments in public health, anthropology, and European politics, including his quest for social justice and democracy in Imperial Germany. The study of Virchow's life and writings may provide contemporary physicians with a powerful role model as we grapple with the complexities of the modern medical enterprise.

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Few physicians have the privilege of making a discovery that lays bare the workings of the body or alters the foundations of a field. For every Harvey or Osler, tens of thousands of us labor quietly in patient care or research, hoping to improve the lives of our patients or add a few bricks to the edifice of medical knowledge. Likewise, most doctors will never enter the political arena or engage in public political discourse. Certainly rare is the individual who achieves both scientific and political greatness. The nineteenth-century Prussian physician and statesman Rudolf Virchow was such a man.

Most contemporary doctors are familiar at least with Virchow's name. Many know that he was a pathologist, active in describing and cataloging the pathologic anatomy of numerous diseases. Some may remember a couple of the numerous clinical signs he described, such as the association between gastric cancer and the presence of an enlarged left supraclavicular lymph node. But few doctors are aware that the enterprise of modern scientific medicine owes more to Rudolf Virchow and his research program than perhaps any other physician, and virtually none has knowledge of his significant accomplishments in public health, politics, and social engineering.

Why should clinicians practicing medicine in the last years of the 20th century care about Rudolf Virchow? Virchow, a paragon of the accomplished researcher, the humanistic physician, and the social activist, provides a useful role model for physicians in our society. In an era in which many patients lament the fact that their doctor may be more technician and businessman than advisor and confidant, study of Virchow and his accomplishments can reinvigorate our faith in scientific medicine and its ultimate goal of alleviating human suffering.

The Physician as Scientist

Virchow was born in 1821 in northeastern Prussia near the border with Poland, an area that has oscillated between a German and Polish identity for centuries depending on whose military is ascendant. The son of a Pomeranian farmer, he received a typical primary education at the local community school and was the head of his class at the gymnasium (high school), where his ambition and love of hard work already were becoming apparent.^{1,2} After completing secondary-school education, Virchow became a student at the Friedrich-Wilhelm Institut, a division of the University of Berlin dedicated to training medical officers for the Prussian army. In spite of the grinding schedule of lectures, laboratories, and studying, he developed wide-ranging intellectual interests, including philosophy, history, archaeology, languages, and politics. Driven by a vague but powerful urge to acquire "no less than a universal knowledge of nature from Godhead to stone," Virchow was rapidly becoming a polymath, that rare individual of great and diversified learning.³

After graduation from medical school, Virchow accepted a position as an intern at one of Berlin's famous teaching hospitals, the Charité, where he quickly developed an interest in the work of its pathologist, Robert Froriep. Froriep taught him the fundamentals of microscopy and informed him on Europe's latest medical research, acquainting the young doctor with current theories about the causes and treatment of disease.¹ Virchow's ability to read multiple European languages as well as Latin and Greek was an advantage since the scientific journals of the day were not predominantly published in one language as they are now.

In the early part of Virchow's career, there were many theories, or so-called systems, of disease.³ Rooted in a Romantic philosophy that claimed the scientist could uncover the truth about nature by reasoning from first principles, these medical theories were usually little more than armchair hypotheses based on incorrect or nonexistent data.⁴ Each system was typically championed by one of the leading European physicians and his followers, and the medical literature of the day abounded with theoretical discourses regarding the strengths and weaknesses of the various theories. Overthrowing such theoretical systems and replacing them with scientific medicine based on observation and experiment became Virchow's stated goal.

While Virchow had great respect for clinical medicine, it was in the autopsy room and laboratory that he excelled, and his research career was quickly launched. Within a few years after graduating from medical school he had made major discoveries about the processes of thrombosis and embolism.⁵ In addition, he described leukemia as cancer of the white blood cells and differentiated it from pyemia, or leukocytosis.^{1,5} He recognized the consequences of stopping blood flow to an organ or tissue and coined the term "ischemia" to denote this process, thus initiating the first serious research into understanding the physiologic mechanisms underlying heart attack and stroke.^{6,7} Usually, Virchow conveyed his results in an argumentative and biting style that humiliated and enraged many of his staid European colleagues.

After a few years, Virchow assumed Froriep's position at the Charité. With his new professional and financial freedom he established a journal, *The Archive of Pathological Anatomy and Physiology, and Clinical Medicine*. The title itself is a direct statement about Virchow's beliefs regarding scientific medicine.⁵ Virchow maintained that the way to make advances in patient care is to understand the disturbed anatomy that results from disease and, crucially, to elucidate how this change affects the function of tissues and organs. While we accept this approach as fundamental, the notion that physicians should evaluate their hypotheses by assessing the results in patients was a controversial proposition in 19th century Europe.

In the first issue of *The Archive*, Virchow published an article which was direct in approach, revolutionary in content, and specifically crafted to challenge his peers. In this paper he laid out a formal plan for medical progress based on understanding pathologic anatomy and physiology, and his exposition is worth quoting:

Let us not deceive ourselves about the present state of medicine. It is undeniable that our spirits are exhausted by the innumerable hypothetical systems which are constantly being cast to the winds and replaced by new ones. A few more mishaps, however, and this time of disturbance will have passed by and it will be understood that only dispassionate, diligent, and steady work, true work of observation or experiment, has permanent value. The science of pathologic physiology will then gradually fulfill its promise, not as the creation of a few overheated heads, but from the cooperation of many painstaking investigators—a pathologic physiology which will be the stronghold of scientific medicine.⁸

The study of pathophysiology was to form the heart of Virchow's research program, and, moreover, this study was to be based on careful clinical observation coupled with intelligent experimentation. The modern paradigm for medical research, this method is one that has yielded steady progress against disease in the 20th century. The success of Virchow's approach can be judged also by the longevity of his journal, which after 150 years remains a respected scientific forum now known as *Virchow's Archive*.

Publishing original scientific manifestos is exemplary, but actually carrying out the research is the challenge. Virchow was more than equal to the task and spent half a dozen years doing groundbreaking work in Würzburg, where he was forced to move in 1849 after taking an active role in the failed democratic revolution of the previous year (for more on this episode, see below.) Virchow's Würzburg research accomplishments were diverse, encompassing areas such as infectious disease, cancer, derangements of the liver and kidney, and mental retardation.^{2,4} The power of his scientific approach became clear as one puzzle after another fell to his method.

By the 1850s Virchow had become the preeminent physician-scientist in Europe, and in recognition of his accomplishments he finally was offered a professorship at the University of Berlin, his alma mater. Upon assuming the Chair of Pathology at the world's leading school of medicine, Virchow was about to make his most important contribution to medical science: the idea that cells are the fundamental units constituting all tissues and organs, and that disease in the organism results when cells fail to perform their normal, specialized functions. The concept of cells as the building blocks of the organism and the locus of disease may seem self-evident to modern physicians and scientists, but it was revolutionary in mid-19th century Europe. When cells are recognized as the essential components of life, no place remains for theories of disease relying on notions of evil humors, strange fluxes, disturbed animisms, or other supernatural explanations of illness.

Building on the work of various German embryologists and microscopic anatomists, Virchow had slowly developed his ideas about cells and disease while in Würzburg.⁹ After his arrival in Berlin, he decided to enlighten the professors and students at the university regarding the latest developments in medical science. Virchow's series of lectures explicating the cellular theory, which were meant to be understandable to anyone with basic medical training, were issued as a book, *Cellular Pathology*. Like Newton's *Principia* two centuries earlier, the work caused an immediate sensation in Europe. Theories about disease now could be unified under a single rubric, the concept of the cell and its normal and pathologic functioning. Before Virchow, doctors could catalog the signs and symptoms of illness, observe its natural history, and describe the appearance of organs and tissues after death, but they had no coherent explanation for the fundamental cause of disease. After the

publication of *Cellular Pathology*, medical scientists had a new paradigm to use in attacking the problems of pathophysiology. Not only did Virchow's cellular pathology rid medicine of the mysterious, his work defined the principles by which physicians should seek to find the where's, why's, and how's of disease. Harvey Cushing, in his biography of William Osler, noted that Virchow's cellular doctrine set the stage for the microbiologic discoveries of Koch and Pasteur and the practical adaptation of them to surgery by Lister.¹⁰ Cancer, viewed since ancient times as some sort of invading scourge, now could be attacked as a disease of deranged host cells.¹ In short, the modern cellular approach to biomedical research is a lineal descendant of Virchow's theory.

Politician and Humanist

Cellular Pathology prompted a revolution in medical thinking, much as the publication of Darwin's *Origin of Species* one year later heralded a paradigm shift in biology. Virchow's notion of cells as the locus of disease is clearly as important an organizing principle in medicine as evolution is in biology. Unlike Darwin, however, Virchow could boast of myriad accomplishments outside of science. He was political revolutionary, statesman, and public health advocate as well as pathologist.

Virchow's first significant political experience came in 1848, when he was still on staff at the Royal Charité in Berlin. In response to public outcry regarding a typhus epidemic raging among textile workers in Upper Silesia, the Prussian government organized a commission of investigation with Virchow as its medical officer. Appalled at the misery he encountered among peasants in the countryside, Virchow concluded that poor sanitation, ignorance of basic hygiene, lack of education, and near-starvation were the root problems of the epidemic. He issued a scathing report, lambasting the Prussian aristocracy for maintaining its subjects in a state of backwardness. As an expression of his burgeoning political liberalism, Virchow also publicly demanded "full and unlimited democracy" coupled with "education, freedom, and prosperity."² His inflammatory comments set the stage for direct conflict with the Prussian government.

That conflict was not long in coming. In 1848 social upheaval spread throughout Europe as revolutionaries in one capital after another took to the streets to demand freedom and democracy.¹¹ Berlin was no exception, and in March, a few weeks after his Silesian expedition, Virchow manned the barricades beside fellow democrats, armed with a rusty sword and an antiquated rifle.¹² He also was elected representative to a newly formed Prussian diet and delivered fiery speeches denouncing the Hohenzollerns, the royal family. When the monarchists rallied and crushed the rebellion a few months later throughout Europe, the authorities could not abide Virchow's continued presence in Berlin. He was dismissed as prosecutor at the Charité early in 1849 and accepted a position in Würzburg after much prodding of the local Bavarian bureaucracy.⁴

When finally lured back to Berlin in the late 1850s, Virchow quickly reentered the political realm. He was elected Berlin City Councillor in 1859, an office in which he served for 42 years. He worked tirelessly to improve the welfare of Berliners, his achievements ranging from improving the city's sewer and water supply systems to reforming the arrangement of public hospitals. In its lengthy obituary in 1902, the *British Medical Journal* opined that the fact that Berlin then ranked as one of the most hygienic cities in Europe was due almost entirely to Virchow's efforts.¹³

Virchow also was active in German national politics. A founding member of the German Progressive Party, he was elected to the House of Deputies, the lower chamber of the Prussian legislature, where he became a strenuous liberal opponent of Bismarck. As chairman of the finance committee, Virchow once blocked the creation of a German navy, which so incensed Bismarck that he challenged the pathologist to a duel. The enterprise was abandoned as ridiculous when Virchow insisted it be fought with his weapon of choice—the scalpel.⁷ Disturbed by the increasingly authoritarian nature of Imperial Germany, Virchow continued to agitate for democracy, separation of church and state, and social welfare programs until his retirement from active politics.⁴

Whether engaged in medical research or national politics, Virchow always was guided by a deep sense of humanitarianism. In his view the physician was a citizen uniquely equipped to further the public good, and the practice of medicine could not be divorced from its social milieu. He worked tirelessly to reform the Berlin hospital system so that all citizens would have access to adequate medical care. In the Franco-Prussian war, Virchow served as a medical officer at the front and organized the military hospital system; he insisted that all injured combatants, regardless of nationality, be entitled to medical aid. Virchow's sentiments regarding the practical aims of medicine are perhaps best summarized in an inscription he wrote on a portrait of himself: "The progress of medicine should be as the progress of humanity, the measure of its practical and theoretical utility should serve at the same time as a measure of the correctness of what it accomplishes."¹⁴ Osler, who, as a student, had spent time in Berlin learning the art of the autopsy from the master, devoted an address to Virchow's accomplishments on the occasion of the pathologist's 70th birthday.¹⁵ Osler believed that Virchow's scientific achievements were amplified by his consistent humanitarianism.

Lessons for Postmodernists

So what lessons can the contemporary physician draw from the life of this 19th century German pathologist? Virchow's writings remind us that medicine must be founded on science, the linking of careful clinical observation and laboratory investigation. While the tenets of scientific medicine may be unquestioned by the vast majority of us, we must remember that the scientific approach has dominated the healing arts for only a brief

time in the history of medicine. In an age of multiple alternative therapies, many based on wishful thinking or motivated by simple greed, we must remain defenders of the principles first enunciated by Virchow. We must insist that all treatments be subject to appropriate investigation.

Virchow teaches us also that medicine cannot be removed from a social context. Currently, more than 40 million Americans lack adequate health insurance, a situation that Virchow undoubtedly would have found deplorable. The majority of us genuinely lament this lack as well, but what form of political action have we effectively used to change the system? The example of the German physician is worth pondering as we grapple with the momentous changes medicine is going through at the moment.

Above all, Virchow reminds us that the essence of medicine is humanitarianism. Advocating for patients with the administrators of managed care conglomerates may not be as heroic as debating Bismarck on the floors of the Reichstag, and most of us will never achieve public renown. However, as George Eliot so perceptively observed in the last sentence of her great Victorian novel *Middlemarch*, published when Virchow was at the height of his career, “the growing good of the world is partly dependent on unhistoric acts; and that things are not so ill with you and me as they might have been, is half owing to the number who lived faithfully a hidden life, and rest in unvisited tombs.”¹⁶

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REFERENCES

1. Winter K: Virchow. Leipzig/Jena: Urania-Verlag; 1956
2. Ackernecht EH: Rudolf Virchow: doctor, statesman, anthropologist. Madison (WI): Wisconsin Press; 1953
3. Rather LJ: Rudolf Virchow and scientific medicine. *Arch Int Med* 1957; 100:1007-1014
4. Boyd BA: Rudolf Virchow: the scientist as citizen. New York: Garland; 1991
5. Nuland SB: Doctors: the biography of medicine. New York: Alfred A. Knopf; 1988
6. Schiller F: Concepts of stroke before and after Virchow. *Med Hist* 1970; 14:115-131
7. Nuland SB: How we die. New York: Vintage Books; 1993
8. Virchow R. Translation quoted in Nuland SB: Doctors: the biography of medicine. New York: Alfred A. Knopf; 1988, p 313
9. Rather LJ: Rudolf Virchow's views on pathology, pathological anatomy, and cellular pathology. *Arch Path* 1966; 82:197-204
10. Cushing H: The life of Sir William Osler. London: Oxford University Press; 1940
11. Hobsbawm H: The age of revolution. London: Weidenfeld & Nicolson; 1962
12. Gardner LI: Doctors afield – Rudolf Virchow. *New Engl J Med* 1955; 252:587-589
13. Rudolf Virchow [obituary]. *Br Med J* 1902 Sep 13:795-800
14. Semon F, Rudolf Virchow: some personal reminiscences. *Br Med J* 1902 Sep 13:800-802
15. Osler W: Rudolf Virchow: man and student. *Boston Med Surg J* 1891; 125:425-427
16. Eliot G. *Middlemarch*. New York: Modern Library edition; 1994