Dr. John Crawford: The Forgotten Pioneer of Germ Theory

A Baltimore Physician Ahead of His Time (1746-1813)

Life and Career

Dr. John Crawford was born in northern Ireland on May 3, 1746, the second son of a Presbyterian clergyman. His father, despite a modest salary of "30 a year with the product of a glebe," managed to give four sons liberal educations and professions, leaving two daughters each £500 sterling—a remarkable achievement that speaks to the family's commitment to education.[1]

Young Crawford was sent to Trinity College Dublin around age 17 (circa 1763), where he began his medical studies. His education was thorough and international: he practiced medicine before 1770, received an M.D. from St. Andrews in 1791, and finally obtained an additional degree from the prestigious University of Leyden in 1794, when he was forty-eight years old.[2] This pursuit of multiple degrees reflected Crawford's scholarly standards and his awareness that institutions like St. Andrews would award degrees based merely on evidence of medical study, while Leyden and Edinburgh demanded more rigorous qualifications.

Crawford's early career took him across the globe. He served as a ship's surgeon on the *Marquis of Rockingham* sailing to Bombay and Bengal for the East India Company, meticulously keeping a medical journal as required of all company surgeons (though this valuable document was never published and remains lost to history).[3] Around 1778, he married the daughter of John O'Donnell of Truagh Castle, Limerick.[4] Shortly thereafter, he accepted an appointment as Physician to the Hospital in Barbados, where he remained until 1782 when ill health forced him to return to England. His wife died during this period, leaving Crawford with two small children.

After recovering, Crawford returned to the West Indies, this time accepting a position as Surgeon-Major to the Colony of Demerara under the Dutch government. But the tropical climate continued to affect his health, and in 1794 he traveled to Holland for his Leyden degree before making a life-changing decision: in 1796, encouraged by his brother-in-law John O'Donnell (the Canton merchant of Baltimore), Crawford emigrated to the United States, hoping the climate would benefit both himself and his children.[5]

A Scholar's Life in Baltimore

Crawford quickly established himself in Baltimore's intellectual and civic life. He became a director of the Library Company of Baltimore, donated books to their collection,[6] helped found the Maryland Society for Promoting Useful Knowledge (1800), aided in establishing the Maryland Penitentiary (1802), and rose to become Grand Master of the Masonic Order in Maryland (1801).[7,8] He also edited a weekly magazine, *The Companion and Weekly Miscellany* (1804-1806), which he eventually turned over to his daughter, Eliza Crawford Anderson.[9]

Benjamin Latrobe, the famous architect, visited Crawford's home on Hanover Street in 1812 and left this vivid description:

> "Dr. Crawford's library is black with smoke, and covered with dust, cumbered with papers, and choked with books, bookcases and desks. In the midst of all this his giant figure sits on an easy chair. He is a true Milesian gentleman, his society and conversation is delightful, and instructive, and he rides his hobby agreeably."[10]

Crawford's "hobby" was his extensive medical library of over 400 volumes, which he advertised could provide "ample opportunity" for a student "to prosecute his studies on an extensive plan."[9] This collection included rare works by Hippocrates, Galen, Boerhaave, Haller, Malpighi, and early microscopists like Kircher and Swammerdam—the intellectual foundation for Crawford's revolutionary theories.

Vaccination Pioneer (1800)

In the summer of 1800, Crawford became one of the first two American physicians to introduce Jenner's smallpox vaccination (the other being Dr. Benjamin Waterhouse of Cambridge, Massachusetts). Dr. John Ring of London sent vaccine matter to Crawford on cotton thread, "rolled up in paper, and covered with a varnish which excluded air."

Ring later reported the success: "From the son of Dr. Crawford, who is now pursuing in this metropolis, his studies in a profession which he is one day destined to adorn, I have received the pleasing intelligence, that when his father wrote to him, he could just discover, by the assistance of a magnifying glass, a vaccine pustule had taken place."[11]

Three leading medical historians—including Sir William Osler—credit Waterhouse and Crawford with contemporary introduction of vaccination in America.[12,13,14] Yet Crawford never pursued this work further, never wrote about it to his friend Dr. Benjamin Rush, and left almost no record of what should have been a crowning achievement. This pattern of brilliant insight without sustained follow-through would define his career.

The Animalcular Theory: Germ Theory 50 Years Too Early

Crawford's most remarkable and tragic contribution came in 1806-1807, when he published a series of articles in his daughter's magazine (now titled *The Observer and Repertory of Original and Selected Essays*) presenting a fully formed theory of infectious disease caused by microscopic organisms.

His paper, titled "Remarks on Quarantines, as Suggested by Dr. Caldwell's Oration" and later "Dr. Crawford's Theory and Application to the Treatment of Disease," argued that epidemics were caused by "animalcular action upon human bodies":

> "All that can be done, therefore, by public authority, is to prevent those persons who are well from going to places where the fever producing animalculae (like musquetoes and fleas) may fasten on them, and to remove those who are already the prey of legions of these creatures, to places where none of these tormentors exist."[15]

Crawford had studied the earliest microscopists extensively. He cited Athanasius Kircher's *Scrutinium Physico-Medicum* (1671) as the first work to suggest "the existence of an animated principle as the cause of disease." In his paper, Crawford wrote:

> "Kircher, the learned Jesuit, so far as my diligent researches have been capable of discovering, appears to be the first who suggested the existence of an animated principle as the cause of disease... It is a scarce work, another copy is not perhaps to be found in this country..."[15]

Crawford's Revolutionary Theory

Crawford's theory was comprehensive and startlingly modern:

- Different diseases were caused by different species of animalculae
- These organisms could be transmitted from person to person
- Insects could serve as disease vectors
- Disease prevention required avoiding areas where animalculae congregated
- The "herding together of insects will be seen the locality of disease"

He even compared disease-causing animalculae to known parasites: "As dropsy may be caused by the hydatid animal, and itch by the psoric animal, so may dysentery be caused by intestinal animals, and yellow fever and other fevers by their appropriate species of animalculae."[15]

The Price of Being Right Too Soon

The *Medical Repository* of New York reviewed Crawford's work in 1807 with polite dismissal:

> "The doctrine of invisible insects and worms, as the exciting causes of popular distempers, has not found many advocates during the discussions that have taken place concerning yellow fever within the last fifteen years... But although the animalcular hypothesis has been neglected so long, it has at length found a serious and zealous supporter in Dr. John Crawford of Baltimore."

After summarizing his arguments, the editors concluded: "For ourselves, who are believers in the chemical theory, we must refer such of our readers as wish further proofs of Dr. C.'s learning and ingenuity, to his original dissertation."[16]

Professional Ruin

The consequences for Crawford were devastating. In January 1806, he wrote to Benjamin Rush:

> "The premature disclosure of my opinions has afforded a means to the envious and malignant to prejudice those I had every reason for valuing myself on, so as to deprive me of all the valuable practice in this City... There is one consolation which I feel. I am convinced that we are both of us earnest in the pursuit of truth, and in as far as our road is the same, we shall necessarily accord. Where we take different directions, I am persuaded also that we shall cordially agree to differ..."[17]

Two years later, Rush recorded in his diary on November 16, 1808:

> "This evening Dr. Crawford of Baltimore drank tea with me. He said his father was a clergyman in Ireland and that from 30 a year salary with the product of a glebe he had given four sons liberal educations and professions and left two daughters each £500 sterling. The Doctor said he had lost all his business by propagating an unpopular opinion in medicine, namely, that all diseases were occasioned by animalculae. He said he was sixty-two years of age and not worth a cent, but in debt."[18]

Final Efforts

Despite this professional ruin, Crawford persisted. In 1811, he commissioned a printed prospectus for "A Lecture Introductory to a Course of Lectures on the Cause, Seat and Cure of Diseases. Proposed to be delivered in the City of Baltimore." He wrote to Rush before beginning:

> "I have at length determined to attempt a course of lectures on the cause, seat, and cure of diseases, and commence on Tuesday, with I assure you, no small share of

> trepidation. I have been fighting under cover for many years.—I have not put forth whatever force I possess.—Having, from this imperfect way, given cause for objections, I am induced to use every endeavor for obviating them by urging everything in my power in defense of what I have heretofore offered. The Truth is that my situation can not be made worse by it, and every change must therefore be for the better... My great aim is to do good, and I leave the issue to him from whom I have received what I have, and in whom is the issue of whatever exists."[17]

The lectures were poorly attended. In 1812, Crawford briefly received a position as "Lecturer on Natural History" at the newly reorganized University of Maryland, but according to contemporary accounts, "this course was shortly abandoned" due to internal discord among the faculty.[19]

Death and Memorial

On May 9, 1813, Dr. John Crawford died after a few days of severe illness. He was buried in the churchyard of Westminster Presbyterian Church on Fayette and Green Streets, then Baltimore's western boundary. Six weeks later, the Masons held a memorial service where Dr. Tobias Watkins delivered a eulogy describing Crawford as one whose "life and services were unselfish and farsighted."[20]

In his will, Crawford left his extensive medical library to be sold.[21] His daughter, Eliza Crawford Godefroy, sold the collection to the Faculty of Physic at the University of Maryland for approximately $500.[19] Before the sale, she placed this poignant notice in the *Federal Gazette and Baltimore Daily Advertiser* on November 11, 1813:

> "Those gentlemen, who have been in the habit of borrowing books from the late Doctor Crawford are earnestly solicited to examine their libraries, and if any belonging to him should be found, to return them to the subscriber without delay. Many valuable works of his collection are rendered useless by the loss of several volumes—amongst others of Sonini's Buffon which cost 300 dollars, and the loss of which is irreparable in this country, there remains but one volume out of ten—this work has been borrowed by someone in the course of the last year, and its loss is truly distressing to the subscriber, since it did not belong to the Doctor, but was lent by a friend, to whom it is utterly impossible for her to make restitution."[22]

Many years later, from Paris, Eliza wrote of her father:

> "My dear Father whom you have honoured with your esteem and friendship, and who lived for more than ten years, and always with us, after our marriage, conceived for Godefroy [her husband], an ardour of esteem and affection which knew no bounds. The thoughts of leaving the happiness of his only child in such hands, soothed his last hours, and in the delirium that preceded his release from

> this world of care, Husband's name, broken epithets of love and tenderness for him, were the only articulate sounds he uttered..."[23]

Why Crawford Was Ignored: The Four Fatal Factors

1. Published in the Wrong Venue

Instead of submitting his revolutionary theory to prestigious medical journals like the *Transactions of the College of Physicians of London* or the *Medical Commentaries of Edinburgh*, Crawford published serially in a small Baltimore weekly magazine edited by his daughter. He knew his ideas were controversial and seemed resigned to avoiding mainstream medical scrutiny. This choice guaranteed his work would be dismissed as provincial speculation rather than serious scientific theory.

2. Wrong Scientific Era

Crawford lived in the age of "humoral" and "chemical" theories of disease. The prevailing medical establishment believed diseases resulted from imbalances in body chemistry, atmospheric miasmas, or environmental conditions—not living organisms. When Boerhaave, Hoffmann, and other medical authorities Crawford respected made no mention of animalcular causation, most physicians saw no reason to consider it.

The scientific infrastructure for germ theory didn't exist: microscopes were primitive, bacterial culture techniques unknown, controlled experiments rare, and the concept of "infectious agent" was foreign to medical thinking.[24]

3. No Experimental Proof

While Crawford had studied Kircher, Leeuwenhoek, and other early microscopists, he lacked the technical means to prove his theory. The microscopes of his era couldn't reliably demonstrate disease-causing organisms in sick patients, there was no method to culture bacteria, no way to conduct controlled infection experiments, and no conceptual framework for Koch's postulates (which wouldn't be developed until the 1880s).

Crawford's theory rested on brilliant deduction and historical analysis—but not on reproducible experimental evidence. In an increasingly empirical age, this was fatal.[25]

4. Personal and Professional Consequences

The combination of financial ruin, professional isolation, and lack of institutional support meant Crawford could not sustain a research program. Unlike Pasteur (who had the École Normale Supérieure), Lister (who had university positions and surgical practice), or even Semmelweis

(who worked in Vienna's premier obstetrical clinic), Crawford worked alone, impoverished, and marginalized in provincial Baltimore.[19]

The Half-Century Gap: Crawford to Pasteur and Lister

Crawford died in 1813 with his theories dismissed. It would take **47-70 years** before the medical establishment accepted germ theory:

Louis Pasteur (1860s-1880s)

- Proved microorganisms cause fermentation (1857-1860)
- Demonstrated spontaneous generation was false (1861)
- Developed germ theory of disease through rigorous experiments
- Created vaccines for anthrax and rabies
- Had institutional support, laboratory facilities, and reproducible methods

Joseph Lister (1860s-1870s)

- Applied Pasteur's germ theory to surgery
- Developed antiseptic techniques using carbolic acid
- Published results showing dramatic reduction in post-surgical infections
- Had university position, hospital access, and surgical practice to demonstrate results
- Built on Pasteur's proven theoretical foundation

Robert Koch (1870s-1880s)

- Isolated specific bacteria causing specific diseases
- Developed Koch's postulates (scientific method for linking microbes to disease)
- Discovered tuberculosis and cholera bacteria
- Created laboratory techniques for culturing and studying bacteria[24]

What Made Pasteur and Lister Succeed Where Crawford Failed?

1. **Better Technology**: Improved microscopes, staining techniques, culture media, and laboratory equipment made bacteria visible and manipulable

2. **Experimental Proof**: Controlled experiments that could be replicated by others, producing consistent results that convinced skeptics

3. **Academic Infrastructure**: University positions, research funding, laboratories, assistants, and institutional prestige

4. **Timing**: A scientific community ready to challenge old theories, with emerging evidence from multiple disciplines (microscopy, chemistry, epidemiology) pointing toward germ theory

5. **Persistence and Publication**: Continued research over decades, publication in prestigious journals, presentations at scientific meetings, and building networks of supporters

6. **Practical Applications**: Vaccines, antiseptic surgery, and public health measures that demonstrably saved lives, convincing the medical profession through results

7. **Building on Predecessors**: Pasteur explicitly acknowledged Leeuwenhoek and other microscopists; Lister built directly on Pasteur's work; Koch systematized what Pasteur and Lister had demonstrated

---

Crawford's Enduring Legacy

Crawford's remarkable medical library of over 400 volumes became the foundation of the University of Maryland Medical Library, where it remains today as the distinct "Crawford Collection." When the Library and Historical Society of the University of Maryland was founded in December 1904 with Dr. William Osler as principal guest speaker, "an interesting display was made in the library of the rare old volumes which once belonged to John Crawford."[19]

The Collection Includes:

- Hippocrates (1657 edition)
- Galen (1565 Junta edition)
- Malpighi's complete works (1687)
- Boerhaave's major writings
- Haller's extensive publications
- Kircher's *Scrutinium Physico-Medicum* (1671)—the very book that inspired Crawford's animalcular theory
- Swammerdam, Leeuwenhoek, Redi, and other early microscopists[1]

A Book's Journey

Ironically, the most valuable book from Crawford's collection no longer resides in Baltimore. Around 1904, Dr. Eugene Cordell (then librarian) gave Crawford's copy of Sydenham's *Observationes Medicae* (1676) to William Osler "on account of its association with John Crawford." Osler noted in his *Bibliotheca Osleriana*:

> "Signature of John Crawford on fly-leaf. Some subjects indexed in MS at end... Given to me in exchange by Dr. Cordell from the Univ. of Maryland Library... Thayer had copied for me for Sir Ronald Ross, Crawford's remarkable papers on 'Quarantine' from the Baltimore 'Observer,' 1806-7. Ross deposited the papers in the Library of the School of Tropical Medicine, Liverpool. Crawford suggests the importance of insects as transmitters of disease."[26]

Thus, Crawford's insights about insect-transmitted disease eventually reached Sir Ronald Ross, who proved that mosquitoes transmit malaria—exactly the kind of connection Crawford had proposed a century earlier.

The Tragedy of John Crawford

One contemporary noted: "Crawford's theories were too much in advance of his generation to be given the recognition which he modestly sought."[19]

But the tragedy runs deeper than mere timing. Crawford saw the fundamental truth about infectious disease—that microscopic organisms cause epidemics—but lived in a century that couldn't or wouldn't see it.

He Had:

- The insight: Diseases are caused by specific animalculae
- The historical scholarship: He studied Kircher, Leeuwenhoek, Redi, and Swammerdam
- The deductive reasoning: He connected insect transmission, disease locality, and microbial action
- The intellectual courage: He published despite knowing it would destroy his practice

But He Lacked:

- The technology to prove it
- The institutional support to sustain research
- The scientific community ready to accept it
- The practical demonstrations to convince skeptics
- The personal resilience to endure decades of rejection

Crawford paid the ultimate professional price for being right too soon. He died impoverished, dismissed as a crank, his theories forgotten. While Pasteur is celebrated as the

"father of germ theory" and Lister revolutionized surgery, Crawford remains largely unknown—a footnote in medical history, if mentioned at all.

His story embodies a painful truth: **scientific progress requires not just insight, but the right tools, the right time, the right institutional support, and extraordinary persistence.** Crawford had the first but not the rest—and so medical history moved forward without him, only to rediscover his truth half a century later, bestowing fame and honor on others who had what he lacked: the ability to prove what he could only assert.

A Kindred Spirit: Ignaz Semmelweis and the Recurring Tragedy

Crawford's story finds a haunting parallel in another physician ahead of his time: **Ignaz Semmelweis (1818-1865)**, the Hungarian obstetrician who discovered that handwashing could prevent puerperal fever (childbed fever) decades before germ theory was established.

Semmelweis's Discovery (1847)

Working at Vienna General Hospital's obstetrical clinic, Semmelweis noticed a horrifying pattern: women giving birth in the clinic staffed by medical students died of puerperal fever at rates of 10-35%, while women in the midwives' clinic died at only 2-3%. When his friend Jakob Kolletschka died after being accidentally pricked by a student's scalpel during an autopsy, and the autopsy showed pathology identical to puerperal fever, Semmelweis made the connection:

Medical students were coming directly from dissecting corpses to delivering babies, carrying "cadaverous particles" that caused the deadly infections.

In May 1847, Semmelweis mandated that everyone working in the maternity ward wash their hands in chlorinated lime solution before examining patients. The mortality rate plummeted from 18% to less than 2% almost immediately.[27]

The Same Four Fatal Factors

Like Crawford, Semmelweis faced the same obstacles:

1. Published in the Wrong Venues (or Not at All)

Semmelweis was notoriously poor at promoting his findings. He didn't publish his results in a timely manner, and when he finally did (*The Etiology, Concept, and Prophylaxis of Childbed Fever*, 1861), it was a dense, hostile tome that attacked his critics rather than persuading them.[28] Like Crawford's magazine articles, this ensured his work would be dismissed rather than seriously considered.

2. Wrong Scientific Era

Semmelweis worked before Pasteur and Lister established germ theory. The prevailing explanations for puerperal fever included "atmospheric miasmas," "cosmic-telluric influences," and imbalances in humors. The idea that invisible "particles" from corpses could cause disease seemed absurd to most physicians—just as Crawford's animalculae seemed absurd in 1807.[29]

3. No Mechanism to Explain Success

Semmelweis could demonstrate that handwashing worked—the statistics were undeniable—but he couldn't explain *why* it worked. Without germ theory, without microscopes powerful enough to see bacteria, without the concept of infectious agents, his colleagues dismissed the results as coincidental. He spoke vaguely of "decomposing organic matter" but had no theoretical framework to make this convincing.[30]

4. Personal and Professional Consequences

Semmelweis's insistence that physicians were killing their patients by failing to wash hands was seen as an insult to the medical profession. He became increasingly angry and erratic as his findings were rejected. He lost his position in Vienna, returned to Budapest, and eventually suffered a mental breakdown. In 1865, he was committed to an asylum, where he died at age 47—ironically, of an infection similar to the puerperal fever he'd fought to prevent.[27,28]

The Bitter Parallel

The similarities between Crawford and Semmelweis are striking:

Factor	John Crawford	Ignaz Semmelweis
Core Insight	Diseases caused by microscopic animalculae	Handwashing prevents disease transmission
When	1806-1807	1847-1865

Evidence	Theoretical/deductive	Statistical/clinical
Reception	Dismissed as speculation	Rejected despite evidence
Career Impact	Lost medical practice, died in debt	Lost position, mental breakdown
Publication	Provincial magazine	Delayed, poorly written book
Died	1813, impoverished and forgotten	1865, in an asylum
Vindication	Pasteur/Koch (1860s-1880s)	Lister/Pasteur (1860s-1870s)

The Difference: Evidence Wasn't Enough

What makes Semmelweis's story even more tragic than Crawford's is that **he had statistical proof**—mortality rates dropped dramatically and consistently when handwashing was implemented. Yet even concrete evidence wasn't enough to overcome the wrong theoretical framework, the professional resistance, and the lack of a mechanism to explain the results.

Crawford had brilliant theory without proof; Semmelweis had proof without theory. Neither could convince their contemporaries.

The Pattern of Rejected Pioneers

Crawford and Semmelweis represent a recurring pattern in medical history—the **"Semmelweis reflex,"** the tendency to reject new evidence that contradicts established norms. Other examples include:

- **John Snow** (1854): Proved cholera was waterborne, but "miasma theory" prevailed for decades[31]
- **Joseph Goldberger** (1914): Proved pellagra was nutritional, not infectious; rejected for years[32]
- **Barry Marshall** (1982): Proved bacteria cause ulcers; ridiculed until he infected himself to prove it[33]

Why This Keeps Happening

These stories reveal uncomfortable truths about scientific progress:

1. **Evidence alone is insufficient**: Without a theoretical framework to explain results, even dramatic proof can be dismissed

2. **Professional identity matters more than truth**: When findings threaten professional prestige (as Semmelweis's handwashing implied physicians were killers), resistance is fierce

3. **Scientific infrastructure determines success**: Crawford and Semmelweis lacked institutional support, research funding, and powerful allies

4. **Personal resilience is required**: Both men broke under the strain of rejection; Pasteur, Lister, and Koch persisted through decades of criticism

5. **Timing is everything**: Ideas need not just to be right, but to arrive when the scientific community is ready to accept them

---

The Ultimate Irony

Both Crawford and Semmelweis died believing they had failed. Neither lived to see their ideas vindicated:

- Crawford died in 1813, **56 years** before Pasteur's germ theory was widely accepted
- Semmelweis died in 1865, **2 years** before Lister's antiseptic surgery proved him right

Today, we honor Pasteur and Lister with Nobel-level recognition. Semmelweis is remembered, at least in medical circles, as a tragic hero. But Crawford remains almost completely forgotten—despite having the insight that enabled everything that followed.

A Final Reflection

The parallel tragedies of John Crawford and Ignaz Semmelweis teach us that **being right is not enough**. Science advances not through individual brilliance alone, but through:

- The right idea
- At the right time
- With the right tools
- In the right institutional context
- Presented to a community ready to listen
- By someone resilient enough to persist through rejection

Crawford and Semmelweis had the right ideas at the wrong time, without the tools, institutional support, or community readiness they needed. They paid for their insights with their careers, their reputations, and their peace of mind.

Medicine eventually arrived at the truth both men saw clearly. But it took a half-century of preventable deaths—from infections Crawford understood, from puerperal fever Semmelweis could prevent—before the medical establishment accepted what these two physicians already knew.

Their stories stand as monuments to the human cost of being ahead of your time, and as reminders that progress often requires not just discovering truth, but surviving long enough, with enough institutional power and personal resilience, to convince others of what you've found.

In the end, Crawford's greatest legacy may be his library—still sitting in Baltimore, a testament to the scholarly foundation that enabled him to see what others couldn't. And perhaps that's the final irony: the books that gave him his insight outlasted both the man and his reputation, waiting patiently for history to prove him right.

References

1. Wilson JE. Dr. John Crawford, 1746-1813. Bull School of Med U of Md. 1940;25:116-120.

2. Smith RW Innes. English-speaking students of medicine at the University of Leyden. Edinburgh: Oliver & Boyd; 1932.

3. Crawford J. An essay on the nature, cause and cure of a disease incident to the liver hitherto but little known, though very frequent and fatal in hot climates. London: George Kearsley; 1772.

4. Cooke ET. John O'Donnell of Baltimore: His forebears and descendants. London: Favil Press; 1934.

5. Cordell EF. Dr. John Crawford, M.D. Old Maryland. 1912;8:17.

6. A Catalogue of the Books, &c belonging to the Library Company of Baltimore. Baltimore: Edes & Leaking; 1809.

7. Schultz ET. History of Freemasonry in Maryland. Baltimore: Mediary; 1885.

8. Cordell EF. Medical Annals of Maryland, 1799-1899. Baltimore; 1903.

9. Companion and Weekly Miscellany. Baltimore; 1804-1806;1-2.

10. Davison C. Maximilian and Eliza Godefroy. Maryland Hist Mag. 1934;29:1-34.

11. Ring J. A treatise on cow-pox; containing the history of vaccine inoculation. London: J & T Carpenter; 1801-1803:459.

12. Garrison FH. History of Medicine. 4th ed. Philadelphia: Saunders; 1929.

13. Bell WJ Jr. Dr. James Smith and the public encouragement for vaccination for smallpox. Ann Med Hist. 1940;2:500.

14. Brooke H. The early history of vaccination in Maryland. Baltimore Health News. 1936;13:19.

15. The Observer and Repertory of Original and Selected Essays. Baltimore; 1806-1807;1-2.

16. Medical Repository. New York; 1807-1808;5(2nd hexade):86.

17. Rush Correspondence—MS Letters of John Crawford to Benjamin Rush. Library Company of Philadelphia.

18. Biddle LA. Benjamin Rush: A memorial. Lanoraie, PA: Privately published; 1905.

19. Cordell EF. Historical sketch of the University of Maryland School of Medicine, (1807-1890). Baltimore: Isaac Friedenwald; 1891.

20. Watkins T. Eulogium on the character of brother John Crawford, M.D., late R.W.G.M. of the Masons in Maryland. Baltimore: Edward J Coale; 1813.

21. Baltimore Register of Wills, MS Records.

22. Federal Gazette and Baltimore Daily Advertiser. Baltimore; November 11, 1813.

23. Hoyt WD Jr. Eliza Godefroy: Destiny's football. Maryland Hist Mag. 1941;36:16.

24. Castiglioni A. A history of medicine. Translated and edited by EB Krumbhaar. New York: Knopf; 1941.

25. Futcher P. Notes on insect contagion. Bull Inst Hist Med. 1936;4:536.

26. Osler W. Bibliotheca Osleriana. Oxford: Clarendon Press; 1929.

27. Nuland SB. The Doctors' Plague: Germs, Childbed Fever, and the Strange Story of Ignác Semmelweis. New York: WW Norton; 2003.

28. Semmelweis IP. Die Aetiologie, der Begriff und die Prophylaxis des Kindbettfiebers. Pest, Wien und Leipzig: CA Hartleben's; 1861.

29. Carter KC, Carter BR. Childbed Fever: A Scientific Biography of Ignaz Semmelweis. Westport, CT: Greenwood Press; 1994.

30. Best M, Neuhauser D. Ignaz Semmelweis and the birth of infection control. Qual Saf Health Care. 2004;13(3):233-234.

31. Johnson S. The Ghost Map: The Story of London's Most Terrifying Epidemic. New York: Riverhead Books; 2006.

32. Kraut AM. Goldberger's War: The Life and Work of a Public Health Crusader. New York: Hill and Wang; 2003.

33. Marshall BJ, Warren JR. Unidentified curved bacilli in the stomach of patients with gastritis and peptic ulceration. Lancet. 1984;1(8390):1311-1315.

This document was compiled from historical sources, primarily the article "An Early Baltimore Physician and His Medical Library" by Julia E. Wilson, published in the Annals of Medical History, and supplementary historical research on Ignaz Semmelweis and the history of germ theory.