

medicine

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The University of Michigan

“An Example Worthy of



The 150th anniversary of the University of Michigan Medical School affords occasion for both celebration and reflection, not just in Ann Arbor but throughout the world, as we consider its contributions to medical education, research, and health care over the past century and a half. This article explores the medical school's origins as a frontier medical outpost, and describes the vital reforms in Medical Education implemented in Ann Arbor long before the landmark Flexner Report on Medical Education of 1910. It also depicts how and why the Medical School developed as it did and what features are distinctive or typical about the School during this period.

Medical School, 1850 - 2000

Imitation”

Health care in Michigan during this period was similar to that of the rest of the early frontier United States. The care of the ill took place primarily in the home and was largely in the domain of female members of a family. Their

understanding of disease was a blend of knowledge picked up from friends, relatives, occasional interactions with physicians and alternative healers, and personal experience.

The few physicians who did practice in Ann Arbor during this period often offered commonly used

medicinals and humoralism-based interventions such as bleeding.^{3,4}

Howard Markel, M.D., Ph.D.

The Early Years: 1817-1847

While Michigan was still a territory of the Northwest Ordinance, a legislative act of August 26, 1817, established the Catholepistemiad, or University, of Michigania in Detroit (population, 4,000). The school, whose mission spanned the primary to the university levels, struggled to exist. After the devastating cholera epidemic of 1832, it closed and sold its property for \$5,000.00 which was set aside as a general fund for a future University of Michigan. It was not until March 1837, shortly after Michigan was granted statehood, that the legislature passed an act to establish the University. After heavy politicking by at least four Michigan settlements, the legislature approved a forty-acre site donated without cost to the state by a group of citizens from Ann Arbor in which to situate the proposed university. This decision was controversial, especially for those living in Detroit, the major entry point to Michigan because of its deep-water port. In 1837, Ann Arbor was 13 years old, a tiny frontier village with a population of only 2,000, including several German immigrant families and nine physicians. Native Americans still came to town to trade goods, and transportation between Ann Arbor and other points relied on stagecoach. Railroad lines to Detroit were not established until 1839.^{1,2}

Founding the Medical School, 1847-1865

Financial crises and administrative inertia made the establishment of a medical school at the University of Michigan difficult until January 1847, when a group of local physicians petitioned the regents. These physicians conducted a survey and found that some 70 “Michigan boys” had left the state to study (and most likely, practice) medicine elsewhere. This potential paucity of a new crop of available physicians, they warned, was bound to have an impact on the health of the young state.^{5,6}

The petition was referred for further study to a committee chaired by physician and University Regent Zina Pitcher, a graduate of the Castleton (Vermont) Medical School and Middlebury College (M.D. 1822). After an eight-year career as a U.S. Army surgeon, Pitcher settled in Detroit in 1836 to marry and practice medicine. In an attempt to spur the University into establishing a medical department of its own, he opened a proprietary medical school in 1846, which failed and closed in 1847. In May 1847, however, Pitcher attended the first annual meeting of the American Medical Association in Philadelphia, where he was a member of the education committee, and learned about the inadequate level of medical education across the United States. He soon ➤

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became convinced that it was the State's obligation to protect the health of its citizens and the best way to reach this goal would be to establish a first-rate medical school. Such thought was remarkably advanced for a post-Jacksonian-era American and presages much public health and medical education policy-making of the late twentieth century. On January 9, 1848, Pitcher submitted the blueprint for the medical school to the regents:

If it can be conceded that it is the duty of this Board when circumstances favor that end, to establish a Medical Department of the university, it may also be seen that we who have the administration of a splendid trust are charged with the execution of a high and responsible duty in setting before such Institutions in our organization, an example worthy of imitation.⁷

The board of regents unanimously adopted Dr. Pitcher's recommendations to establish a medical school and appropriated \$3,000 to construct a medical building to be opened by the following autumn. Five professors were appointed over the next two years: Silas Douglass (pharmacy and medical jurisprudence, 1848), Abram Sager (physic or medicine, 1848, and obstetrics and the diseases of women and children, 1850, and the first dean), Moses Gunn (anatomy and surgery, 1849), Jonathan Adams Allen Jr. (pathology and physiology, 1850), and Samuel Denton (physic, 1850).⁸

Underestimates of construction costs and inclement weather plagued the opening of the Medical School, and the medical building, modeled after a Greek temple with columns and a portico, was not ready until the fall of 1850. The final cost of the building was approximately \$9,000, but it boasted several lecture rooms, offices for the professors, a chemistry laboratory, and a room under a domed roof designed for anatomical dissections whenever a human cadaver could be procured.^{9,10} The first class consisted of 90 matriculants and five physicians seeking additional training. Unlike many U.S. medical schools at that time, Michigan could claim its own building on a university campus — as opposed to another location or no affiliation at all with a university — and, unlike all other medical colleges in the nation, in having professors whose salaries were entirely paid by the university. The latter meant that students were not required to buy admission tickets directly from professors for the lectures and demonstrations that made up the curriculum.¹¹ Many other schools were owned by busy practitioners and operated on a for-profit basis, hence the term “proprietary medical school.” Few medical schools were attached to a hospital nor did many have a specific building for laboratory exercises or lectures. At most of these institutions during the early to mid-nineteenth century, medical instruction was deemed by contemporary observers to be inadequate.



At Michigan, admission required evidence of “good moral character” and knowledge of Greek and Latin. Few students went to college, but many were graduates of provincial high schools as was typical for the good medical schools in the nation such as Harvard Medical School in Boston and the College of Physicians and Surgeons in New York. Once in medical school, students attended four lectures per day, Monday through Friday, with a clinical demonstration on Saturday mornings, from October to April. Students were required to repeat the same six-month regimen the following year and to present a thesis on the topic of their choice, which was essentially a review of the literature on a specific topic.

University of Michigan medical students, like their peers at other medical schools across the nation, were also required to serve as apprentice to a “respectable physician” for three years before or



Reform and Expansion, 1866-1891

In the decades after the Civil War, Michigan began a steady transformation that placed it at the forefront of U.S. medical education. In 1869 Michigan established the nation's first university-owned hospital when a house originally built for a professor was converted into a hospital. The hospital served merely as a home for patients to stay before and after being presented to the medical students. There were, as Victor Vaughan recalled, "no wards and no operating or dressing rooms, no place where students might receive bedside instruction."¹⁵ In 1876, a pavilion hospital with 70 beds was erected for the treatment of patients and clinical presentations for medical students.

The University of Michigan Medical School, as a public institution charged with providing instruction for all of Michigan's citizens, began to routinely accept women, Asians, and African-Americans and other minority students long before this was a common practice at other American medical schools. During the late 19th century, the average number of women students in each medical class was about 15; there was one African-American per class.¹³ The first African-American medical graduate, Henry Fitzbutler, graduated in 1872. Saiske Tagei, a Japanese student, graduated in 1874; Jose Celeso Barbosa was the first Puerto Rican medical graduate in 1880; and two women from China, Ida Kahn and Mary Stone, received their medical degrees in 1896.¹³

Although it was accomplished, the decision to admit women to the University of Michigan was not easily reached and provides a context for how revolutionary the University's admission policy really was during a period decades before the concept of co-educational education was introduced at other institutions. Although women had petitioned the regents to matriculate as early as 1858, it was not until January 1870 that women were finally accepted as students. Shortly thereafter, the Medical School admitted 18 women. At that time, there were fewer than six schools in the United States where a woman could obtain a medical education. ➤

during the periods between the didactic terms in Ann Arbor. This requirement served as the principal means of teaching clinical medicine at Michigan until 1880. While an apprentice, the student took on a variety of duties ranging from hitching the physician's horse to his buggy and compounding prescriptions to holding down a patient undergoing an operation without anesthesia.^{5(pp1-7)} The term "respectable," as used by the Michigan medical faculty, meant that the precepting physician subscribed to the methods and theories of the "regular" profession as opposed to other popular medical philosophies such as homeopathy or eclecticism. Indeed, there existed much rancor and competition between allopathic and homeopathic physicians in the state of Michigan during this period, and the University maintained a separate homeopathic medical college and hospital from 1875 until 1922, one of the few state-run homeopathic medical schools in the nation.^{2(pp1003-1012)}



Many members of the all-male faculty worried that some of the subjects routinely taught might offend the “sensibilities” of women students. Others protested based on notions of a woman’s “physical incapacity” to practice medicine. Some went as far as to suggest creating a separate “Female Medical College” to be based in Detroit. Finally, a compromise was struck in the summer of 1870: women would be admitted to the medical school, but courses such as anatomy and gynecology would be taught to them separately. Faculty members who had to teach separate sessions were paid an additional \$500 per year, although this was soon declared “inefficient” by the medical faculty, and while women continued to be seated separately in the main lecture hall as well as the anatomy laboratory until 1908, all course work was truly co-educational by 1871. Amanda Sanford of Auburn, New York, was the first woman to receive a medical degree from the University of Michigan. Dean Abram Sager announced that autumn



“All of these changes reflect what
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that “our experiment had been conducted with entire harmony and success.” Alas, the reality was not quite as idyllic. As Sanford walked across the stage of the Ann Arbor Methodist Church in 1871 to receive her diploma, with honors, she was “hooted and showered with abusive notes from young male students sitting in the church’s balcony.”¹⁴⁻¹⁸

Through the mid-1870s, the curriculum remained lecture-based, except for chemistry and anatomical dissection, with little practical experience in the care of patients. The focus was on the rote memorization of details. Some medical faculty members in the early 1870s hoped to improve the educational standards but expressed concerns that setting the bar too high would encourage prospective students to apply elsewhere where a medical degree might be more easily obtained. By 1877, however, the Michigan faculty could no longer ignore these problems, and the annual session was increased in length from six to nine months. In 1880, a new three-year graded course was instituted that introduced a sequence of basic science courses, followed by pathology and therapeutics, and then clinical work. Similar curriculum changes were being made at Harvard and the University of Pennsylvania School of Medicine during this period. Finally, in 1890, a fourth year of clinical studies became mandatory. In that same year, Pennsylvania, Harvard, and Columbia adopted similar four-year programs. Moreover, Michigan students were now required to have completed at least two years of college. Throughout this period, laboratory instruction was increasingly emphasized so that, as early as 1878, all students were required to complete laboratory instruction in each scientific subject offered, with particular emphasis in physiology, anatomy, and chemistry. All of these changes reflect what was soon to become the gold standard of medical education in the United States. The University of Michigan, along with Columbia, Harvard, Pennsylvania, and, after its opening in 1893, the Johns Hopkins University School of Medicine, were making fundamental changes to their medical curricula by requiring medical students to be active participants almost two decades before the landmark Flexner Report on Medical Education of 1910 mandated the reform of U.S. medical training.¹⁹⁻²¹

The Rise of Scientific Medicine, 1891-1921

At Michigan and most other U.S. universities during the late nineteenth century, original research was not considered to be a part of a professor’s responsibilities. Instead, the focus was on teaching, administration, and, if a clinician, the practice of medicine. Those few U.S. medical educators engaged in research did so in their spare time and at their personal expense. This changed as the nation entered the twentieth century, largely under the influence of the German research universities and other major academic centers in Europe.

In 1891, University of Michigan President James B. Angell named Victor C. Vaughan dean of the Medical School. Vaughan was one of Michigan’s first doctoral graduates (Ph.D., Chemistry, 1876) and a member of the last medical class at Michigan to take the old two-year curriculum (M.D. 1878). In the decade that followed, he rose from an instructor to professor of physiological chemistry. He was also director of the Hygienic Laboratory, which functioned as the Michigan state health laboratory until 1903, one of many examples where the medical school played an integral part in the health of Michigan citizens outside the confines of Ann Arbor.^{12(pp213-261),22}

Vaughan recruited a number of excellent scientists, such as pharmacologist John Jacob Abel and bacteriologist Frederick Novy, who imbued their students with the love of discovery and the importance of the biological basis of disease.²³ For example, two Michigan students during this period who went on to active research careers included Alice Hamilton (M.D. 1893), who became the founder of the field we now call industrial medicine,²⁴ and Carl J. Wiggers (M.D. 1906), a pioneer in the modern understanding of cardiovascular hemodynamics.²⁵ Perhaps the best known example of the research ethos created at Michigan can be found in Sinclair Lewis’s 1925 Pulitzer Prize winning novel *Arrowsmith*.²⁶ Lewis consciously modeled Martin Arrowsmith’s medical school, the University of Winnemac, after Michigan largely with the help of bacteriologist, Michigan graduate, and popular writer Paul deKruif (B.S. 1912, Ph.D. 1916). Indeed, the climactic scene of the novel where Martin Arrowsmith’s wife Leora unknowingly smokes a cigarette tainted with plague bacillus was based on a real-life episode in Ann Arbor in which a medical student did the same thing in the laboratory of Frederick Novy. Fortunately, the student survived even if the fictional character did not.^{26,27} ►

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Equally important were the physicians Vaughan hired to teach clinical medicine. George Dock, professor of medicine from 1891 to 1908, established the clinical clerkship at the University, beginning in 1899, as the basic form of instruction where students were responsible for providing direct patient care under faculty supervision.^{28,29} The medical clerkship at the University, similar to the one inaugurated by William Osler at Johns Hopkins in 1895, became a model for medical schools throughout the United States.

In 1891, the clinical departments moved into a new 64-bed University Hospital where students could “walk the wards” under the supervision of their clinical professors and have a more meaningful hands-on experience in the care of patients.^{2(pp953-987)} The greatest virtue of the hospital was that it was completely under the control of the university. Such an organization avoided the internecine battles between hospital trustees, politicians, and others over matters such as clinical appointments or educational methods that plagued other medical schools partnered with charity hospitals or municipal- or state-operated facilities. By 1925, the University Hospital occupied 20 buildings and contained more than 500 beds on its medicine, pediatrics, surgery, specialty surgery, and dermatology wards. It now played a major role in caring for the state’s most indigent citizens in addition to serving as a referral center for “difficult cases” and medical student instruction. As Abraham Flexner noted when he inspected the Medical School in 1909 as part of his influential Report on Medical Education, while Michigan was far from a large urban center, “the school is fortunate in the possession of its hospital, every case in which can be used for purposes of instruction.The thoroughness and continuity with which the cases can be used to train the student in technique of modern methods go far to offset defects due to limitations in their number and variety.”³² For medical educators across North America, five medical schools were heralded as the models to imitate: Johns Hopkins, Harvard, Columbia, Pennsylvania and Michigan.^{21(p184)}

Building the Modern Teaching Hospital, 1921-1935

In 1920 Hugh Cabot was recruited from Massachusetts General Hospital to be professor of surgery at Michigan, and in 1921, after Victor Vaughan’s retirement, the regents named him dean. Cabot had ambitions to develop a “full-time” system or cooperative multimembered practice of specialists and general physicians that would offer a “more complete and varied service to patients,” reduction of costs, and the elimination of competition between private physicians practicing in the same area. Cabot believed he could effect change in a place like Ann Arbor because it was not as encumbered by tradition and old habits as Boston.^{33,34} Although Michigan boasted a “full-time” system wherein its basic science faculty was paid directly by the University and, for the clinical faculty with private practices, a combination of funds from the University and the hospital, not every department of the Medical School subscribed to this plan. Many clinical faculty members maintained lucrative private practices elsewhere in Ann Arbor or Detroit. Indeed, Cabot’s goals of implementing a full-time system for the entire faculty led to a series of acrimonious debates. The issue, for the clinicians, was largely one of money; Cabot’s proposed system would seriously curtail their incomes.³⁵

On the positive side of Cabot’s tenure as dean was the complete transformation of the medical campus including the 1925 opening of a new 893-bed University Hospital. It was heralded as the largest and most modern facility of its kind in the nation. On the negative side, however, was his contentious relationship with the faculty. While his plan for developing a full-time group practice at Michigan was both novel and prescient, his harsh methods of rule did little to advance his most significant administrative measures. Professors bitterly complained about being “terrorized” by Cabot and petitioned University of Michigan President Alexander Ruthven in January 1930 for his immediate dismissal. Refusing to resign voluntarily, Cabot was “relieved” by the board of regents of his duties as dean and chair of surgery “in the interests of greater harmony in the Medical School” on February 7, 1930.^{36,37} Following Cabot’s departure to the Mayo Clinic, an executive committee of five, chaired by bacteriologist Frederick Novy, ran the medical school. During this period, Cabot’s ambitious full-time plan was dismantled and would not be fully resolved until well into the 1970s. In 1935, otolaryngologist



Albert C. Furstenberg was appointed dean. There were several research accomplishments during this period that had international effects on health including pediatrician David Murray Cowie's work to develop iodized salt as a goiter preventive in 1924³⁸ and cardiologist Frank Wilson's refinement of the electrocardiograph as a diagnostic tool between 1914 and the 1940s.³⁹

World War II and Post-War Expansion, 1935-1970

During Furstenberg's tenure, 1935-1959, the Medical School faculty doubled in size, from 155 to more than 300, and most of the preclinical and clinical faculties were consolidated in one geographic area. In 1970, when William Hubbard stepped down as dean of the Medical School and director of the Medical Center, the faculty included 639 active members.⁴⁰

In response to World War II, the Medical School increased each academic year's course load to graduate more physicians in three rather than four years. During the war, the Medical School formed a military hospital, the 298th General Hospital Unit, which attended to more than 40,000 wounded soldiers in the European theater.⁴¹ The University of Michigan, like every major medical center in the United States, benefited greatly from the post-war boom in industry, transportation, and the federal government's involvement in scientific research, medical care, and education. With the advent of the Medicare and Medicaid programs in the 1960s, expansion of medical care, education, and research only continued. New research and patient care buildings were erected during this period. Enrollment at the Medical School increased. Private medical insurance as well as federal and state programs for the elderly and the poor ensured that clinical facilities and medical care expanded at an exponential rate. In addition, a number of landmark medical events occurred in Ann Arbor, including Cameron Haight's development of a surgical procedure to correct tracheo-esophageal fistula in 1941 and Jerome Conn's elucidation of primary hyperaldosteronism (Conn's Syndrome) in 1954. ►



New Challenges and Adaptation, 1971-2000

Under Deans John Gronvall (1970-1983), Peter Ward (interim dean, 1983-85), Joseph Johnson (1985-1990), Giles Bole (1990-1996), A. Lorris Betz (interim dean, 1996-1998), Allen S. Lichter (1999-present), George Zuidema, vice provost for medical affairs (1984-1994), and Gilbert S. Omenn, executive vice president for medical affairs and chief executive officer (1997 to present), the Medical School has continued to advance medicine and medical education. In addition to responsive curriculum changes over this period, the Medical School has been a leader in developing minority affairs, affirmative action, and outreach programs for potential and matriculated medical students.

By the late 1970s it was clear that the University's hospital, affectionately known as "Old Main," was no longer adequate and it was replaced in 1986. As of 1999, the Medical Center includes a new, state-of-the-art 848-bed University Hospital, a large outpatient center, a new medical library, a health maintenance organization, a cancer and geriatrics center, new laboratory buildings, a maternal and child health center, and more than 30 community-based satellite clinics throughout the state. In 1998, the University of Michigan Health System recorded approximately 1.1 million outpatient visits, 33,000 inpatient admissions, and 37,000 surgical cases. Student enrollment included more than 650 medical students, 260 graduate students and 450 post-doctoral fellows. The faculty numbers 1,865 members in addition to 826 house officers and a support staff of more than 1,800 workers.^{6(pp297-306),42}

During this period, the University of Michigan has been consistently rated in the top ten medical centers annually by the National Institutes of Health and similar rankings of U.S. medical schools and medical centers. Several innovations or discoveries occurred through the efforts of Michigan biomedical scientists and physicians,

including the identification of the gene that codes for cystic fibrosis, extracorporeal membrane oxygenation (ECMO), and new methods for gene therapy and transfer.

Perhaps the most important conclusion to be gleaned from this brief review of a century and a half of medicine at the University of Michigan is that mere bricks and mortar or fiscal dynamics alone cannot explain the success of such a complex enterprise. Instead, the growth and achievements of the University of Michigan Medical School have rested squarely on the shoulders of its most important resource — the men and women who have dedicated their talents and energies to the art of healing and expanding our knowledge of human disease. This group also includes our thousands of students who have gone on to practice their expertise outside of Ann Arbor, a devoted support staff, and above all, our millions of patients over the past 150 years from whom we all learn so much not only about our profession but also about ourselves. It is all of these people who have made the University of Michigan "an example worthy of imitation." 

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References

1. Peckham, H. *The Making of the University of Michigan, 1817-1992*. Ann Arbor: Bentley Historical Library, University of Michigan, 1994, 1-30.
2. Shaw, W.B. *The University of Michigan: An Encyclopedic Survey, II*. Ann Arbor: University of Michigan Press, 1951, 773-80.
3. Burr, C.B., ed. *Medical History of Michigan*. Minneapolis, Minn.: Bruce Publishing Co/Michigan State Medical Society, 1930.
4. Anderson, F. *Doctors Under Three Flags*. Detroit: Wayne State University Press, 1951.
5. Davenport, H.W. *Not Just Any Medical School: The Science, Practice, and Teaching of Medicine at the University of Michigan, 1850-1941*. Ann Arbor: University of Michigan Press, 1999, 1-20.
6. Steneck, N.H. "From Frontier Medicine to Academic Health Science Programs." *The Origins of Michigan's Leadership in the Health Sciences*. Eds. W.N. Hubbard, N.H. Steneck. Ann Arbor: Historical Center for the Health Sciences, University of Michigan, 1995, 17-46, Monographs No. 1.
7. Pitcher, Z. "Report of the Special Committee on the Establishment of a Medical Department, January 19, 1848." *Proceedings of the Board of Regents of the University of Michigan, 1837-1864*. Ann Arbor: University of Michigan, 1848, 390.
8. Novy, F.G. "Memoirs: Zina Pitcher." *Physician and Surgeon*. 1908, 30, 49-64.
9. Bonner, T.N. *Becoming a Physician: Medical Education in Great Britain, France, Germany, and the United States, 1750-1945*. New York: Oxford University Press, 1995, 224.
10. Letter from Charles Wellington Tufts to his mother, Mrs. G.S. Tufts, Cleveland, Ohio, October 1, 1876. Michigan Historical Collections, Bentley Historical Library, University of Michigan.
11. *First Annual Announcement of the University of Michigan Medical Department, 1850*. Michigan Historical Collections, Bentley Historical Library, University of Michigan.
12. Vaughan, V.C. *A Doctor's Memories*. Indianapolis, Ind.: Bobbs-Merrill, 1926, 97-98.
13. Lewis-Johnson, G.A., ed. *Black Medical Graduates of the University of Michigan*. East Lansing, Mich.: Gloria A. Johnson Publishing Co., 1994.
14. McGuigan, D.G. *A Dangerous Experiment: 100 Years of Women and the University of Michigan*. Ann Arbor: University of Michigan Center for Continuing Education of Women, 1970, 37-38.
15. Bordin, R. *Women at Michigan: The "Dangerous Experiment," 1870s to the Present*. Ann Arbor: University of Michigan Press, 1999.
16. Marantz-Sanchez, R.M. *Sympathy and Science: Women Physicians in American Medicine*. New York: Oxford University Press, 1985.
17. Bonner, T.N. *To the Ends of the Earth: Women's Search for Education in Medicine*. Cambridge, Mass.: Harvard University Press, 1992.
18. *General Catalogue of Officers and Students of the University of Michigan, 1837-1911*. Ann Arbor: University of Michigan, 1912.
19. *University of Michigan, President's Report for 1872* [12]; *President's Report for 1876* [11-13]; *President's Report for 1883* [12-13]; *President's Report for 1890* [90]; *President's Report for 1891* [16, 27-29]. Michigan Historical Collections, Bentley Historical Library, University of Michigan.
20. Reports of the Various Departments of the Medical School Regarding the Years 1880-1882. *University of Michigan Medical School Dean's Papers*. Michigan Historical Collections, Bentley Historical Library, University of Michigan, Box 72.
21. Ludmerer, K.M. *Learning to Heal: The Development of American Medical Education*. New York: Basic Books, 1985.
22. Davenport, H.W. *Victor Vaughan: Statesman and Scientist*. Ann Arbor: University of Michigan Historical Center for the Health Sciences, 1996, 1-28, Monograph Series No. 4.
23. Parascondola, J. *The Development of American Pharmacology: Johns J. Abel and the Shaping of a Discipline*. Baltimore: Johns Hopkins University Press, 1992.
24. Hamilton, A. *Exploring the Dangerous Trades*. Boston: Little, Brown & Co., Inc., 1943.
25. Wiggers, C.J. *The Pressure Pulses in the Cardiovascular System*. London: Longmans, Green & Co., 1928.
26. Lewis, S. *Arrowsmith*. New York: Harcourt, Brace & Co., 1925.
27. DeKruif, P. *The Sweeping Wind: A Memoir*. New York: Harcourt, Brace & World, 1962, 73-119.
28. Dock, G. *Notes of Medical Clinics Taught by Professor George Dock, 1891-1908*. Michigan Historical Collections, Bentley Historical Library, University of Michigan.
29. Davenport, H.W. *Doctor Dock: Teaching and Learning Medicine at the Turn of the Century*. New Brunswick, N.J.: Rutgers University Press, 1987.
30. Osler, W. "The Hospital as a College." *Aequanimitas and Other Addresses*. Philadelphia: P. Blakiston's Sons & Co., 1904, 327-342.
31. Pratt, J.H. *A Year With Osler, 1896-1897*. Baltimore: Johns Hopkins University Press, 1949.
32. Flexner, A. *Medical Education in the United States and Canada*. New York: Carnegie Foundation for the Advancement of Learning, 1910, 243-244.
33. *Proceedings of the Board of Regents of the University of Michigan, January Meeting, 1920*. University of Michigan, 1920, 811-816.
34. Cabot, H. *The Doctor's Bill*. New York: Columbia University Press, 1935.
35. Davenport, H.W. *University of Michigan Surgeons, 1850-1970: Who They Were and What They Did*. Ann Arbor: University of Michigan Historical Center for the Health Sciences, 1993, 61-80, Monograph Series No. 3.
36. *Proceedings of the Board of Regents of the University of Michigan, February 7, 1930 Meeting*. University of Michigan, 1930, 169.
37. "Dean Cabot Ousted: Regents Demand Resignation of Medical Chief by Noon Saturday." *Washtenaw Tribune*. February 7, 1930, 1, 1.
38. Markel, H. "When It Rains It Pours: Endemic Goiter, Iodized Salt, and David Murray Cowie, M.D." *American Journal of Public Health*. 1987, 77, 219-229.
39. Howell, J. "Frank Wilson." *Medical Lives and Scientific Medicine at Michigan, 1891-1969*. Ed. J. Howell. Ann Arbor: University of Michigan Press, 1993, 101-127.
40. *University of Michigan Faculty Roster, 1850-1972*. Archival Collections of the University of Michigan Historical Center for the Health Sciences.
41. Williams, B.A. "Michigan on the March: The University of Michigan in World War II." *University of Michigan Bentley Historical Library Bulletin* 42, 1995.
42. *Annual Report of the University of Michigan Medical Center for the Year 1969-70* [9-10]; *Annual Report for 1973-74* [1-2]; *Annual Report for 1975-1976* [2]; *Annual Report for 1986; Annual Report for 1990; Annual Report for 1998*. Michigan Historical Collections, Bentley Historical Library, University of Michigan.