JOURNAL of MAINE MEDICAL CENTER

Journal of Maine Medical Center

Volume 6
Issue 1 *Winter 2024*

Article 5

2024

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Recommended Citation

Remick, Scot C. (2024) "Victor A. McKusick, MD and The Osler Medical Service – Firm System Threads Between Baltimore and Maine: The 15th Annual McKusick Lecture," *Journal of Maine Medical Center*: Vol. 6 : Iss. 1 , Article 5.
Available at: https://knowledgeconnection.mainehealth.org/jmmc/vol6/iss1/5 https://doi.org/10.46804/2641-2225.1175

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Victor A. McKusick, MD and The Osler Medical Service – Firm System Threads Between Baltimore and Maine: The 15th Annual McKusick Lecture

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Editor's note: Douglas Sawyer, MD, PhD, and chief academic officer at MaineHealth extended an invitation to Dr. Remick to give the 15th Annual McKusick Lecture on July 18, 2023. This lecture has been hosted each year by the Department of Medical Education at Maine Medical Center since the inception of the Maine Medical Center Maine Track Program of Tufts University School of Medicine in 2008, and it is given to honor the entering class (Table 1). The lecture is named after Victor A. McKusick, MD, who was born and raised in Maine and regarded as the *Father of Medical Genetics.* Dr. McKusick spent his entire career at Johns Hopkins University School of Medicine and The Johns Hopkins Hospital in Baltimore, Maryland. It is fitting that the lecture to our incoming medical students should be named in his memory because of Dr. McKusick's commitment to lifelong learning, discovery, and his Maine roots.

INTRODUCTION

I had the good fortune to serve my residency from 1982 to 1985 on the Osler Medical Service at The Johns Hopkins Hospital in Baltimore on the Longcope Firm. My term coincided with the last 3 years of Dr. Victor McKusick's tenure as the William Osler Professor of Medicine, director of the Department of Medicine, and physician-in-chief at Hopkins. I was invited to share my reflections of Dr. McKusick and my experience at Hopkins for this 15th Annual Lectureship named in his honor. Dr. Richard Kahn (Tufts School of Medicine Class of 1966) proposed such a lectureship at Maine Medical Center given his Maine upbringing and *"favorite son"* status as a physician. The McKusick family has a strong history with Maine Medical Center, lending their name and support to our annual lecture and announcement of each year's incoming Maine Track class (Figure 1). Over the arc of my career, I have yet to encounter a more admired or revered physician. He is regarded as the Father of Medical Genetics, readily attributable to his seminal body of near lifelong work—*Mendelian Inheritance in Man*—that led to his 1997 Lasker Award. Since 1945, the Lasker Awards have been given annually to living persons who have made major contributions to medical science or performed public service on behalf of medicine.

In many regards, Dr. McKusick was a self-trained cardiologist with his service at the Baltimore Marine Hospital during World War II that shortly thereafter culminated in his interest in heritable disease(s). His work began in earnest as he described and cataloged the phenotypic characteristics of patients affected with Marfan syndrome.[1] The syndrome was originally (and mistakenly, later thought to be congenital contracture arachnodactyly) characterized by a French pediatrician, Antoine Marfan, in 1896 upon caring for a young girl with long, spider-like fingers and other curious skeletal abnormalities.[2] He also led seminal studies in the Amish, whose community remains burdened with a highly unfavorable genetic load.

What is less well appreciated, and perhaps his most cherished contribution, was the re-design of the Osler Medical Service training program that he initiated in 1975.[3] The creation of the firm system and Hopkins' national profile in postgraduate medical training provides the backdrop for this lecture. In a few years, this training model will celebrate its 50th anniversary. We do not celebrate institutional history often enough, and Johns Hopkins Medicine is the exception to that. Similarly, what is also less known is the national leadership that is occurring at Maine Medical Center in both undergraduate medical education and postgraduate training. Throughout my preparation for this lecture, I delighted in the "threads" that connect us, from Victor McKusick's Maine upbringing to his Baltimore academic life, and how we, indeed, have much to be proud of at Maine Medical Center. We too enjoy a credible history. I value sharing a "collective imagination" of the history of medicine in Maine and the Department of Medicine at Maine Medical Center. At the outset of the lecture, I readily offered that the thoughts presented herein are entirely my own. Kindly excuse any misrepresentation(s) or omission(s) as there are likely scores of folks and events I have missed, could capture, or simply do not know—so this is "my take".

VICTOR A. MCKUSICK, MD – BIOGRAPHY, PERSONAL REFLECTIONS, AND VIGNETTES

Modest beginnings and early life – Maine threads

Dr. McKusick was born on October 21, 1921 (he died in Towson, Maryland on July 22, 2008) in Parkman, Piscataquis County, Maine (population 747 at the 2020 census) and raised on a dairy farm (Figure 2). He had a twin brother, Vincent Lee McKusick, who served as the chief justice of the Maine Supreme Judicial Court. Dr. McKusick attended Tufts University but never finished his undergraduate degree, and, instead, pursued an accelerated medical degree at Johns Hopkins University School of Medicine during World War II, which he completed in 1946. During his tenure at Hopkins, he would host an annual short course every summer beginning in 1959 at the Jackson Laboratory in Bar Harbor on human and mammalian genetics. This course continues to evolve, and this past summer, enjoyed its 64th rendition.

Following his internship at The Johns Hopkins Hospital in 1947, his residency was interrupted because of the physician shortage during the war.[4-6] Between 1948 and 1950, he completed military service at the Baltimore Marine Hospital as chief of the cardiology unit. He returned to Hopkins and the Osler Clinic to complete his residency in 1952. In 1957, he joined the Moore Clinic for chronic disease that led to the establishment of a clinic devoted to the study of medical genetics. During this period, he also led adaptations of sound spectroscopy for analysis of heart sounds and authored a unique catalog of heart sounds and murmurs in 1958.[7] In 1973, he was appointed William Osler Professor of Medicine, the seventh director of the Department of Medicine at Johns Hopkins University School of Medicine, and physician-in-chief at The Johns Hopkins Hospital—duties he held up until the summer of 1985. His seminal contributions to medicine included his lifelong catalog of M*endelian Inheritance in Man*, description of Marfan syndrome, and seminal studies in the Amish; and he re-imagined residency training, establishing the firm system on the Osler Medical Service in 1975.[3]

Mendelian inheritance in man

In 1966, he first published his catalog of autosomal dominant, autosomal recessive, and X-linked phenotypes.[8] Remarkably, this text would be printed over 12 editions between 1966 and 1998; the subtitle was changed for the 12th and last printed edition to *A Catalog of Human Genes and Genetic Disorders.* Web access launched in 1987, and today, it is maintained and updated daily from published biomedical literature by John Hopkins University and the National Genome Research Institute as *OMIM®: Online Mendelian Inheritance in Man*.[9] With the completion of mapping the human genome in 2003, entries exponentially increased from approximately 1600 in 1966 to present day of more than 27 000 (Table 2).[9,10]

Marfan syndrome

It is not surprising that during the formative phase of his clinical career and interest in cardiology, Dr. McKusick gravitated to better understand and characterize Marfan syndrome—given its life-threatening cardiovascular manifestations.

This heritable connective-tissue disorder affects approximately 1 in 5000 persons with demonstrable pleiotropism and clinical variability that was foundational in McKusick's pursuit of genetic disease(s). Three syndromic cardinal features span 3 organ systems comprising ocular (with retinal detachment and lens dislocation), cardiovascular (aneurysm of the ascending aorta and aortic valve regurgitation), and myriad skeletal abnormalities (Figure 3).[1,11] McKusick and his colleagues transformed the clinical approach to these patients, including early diagnostic recognition, surgical repair of aortic aneurysm, and the medical management of aortic valvular regurgitation (AR).[12-14] By the 1990s, the molecular basis for the condition was attributed to a mutation in the FBN1 gene encoding fibrillin.[15,16] What is notable is that most individuals would die from rupture of an unsuspected aortic aneurysm by 40 years of age, and today, most individuals enjoy a normal life expectancy.[17,18] While President Abraham Lincoln is long regarded to have had Marfan syndrome, at the time of his assassination in 1865, he was 56 years of age, further attesting to the highly variable nature of this condition (Figure 3).

In summary, Table 3 provides the spectrum of incompetency of the aortic valve (AV) from a Mendelian genetic framework adapted from OMIM. In addition to Marfan syndrome, OMIM defines 2 categories of aortic valve disease: (1) AOVD1: bicuspid AV with AR and aortic stenosis, and (2) AOVD2: bicuspid AV with aortic stenosis. While heritable AOVD1 is rare, bicuspid AV is the most common congenital cardiac abnormality affecting 1% to 2% of the general population and is clearly associated with proclivity toward aneurysm of the ascending aorta.[19-22] Mutations in NOTCH1 have been described in patients with bicuspid AV and thoracic aneurysms.[23] Acute rupture of the AV can also be caused by infection or trauma, expanding the differential pathogenesis of AR. Notably, in 1886, William Osler described the clinical significance of bicuspid AV in 18 of 800 (2.25%) patients in a necropsy series.[20]

My personal reflections of Dr. McKusick and vignettes

Dr. McKusick possessed an encyclopedic knowledge and recall of medical genetics. The house staff valued his Osler Rounds that would occur twice a year on each firm. We delighted in collecting cardiac auscultatory findings on our patients and/or those with potential or an

unverified hereditary basis for their illness, and sharing these patients with him on rounds. It was a treat to behold. He ushered in Osler Lunch that the department would host every Friday at noon, and there was the expectation for all residents, with the exception of those rotating on the intensive care units, that we wore our Osler ties and scarves that he designed (Figure 4). He maintained a very structured discipline for all interns, who were required to present at least 1 case at medical grand rounds over the course of the year. The intern or resident was allowed 5 minutes and 1 note card to summarize a case for the audience. Vital signs and all laboratory measurements were to be cited with units of measure without exception (eg, blood pressure 120/80 mmHg, Hgb 12.3 g/dL, and so on). Osler Grand Rounds were scheduled every Saturday morning (8:00 am to 11:00 am) in a conference facility across the street from the hospital. It was a big auditorium. The house staff endearingly referred to it as *"The Pit",* and the Baltimore medical community was invited. Dr. McKusick was always seated in the first row in front of the podium and would greet the presenter(s). For the first 90 minutes, the house staff would present 3 cases (each over 30 minutes), with radiographic studies and pathology presented briefly prior to the invited discussant. After a break for coffee and refreshments, a final hour was devoted to a full lecture, often with an invited speaker.

The Osler house staff would also enjoy an annual Christmas party that Dr. McKusick and his wife (Dr. Anne Bishop McKusick) would host at their home. He would walk around the house offering the "spike" for spiked punch or hot cider, and we were given sheets of music to sing Christmas carols around their piano. At the close of these holiday gatherings, we would receive a signed photograph of William Osler (Figure 5) and a copy of O*sler's Textbook Revisited* that he co-edited with Dr. Harvey the next year.[24] One pearl that has always stuck with me was Dr. McKusick's welcome and entreaty to incoming interns: *"Your internship will be the most enjoyable year of your professional life".* As I reflect back on my career and suggested during my talk, this likely holds true for most physicians. Anecdotally, he possessed a dry sense of humor, and more than anything, he was a gentle man (think Maine threads).

THE OSLER MEDICAL SERVICE, 1975 TO PRESENT DAY

Aequanimitas

In 1888, William Osler was recruited from the University of Pennsylvania as the first physician-in-chief of the new The Johns Hopkins Hospital that would open a year later. The Johns Hopkins University School of Medicine would open several years later in 1893. He was joined by the 3 other founding physicians [William Welch (pathology), William Halsted (surgery), and Howard Kelly (gynecology)], referred to as the "Big Four", that launched Hopkins into international prominence. On May 1, 1889, Osler gave a valedictory and farewell address to new physicians he entitled, *Aequanimitas,* at the Pennsylvania School Medicine.[25] His speech is a testament to modern medicine and highly revered and applicable today. Its foundation that 2 qualities, *"imperturbability"* and *"equanimity"*, which he defined as "coolness and presence of mind under all circumstances", are vital characteristics of all physicians.

Osler is credited with framing modern postgraduate medical training comprising a 1-year general internship followed by several years of residency (with increasing clinical duties) under the tutelage of senior physicians [ie, trainees in residence (house staff) in the hospital(s)]. In short order, Osler mentored and influenced scores of physicians, including Lewellys Barker, Theodore Janeway, William Thayer, and Warfield Longcope (Table 4), each of whom would

serve in succession as physician-in-chief and director of the Department of Medicine following his departure from Hopkins in 1905.

Table 5 summarizes the expansive disciplinary focus in internal medicine in the early 20th century and the tools that supported clinical inquiry and investigation. Pathology, extensive necropsy study, keen sensitivity to physical examination, and microscopy (ie, blood cells and infectious pathogens despite the discovery of penicillin in 1928, to put into context) were foundational to the study of medicine. What is remarkable is that many of their clinical observations are relevant to this day.[24,26] As I welcomed the Maine Track Class of 2027, one wonders what the new tools of their generation and clinical practice will be more than a century later. Our expansive understanding of the molecular basis of human disease, era of precision medicine (eg, targeted therapeutics and prevention of disease altogether); the role of artificial intelligence in history taking, navigating social determinants of health, equity, medical decision-making, predictive analytics, and diagnostic accuracy; and bioengineering and new technologies that will improve functional and sustainable life (eg, restoring cardiovascular, neurological, and movement function) are just a few examples already on the horizon.

The firm system

In 1973, Dr. McKusick was appointed the seventh director of the Department of Medicine and physician-in-chief. He "bemoaned" how much had changed since his training in the early 1950s with the growth of the house staff from 28 to 80 residents.[3] At the same time, he wanted to preserve Hopkins' legendary collegiality that resonates at Maine Medical Center, as well as to this day, from my experience. With this backdrop, Dr. McKusick set upon a re-design of the department's internal medicine residency program, and in 1975, launched the Osler Medical Service. He divided the service into 4 firms (ie, British term for a unit of caregivers) named after each of the 4 directors of the department, who succeeded Osler (Table 4) under the banner of *Aequanimitas*.[25] Each firm is directed by an assistant chief of service (ACS) who, in the early years, was a junior faculty member having completed fellowship training in the majority of circumstances and appointed for a 2-year term. The ACS served as the physician-of-record to accommodate professional billing. The ACS role shortly transitioned to a 1-year term. The junior and/or senior assistant resident would round with the ACS every evening and on weekends on the firm, and this afforded a unique learning opportunity as well. In 1977, McKusick launched the Osler Lunch every Friday at noon, and all house staff were expected to attend. It was also around this time that the Osler ties and scarves were designed, directed to be worn on Fridays, and given to new interns at the start of their training. The firm system undoubtedly created friendly competition across the Osler Service, provided a remarkable clinical environment for empowering trainees, and most importantly, setting up lifelong relationships among the house staff. Illustrative of this point, of the 6 categorical interns on the Longcope Firm during my residency, I have enjoyed personal and professional relationships with 3 others, which is remarkable since many Hopkins graduates span the country following their residency. Additionally, half of us (including myself) pursued clinical interests in HIV infection/AIDS with the emergence of the AIDS pandemic in 1982. Curiously, one wonders with current internal medicine trainees not only at Hopkins, how many may devote their professional careers to COVID-19 and/or the next global emerging pathogen(s).

In 2025, the firm system will celebrate its 50th anniversary and continues to evolve. Medical grand rounds at Hopkins now convene on Friday mornings; Osler Rounds are held monthly with a mystery case; and firm faculty rounds (formerly Osler Rounds during my training) every Tuesday.[27] I learned from my colleague, Sigrid Berg, that she had the good fortune of Dr. McKusick serving as her firm faculty on the Barker Firm following his retirement during her training at Hopkins 20 years later. The success of the Osler Medical Service is a testament to Dr. McKusick's vision and impact on postgraduate internal medicine training.

MEDICAL EDUCATION AND POSTGRADUATE TRAINING IN MAINE AND MAINE MEDICAL CENTER

History of medical education in Maine

Undergraduate medical education in Maine has a storied past (Table 6). Following statehood in 1820, the Maine legislature approved $1500 for start-up and committed $1000 annually thereafter to support the launch of the 11th medical school in the nation—Maine School of Medicine.[28] This decision was prompted by a survey of doctors that found 74 "MDs" had no college or medical degrees. The school was placed on the campus of Bowdoin College in Brunswick. The first class comprised 21 students, there was no requirement for a baccalaureate degree, and, remarkably, the medical curriculum was completed over 24 weeks.[28]

By the 1870s, the school was clearly on an upward trajectory substantiated by new departments in physiology, public hygiene, and hospital affiliation with Maine General Hospital in Portland in 1874.[28] The latter arrangement would present considerable challenge over the next 50 years. Scholarship and coursework were added each decade, and by 1904, instruction spanned nearly 3 years to earn an MD degree.

The publication of the Flexner Report in 1910 led to transformational change in medical education across the United States and Canada.[29] By 1920, the Maine School of Medicine, having produced 2138 graduates, was faced with the reality of closing.[28,30] Flexner's assessment in 1910, while relatively benign when compared to others, that *"Neither end of this school meets the requirements of teaching"* was insurmountable.[28-30] The singular challenge for the school was overcoming the geographic dislocation of the teaching campus in Brunswick, with the clinical (hospital) campus in Portland at Maine General Hospital. Thus, the Flexner Report led to the closing of 75% of US medical schools, including 5 of 7 Black medical schools.[28,29,31] Contemporary reappraisal of the Flexner Report is critical of this latter aspect of its recommendations.[31] Importantly, however, the Report led to dispensing of a proprietary education to the creation of a biomedical model and pursuit of the scientific method in formative medical education and clinical instruction.[31] Dr. Franklin Nathaniel Whittier, a former graduate of the Maine School of Medicine (Class of 1859), was an accomplished physician around this time at the school. He served as Bowdoin's physician, as demonstrator of bacteriology and pathological histology, in the Medical Corps during World War I based in Portland, and as medical examiner in Cumberland County.[28,30] Dr. Whittier was also a noted criminologist and first to distinguish animal and human blood at a crime scene. At his passing in 1924, then Bowdoin President Kenneth C. Mills remarked during his eulogy, *". . . He was the heart of the institution working indefatigably on its behalf".* Despite the challenges over the course of its century-long existence, Dr. Whittier was a tireless advocate and champion for his alma mater.[28,29]

National leadership undergraduate medical education – The Maine Track Program

Another 50 years would pass since closing of the Maine School of Medicine before undergraduate medical education would be revisited in Maine (Table 6). Between 1970 and 1980, Maine Medical Center was affiliated with the Tufts University School of Medicine, as well as the University of Vermont Larner College of Medicine that spanned 1980 to 2011. These affiliations primarily afforded elective rotations in Portland for medical students from Boston or Burlington. In 1978, the University of New England College of Osteopathic Medicine was founded in Biddeford. This medical school is consistently among the leading schools in the nation graduating physicians that pursue primary care.

In 2008, a request for applications under the leadership of Dr. Peter W. Bates at Maine Medical Center led to the creation of the Maine Track Program in affiliation with Tufts. This affiliation established formal allopathic medical education for the first time in Maine, with the first 2 years of instruction based in Boston and the second 2 years (largely clinical clerkships and electives) occurring in Maine. The program garnered significant philanthropic investment, with a present endowment of nearly $40 million dollars that provides scholarship support for eligible students, especially those from Maine.

In spring 2020, a second 10-year affiliation with Tufts was renewed following the re-design of the curriculum, with now the first year of instruction in Boston and the remaining 3 years of instruction taught wholly in Maine. The hematology-oncology course (taught over a 5-week period every October to November) is one of several new courses taught by Maine faculty in Portland. The Maine Track Program has now graduated 401 physicians, with nearly 40% of graduates returning to Maine to practice. The profile of the Class of 2023 is summarized in Table 7. The essential goal of the program is to collaboratively develop and deliver a unique and innovative medical school curriculum to address workforce needs and access in the State of Maine. This is substantiated by our Longitudinal Integrated Curriculum teaching model allowing third-year students to follow a panel of patients and their families continuously over 9 months in rural settings as they navigate the health system and our Competency-based Apprentices in Primary Care programs. To date, the Maine Track Program has far exceeded expectations. This is nicely illustrated by 2 graduates, who now practice in the MaineHealth Cancer Care Network: Dr. Lindsay Hathaway (Class of 2016) at the Harold Alfond Center for Cancer Care in Augusta, and Dr. Hilary Glick (Class of 2019) at MaineHealth Cancer Care–Brunswick and Damariscotta.

National leadership postgraduate medical training – iPACE and MERGE Programs

What is less well known is that Maine Medical Center is providing national leadership and pioneering innovative postgraduate and interprofessional training. These efforts are largely coordinated and led by the departments of medical education and medicine. Table 8 summarizes institutional training grants. In 2016, Maine Medical Center successfully competed for 1 of 8 national grants by the American College of Graduate Medical Education, *Pursuing Excellence in Clinical Learning Environments* (aka, the CLER program). Our project entitled, *Interprofessional Partnership to Advance Care and Education* (iPACE), is centered on the patient and single interprofessional care team. The team (“1 team”) rounds on 1 patient [scheduled in advance with the patient and family and/or caregiver(s)] yielding “1 round, 1 note,

1 message, 1 plan, and 1 aim".[32] In this manner, rounding serves as a continual improvement process devoted to enhancing patient care and communication among the patient, family, and care team members. The project was piloted on an Internal Medicine Teaching Unit (Pavilion 2C) at Maine Medical Center. At the end of this 3-year pilot study, the tangible outcomes included enhanced care team experience and communication; patient experience; and diminished length of stay and cost of care.[32,33] This experience paved the way for a successor American Medical Association grant supporting expansion of the iPACE platform to other care settings across MaineHealth as part of our 2023 Strategic Plan.[34] In 2022, the Maine legislature awarded another grant to establish the Maine Rural Graduate Medical Education (MERGE) Collaboration. This first-of-its-kind project bridges 4 graduate medical education programs in Maine and is providing opportunities to invest in faculty development and rural medicine workforce for interdisciplinary rural health care providers. Taken together, these peer-reviewed training grants substantiate a vibrant, nationally recognized learning and research environment for graduate medical education in Maine.

The Department of Medicine and an "imagined" firm system

The Maine Medical Center Department of Medicine also enjoys a storied history, and one can easily "imagine" a firm system, which was presented during my lecture (Table 9). A stunning observation as one peruses the nearly first century of medicine at Hopkins from 1888 to 1985 (the end of Dr. McKusick's tenure as director) and the last 40 plus years at Maine Medical Center from 1981 to present is that both organizations benefited from an average 14-year term of their respective chairs of medicine. This singular observation, more than anything, drives departmental culture that thrives with strong and consistent leadership.

With this backdrop, 4 eponymous firms —Whittier, Blaisedell, Hillman, and Bates—were enjoyably presented and defended for the Department of Medicine at Maine Medical Center (Table 9). Of these firms, Dr. Elton Randolph Blaisedell, a 1915 graduate of the Maine School of Medicine, stands out as an accomplished physician leader in the history of Maine Medical Center.[31,32] He practiced in Aroostook County early in his career. He later practiced in Portland as an internist and expert in diabetes. In 1947, he served as chief of staff at Maine General Hospital, taught internal medicine, and, in 1951, played an instrumental role bringing together Maine General Hospital, Maine Eye and Ear, and Maine Children's Hospital. In 1956, this effort culminated in the merger and creation of Maine Medical Center. He also served numerous posts in organized medicine and developed a comprehensive diabetes control plan for Maine.

Decades later, the Department of Medicine was blessed with strong and visionary leadership that spans from 1980 to the present day. Dr. Robert S. Hillman served as chair from 1981 to 1999.[35] He was an esteemed educator, expanded postgraduate training, established the Maine Rural Practice Network, and led creation of the Maine Medical Center Research Institute. He edited an authoritative textbook on hematology through 6 editions and was an expert in iron and folate metabolism. Dr. Bates served as chair from 1999 to 2008.[36] In 2008, he was founder of the Maine Track Program as discussed above. He trained as a pulmonologist and held numerous administrative and academic posts at our institution—chief medical officer, first chief academic officer, and dean ad interim at Tufts University School of Medicine during a stressful period from 2020 to 2021 in the midst of the COVID-19 pandemic—and championed campus social justice reforms.

Lastly, upon reflection of Dr. Whittier's career and impact on the practice of medicine in Maine, it is easy to imagine one of our firms being named after him. As noted above, he was memorialized as an indefatigable advocate of the Maine School of Medicine. Kindly excuse my discretion here as the McKusick lecturer—*"indefatigable"* means persisting tirelessly.[37] Indefatigable is synonymous with assiduous, diligent, dogged, energetic, inexhaustible, and painstaking, which are desirable attributes of physicians.[38] Its Latin equivalent is *sed impiger* (sed im-pi-ger; pronounced "said im-pee-ger"). We now have our "*Aequanimatas"* and motto for our imagined firm system in the Department of Medicine at Maine Medical Center – "*Sed Impiger"!*

FINAL THOUGHTS

Department of Medicine – ways forward

In January 2022, Maine Medical Center had the good fortune to recruit Dr. Arjang Djamali from the University of Wisconsin, where he served as division chief of nephrology, as our next department chair. He succeeded Dr. Michael Roy, who led the department from 2008 to 2022 and oversaw unprecedented growth with the creation of the Adult Medicine Service Line and Hospital Medicine Program. Dr. Djamali leads a dynamic department (Table 10). He brings a new vitality to the department with the singular goal, *"To be the department everyone wants to work".* He has outlined 3 strategic priorities over the next 5 years: (1) professional wellness, including diversity-equity-inclusion initiatives; (2) academic integration and advancing scholarly training programs and research; and (3) facility expansion.[40] In his short tenure, our 3-year hematology-oncology fellowship program launched in 2023, and with the anticipated merger of Maine Medical Center and Southern Maine Health Care in 2024, there are opportunities for expansive growth in our internal medicine residency program. I also took the opportunity to highlight the Division of Hematology-Oncology faculty and their leadership and contributions to the National Cancer Institute (NCI) research agenda, with 4 faculty serving on NCI disease-focused steering committees and task forces (Drs. Lu-Emerson, Bradford, Siegel, and Tchekmedyian) and 3 of our faculty recipients of Teaching Excellence Awards nominated by our Maine Track students (Drs. Moran, Rogers, and Tchekmedyian). In short, the Department of Medicine is poised for a vibrant future.

"Oslerisms"

Near the conclusion of the presentation, I shared several Oslerisms with the Maine Track Class of 2027. William Osler was a brilliant physician, a prolific writer, and pithy man. His professional advice for *all* physicians have stood the test of time for nearly a century-and-a-half. Ones that harmonized nicely with my lecture and were shared with the class are outlined in Table 11. I also shared "my takes" from Osler's quotes for the contemporary practice of medicine.

Personal reflections

Lastly, until my closing remarks, I had never shared publicly that during my senior assistant resident year, I led and worked closely with Dr. Robert Redner, ACS Longcope Firm (1984 to

1985) and oncologist, on the house staff–led reception celebrating Dr. McKusick's stewardship of the Osler Medical Service upon his retirement in June 1985. It was quite a party. The same admiration and love for a physician I have yet to encounter. Also, Dr. McKusick extended me an invitation to serve as ACS from 1985 to 1986. Had I accepted, I would have been the first resident ever offered this position at The Johns Hopkins Hospital.

There are 2 corollaries: One may always wonder how things may have been different in one's life, especially with decisions you do not make. To be honest, until my working on this lecture, I had never given this much thought. But know this: had I accepted, it is doubtful that I would have had this experience to share my thoughts about Victor A. McKusick. It is remarkable, the threads we share in honor of Dr. McKusick from his Maine upbringing and academic accomplishments in Baltimore, even the architectural symmetry of our 2 hospitals at the turn of the 20th century (Figure 6), and the national leadership Maine Medical Center is proudly charting in undergraduate medical education and postgraduate training.

Acknowledgments

Over the course of my academic career, I have never prepared a lecture quite like this. I am humbled and grateful for this opportunity and wish to extend my appreciation to Dr. Douglas Sawyer, chief academic officer, who invited me to give this lecture. This lecture brought back indelible memories for me that I valued sharing with the Maine Track Class of 2027. At the same time, I wish to acknowledge the considerable help of others who assisted with historical research and assembling lecture material and internet content for my presentation. These individuals include: Jennifer Hayman, MD, assistant dean of educational affairs, Tufts University School of Medicine, Maine Track Program; Dina McKelvy, MA, MLS, director, Library and Knowledge Services at Maine Medical Center; Jill Prescott, MS, NCORP administrator; Kalli Varaklis, MD, MSEd, designated institutional official, Graduate Medical Education, Maine Medical Center and iPACE and Maine Rural Graduate Medical Education programs; and Richard Kahn, MD, Tufts University School of Medicine Class of 1966, Tenants Harbor, Maine. Lastly, for those readers so inclined, the Department of Medical Education maintains a link for the 15th Annual McKusick lecture, which can be viewed at: https://www.youtube.com/watch?v=UfiWWeic0EE.

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Table 1. Invited Speakers for the McKusick Lecture at Maine Medical Center, Portland, Maine

Year	Invited speaker	Title	Organizational affiliation
2009	Diana Bianchi, MD Executive Director of Mother-Infant Research Institute	What I Learned from Victor McKusick that I Use Every Day	Tufts Medical Center, Boston, MA
2010	John Tooker, MD, MBA, FACP Executive Vice President and CEO, American College of Physicians	Policy and Politics: The Role of the Profession in Health Care Reform	American College of Physicians, Philadelphia, PA
2011	Kelley Skeff, PhD Vice Chair of Education	The Future of Medical Education	Stanford University, Palo Alto, CA
2012	Jerome Kassirer, MD Distinguished Professor and Senior Assistant to the Dean	How Financial Conflicts of Interest Endanger our Profession	Tufts University School of Medicine, Boston, MA
2013	David Wennberg, MD, PhD CEO for the Northern New England Accountable Care Collaborative and Chief of Technology Advisor	Health Care 2020: What will the world be like when I grow up?	Dartmouth Institute, Dartmouth University, Hanover, NH
2014	Christine Cassell, MD President and CEO	Systems Engineering: The Key to Personalized Patient Care	The National Quality Forum, Washington, D.C.
2015	Jeanne Lambrew, PhD Deputy Assistant to the President for Health Policy	The Intersection of Policy, Politics, and Patients in Health Reform	The White House, Washington, D.C.
2016	Farzad Mostashari, MD Founder and President	From Volume to Value, From Process to Outcomes, the Future of Medical Care	Aledade, Inc., Bethesda, MD
2017	George Thibault, MD President	Medical Education Transformation	Josiah Macy Jr. Foundation, New York, NY
2018	Chadwick Szylvian, MD Family Physician	How the Opioid Crisis Can Make Us Better Physicians	St. Joseph Healthcare, Bangor, ME
2019	Edison Liu, MD President & CEO	GENOMIC Futures for the New Clinician	The Jackson Laboratory, Bar Harbor, ME
2020	Tony Monaco, MD, PhD President	An Epigenetic, Transgenerational Model of Mental Health Disorders	Tufts University, Boston, MA
2021	Andrew Mueller, MD CEO	What I Wished Someone Told Me Before I started Medical School	MaineHealth, Portland, ME
2022	Helen Boucher, MD, FACP, FIDSA Dean ad interim and Professor of Medicine	Antimicrobial Resistance: The Silent Pandemic	Tufts University School of Medicine, Boston, MA
2023	Scot Remick, MD, FACP Chief of Oncology and Professor of Medicine	Victor A. McKusick, MD and The Osler Medical Service – Firm System. Threads between Baltimore and Maine	MaineHealth Cancer Care Network and Maine Medical Center, Portland, ME; Tufts University School of Medicine, Boston, MA

Table 2. OMIM Entry Statistics (Reported as of October 16, 2023)[9]

MIM number prefix (OMIM code)	Autosomal	X-linked	Y-linked	Mitochondrial	Totals
Gene description	16 243	768	51	37	17 099
Gene and phenotype, combined	21	0	0	0	21
Phenotype description, molecular basis known	6304	380	5	34	6723
Phenotype description or locus, molecular basis unknown	1394	112	4	0	1510
Other, mainly phenotypes with suspected Mendelian basis	1640	101	3	0	1744
Totals	25 602	1361	63	71	27 097

Abbreviation: OMIM, Online Mendelian Inheritance in Man.

Table 3. The Spectrum of Incompetency of the Aortic Valve from a Mendelian (Genetic) Framework*

Phenotype-Gene relationships	**Marfan syndrome**	**Aortic valve disease 1†**	**Aortic valve disease 2‡**	**Acute rupture aortic valve**
Phenotype MIM#	154700	10973	614823	NA
Location	15q21.1	9q34.3	15q22.31	--
Inheritance	Autosomal dominant	Autosomal dominant	Autosomal dominant	--
Phenotype mapping key	3	3	3	--
Gene/Locus	FBN1	NOTCH1	SMAD6	--
Gene/Locus MIM#	134797	190198	602391	--
Pathophysiology	Mutation FBN1 gene encoding fibrillin	(1%-2% general population common congenital defect)	Not well characterized	Infection trauma
Risk aortic rupture	+++++ (undiagnosed)	+ (aortic root dilatation well described; <10% autopsy series)	Coarctation and aneurysm described	± Depends on pathogenesis
Natural history	Life expectancy historically mid-40s (y); now extends into 70s (y)	Male predominance; essentially normal life expectancy	Likely normal life expectancy	Can be lethal

Abbreviations: MIM, Mendelian Inheritance in Man; NA, not applicable.

* Adapted from OMIM.[9]

† Refers to bicuspid aortic valve with aortic valvular regurgitation and aortic stenosis.

‡ Refers to bicuspid aortic valve with aortic stenosis.

Table 4. Directors, Department of Medicine, Johns Hopkins University School of Medicine and Physicians-in-Chief, The Johns Hopkins Hospital, Baltimore, MD, 1888-1985[5] *

Physician	Term	Medical education	Disciplinary expertise
William Osler, MD	1888-1905	McGill University,1872	Founding Physician-in-Chief, The Johns Hopkins Hospital in 1989; Director, Department of Medicine, Johns Hopkins University in 1893; authored *Principles & Practice of Medicine*; regarded as the Father of Modern Medicine.
Lewellys F. Barker, MD	1905-1914	University of Toronto, 1890	Remarkable diagnostician; clinical interests in neurology, endocrinology, and internal medicine.
Theodore Caldwell Janeway, MD	1914-1917	Columbia College of Physicians and Surgeons, 1895	Guided use of the sphygmomanometer in the clinic; established blood pressure norms.
William Sydney Thayer, MD	1919-1921	Harvard University, 1889	Bacterial endocarditis; set up first course in clinical microscopy.
Warfield Theobald Longcope, MD	1922-1946	Johns Hopkins University, 1901	Seminal work on Boeck's sarcoid and autoimmunity.
A. McGehee Harvey, MD	1946-1973	Johns Hopkins University, 1934	Expert on systemic lupus erythematosus and paraneoplastic syndromes; first faculty member designated a Distinguished Service Professor.
Victor A. McKusick, MD	1973-1985	Johns Hopkins University, 1946	Authored *Mendelian Inheritance in Man*; fully characterized Marfan syndrome; regarded as the Father of Medical Genetics; recipient of the Lasker Award in 1997.

* The Osler Medical Service comprises the Barker, Janeway, Thayer, and Longcope Firms.

Table 5. In Early 20th Century Medicine, Extensive Study Was Sought in Europe and Increased Laboratory Capabilities Was Desired

Disciplinary focus	**Clinical tools**
Pathology – foundational • Extensive necropsy study and series	Histology laboratory
Cardiovascular system and cardiology • Keen sensitivity to physical examination	Applications of the sphygmomanometer
Hematology	Microscopy • Blood – circulating cells • Infectious pathogens
Infectious and inflammatory diseases	Bacteriology laboratory
The Clinical Microscopy Laboratory at Johns Hopkins Hospital. Adjacent to the wards, it accommodated 110 students. Osler remarked, "Conducted properly, with a protracted course and ample material, this class becomes one of the most popular, as it certainly is one of the most useful, in the curriculum" (Osler, 1901).[26]	

Table 6. History of Undergraduate Medical Education in Maine

Years	Institution	Comment
1820-1920	Maine School of Medicine, Bowdoin College, Brunswick, ME	School produced 2138 graduates and was closed in 1920 following publication of the Abraham Flexner Report (1910). Distance of the principle teaching hospital affiliation in Portland at Maine General Hospital was too much to overcome.
1970-1980	Maine Medical Center affiliation with Tufts University School of Medicine, Boston, MA	Affiliation provided elective rotations of medical students in Portland.
1978-present	Founding University of New England College of Osteopathic Medicine, Biddeford, ME	First 4-year medical curriculum established in Maine leading to Doctor of Osteopathy degree. Approximately 6th largest graduating class devoted to primary care in the United States.
1980-2011	Maine Medical Center primary affiliate of University of Vermont Larner College of Medicine, Burlington, VT	Affiliation provided elective rotations of medical students in Portland.
2008-2019	Launch of Maine Track Program with Tufts University School of Medicine, Boston, MA	Formal affiliation leading to the award of Doctor of Medicine (allopathic) degree in Maine with first 2 years of instruction in Boston and the last 2 years in Maine.
2020-present	Expansion of Maine Track Program in affiliation with Tufts University School of Medicine, Boston, MA	Expansion of the Maine Track Program with first year of instruction in Boston and last 3 years wholly taught in Maine leading to a Tufts Medical Doctor degree. Since 2008, 401 physicians have graduated from the Maine Track Program.

Table 7. Profile of the Tufts University School of Medicine Maine Track Program Class of 2023*

Maine Track Program profile	Graduates
Total graduates since 2008, No.	401
Class of 2023 graduates, No. (%)	39 (100)
Female, No. (%)	20 (51)
Male, No. (%)	19 (49)
Students matched to Maine Medical Center for postgraduate training, No. (%)	12 (31)
Tufts students matched to Maine Medical Center for postgraduate training, No.	6
Students matched to primary care disciplines (ie, family medicine, internal medicine, and/or pediatrics)	13 (33%)

* Nearly 40% of graduates return to Maine to practice.

Table 8. National leadership Graduate Medical Education at Maine Medical Center – Grants Supporting Graduate Training and Interprofessional Education

Years	Grant program	Summary of project
2016-2019	American College of Graduate Medical Education – Pursuing Excellence in the Clinical Learning Environment – Robert Bing-You, MD, MEd, MBA, PI ($400,000 TC), Peter Bates, MD and Marge Wiggins, DNP, MBA, RN Key collaborators: Sarah Hallen, MD; Thomas van der Kloot, MD; Kalli Varaklis, MD, MSEd; Lisa Wendler, PharmD; and Christyna McCormack.	Supported launch of iPACE™ continuous improvement project, in essence, "1 patient – 1 round, 1 note, 1 message, 1 plan, 1 aim – 1 team" with creation of the Pilot Internal Medicine Teaching Unit at Maine Medical Center.
2019-2024	American Medical Association Reimagining Residency Initiative: Ensuring Readiness for Practice Through Growing Interprofessional Partnerships to Advance Care and Education – Kalli Varakllis, MD, MSEd, PI ($2,000,000) Key collaborators: Thomas van der Kloot, MD; Daniel Meyer, MD; and Thomas Gearan, MD.	Provides support to launch *Let's Pick up the iPACE* and expand iPACE principles to other care settings across MaineHealth as part of its 2023 Strategic Plan.
2022-2025	Maine Rural Graduate Medical Education Collaborative – Maine legislative initiative – Kalli Varaklis, MD, MSEd, PI ($950,000) Key collaborators: Central Maine Medical Center, Maine Medical Center, Northern Light Health, and Maine-Dartmouth Family Residency Program at Maine General Hospital.	Project creates first-of-its-kind collaboration across 4 graduate medical education training programs in the State of Maine. The goal is to invest in further developing the rural medicine work force and faculty development for interdisciplinary and interprofessional rural health care providers.

Abbreviations: iPACE, Interprofessional Partnership to Advance Care and Education.

Table 9. "Imagined" Firm System, Department of Medicine at Maine Medical Center, Portland, ME

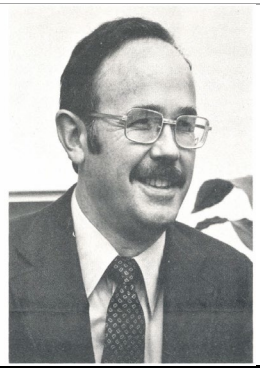
	Whittier Firm	**Blaisedell Firm**	**Hillman Firm**	**Bates Firm**
Named After	Franklin Nathaniel Whittier, MD	Elton Randolph Blaisedell, MD	Robert S. Hillman, MD	Peter W. Bates, MD
Medical Education	Bowdoin Class of 1885; Maine School of Medicine, 1989	Maine School of Medicine, 1915	Tufts undergraduate; Columbia College of Physicians and Surgeons, 1959	University of Washington, 1977
Term of Service	*"Indefatigble"* advocate for Maine School of Medicine 1897-1920	Chief of Medical Staff at Maine General, 1947; instrumental in creation of Maine Medical Center	1981-1999, Chair, Department of Medicine, Maine Medical Center	1999-2008, Chair Department of Medicine, Maine Medical Center
Disciplinary Expertise	Demonstrator of Bacteriology and Histology	Internal medicine; led pioneering studies of diabetes at Harvard University	Hematologist with research interest in folate and iron metabolism; esteemed educator; established the Maine Rural Practice Network	Pulmonologist; Founder of Maine Track Program, 2008; Chief Medical Officer and first Chief Academic Officer, Maine Medical Center
Additional Comments	Medical Examiner in Cumberland County and criminologist; first to distinguish animal and human blood at a crime scene.	Developed comprehensive diabetes control for the State of Maine.	Authored and edited hematology textbook, *Hematology in Clinical Practice* (6 editions).	Served *Dean ad interim* Tufts University School of Medicine, 2020-2021; led school through COVID-19 pandemic and campus social justice reforms.
Photograph		Not available		

Table 10. Recent History of the Department of Medicine, Maine Medical Center, Portland, ME, 1981-present

Department chairs	Current status	Sampling of national thought leaders
1981-1999 Robert S. Hillman, MD, MACP 1999-2008 Peter W. Bates, MD 2008-2022 Michael Roy, MD 2022 to present Arjang, Djamali, MD, MS, FACP, FASN The Maurice S. Segal Chair of Medicine	500+ MD and advanced practice providers 17 Divisions & 5 Service Lines 10 graduate medical education training programs Department trainees: • 36 categorical residents • 3 rural internal medicine • 3 internal medicine-geriatrics • 16 internal medicine-pediatrics • 14 preliminary • 7 fellowship programs	• Irwin Brodsky, MD – diabetes mellitus • Daniel Diekema, MD – antimicrobial drug resistance, hospital acquired infections, and epidemiology • Arjang Djamali, MD, MD – renal transplantation and biology • Kathleen Fairfield, MD, MH, DrPH – health services and improvement science • Sanjeev Francis, MD – chemocardiotoxicity and educator • Christine Lu-Emerson, MD – gliomas and member of NCI Steering Committee • Susan Miesfeldt, MD – cancer genetics • Clifford Rosen, MD – osteoporosis and calcium homeostasis • Douglas Sawyer, MD, PhD – heart failure and chemotoxicity • David Seder, MD – survivorship cardiopulmonary arrest • Robert Smith, MD – vector-borne (Lyme) disease • Vatche Tchekmedyian, MD, MEd – head and neck cancer and member of the NCI Task Force, thyroid cancer, and educator • Kinna Thakarar, MD – injection drug use and infectious comorbidities • Robert Trowbridge, MD – clinical reasoning, diagnostic error, and educator

Abbreviation: NCI, National Cancer Institute.

Table 11. Oslerisms from the Late 19th to Early 20th Century and "Contemporary Perspectives" Shared with the Maine Track Class of 2027[25,41,42]

"It is much more important to know what sort of patient has a disease than what sort of disease a patient has." *My take: Origins of patient-centered care and social determinants of health.*
"The first duties of the physician is to educate the masses not to take medicine." *My take: The consumption of health care may not be a good thing.*[43]
"The young physician starts life with 20 drugs for each disease, and the old physician ends life with one drug for 20 diseases." *My take: The origins of value-based care.*
"To study the phenomena of disease without books is to sail an uncharted sea, while to study books without patients is not to go to sea at all." *My takes:* *1) Read about your patient(s). They will come alive in the pages of your books and articles. If you do this, you will be a fast learner.* *2) We often overlook the natural history of disease. Pay attention to the social determinants of health and be reminded that the human genome across genders, race, and ethnicities is >99.9% identical.* *The 0.1% differences come from variations among nearly 3 billion bases (or "letters") in our DNA. Sometimes these variations can influence our chances of developing a disease – I am calling this "McKusick's space" for today's lecture.*[44,45] *3) Over the next 12-15 years of your life, you will be on steep learning curves every 3-4 years. But know this: your best teachers will be your colleagues during your residency.*
"There is no disease more conducive to clinical humility than aneurysm of the aorta." *My take: Human genes and especially social determinants of health are important contributors to the natural history of disease.*

Figure 1. Photograph (July 18, 2023) of the Maine Track Class of 2027 in the Dana Center at Maine Medical Center. Photo was taken after the lecture and students receiving their stethoscopes from the leadership of the Maine Medical Center Department of Medical Education. *Podium:* Dr. Remick. *First row, left end:* Dr. Douglas Sawyer, Chief Academic Officer. *First row, second from left end:* Dean Helen Boucher. *First row, right end:* Dr. Linda Chaudron, Vice President of Medical Education. *First row, third from right end:* Dr. Jennifer Hayman, Assistant Dean, Maine Track Program. *Second row, left end:* Dr. Joel Botler, CMO and Interim President Maine Medical Center. *Second row, second from left end:* Dr. Andrew Mueller, CEO MaineHealth.

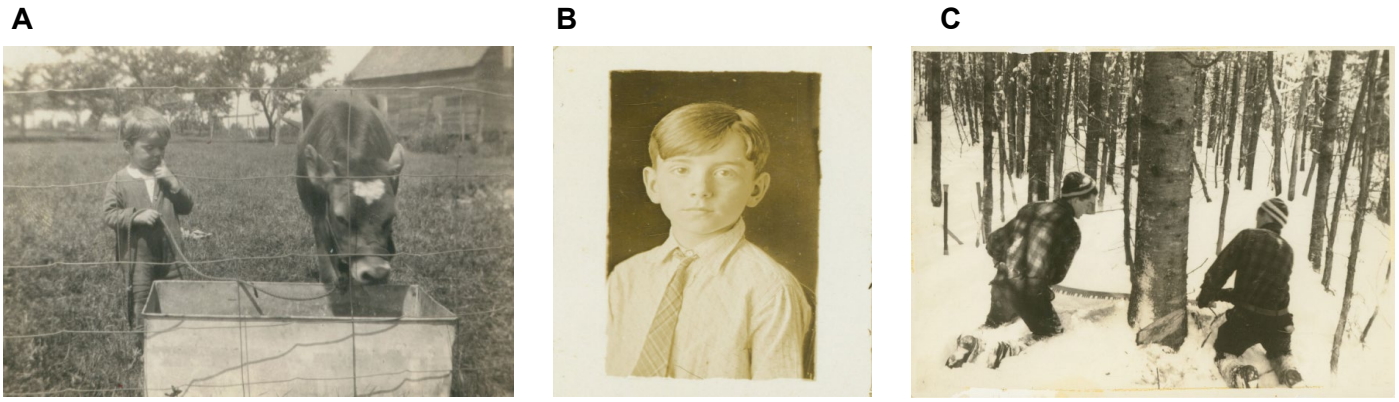


Figure 2. Maine Roots – Victor McKusick, Early Boyhood Photos. Victor with the family cow, "Alice" (A); at age 11 (B); and cutting a tree with his brother, Vincent (C). [Photos from the NIH National Library of Medicine.[4]]

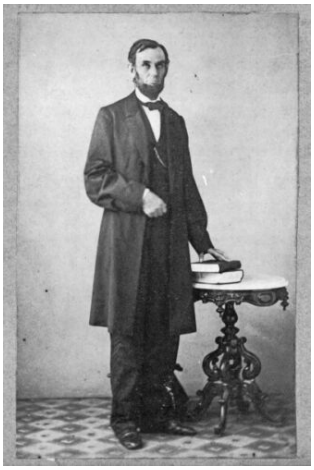


Figure 3. Pleiotropic Skeletal Manifestations of Marfan Syndrome.[1,11] Skeletal features of Marfan syndrome may include: tall and slender build; disproportionately long arms, legs, and fingers; a breastbone that protrudes outward (pectus excavatum) or inward (pectus cavus); an abnormally curved spine and flat feet; and a high, arched palate and crowded teeth.

Figure 4. Portrait of Victor A. McKusick, MD. The portrait was taken in front of a picture of Johns Hopkins wearing his Osler tie, which he designed with the inscription *"Aequanimitas"*.

DOI: 10.46804/2641-2225.1175

Figure 5. The Johns Hopkins Hospital, circa 1980s, around the time of my residency (A), and Dr. McKusick's signed photograph of William Osler gifted to the Osler Housestaff, December 1982 (B).

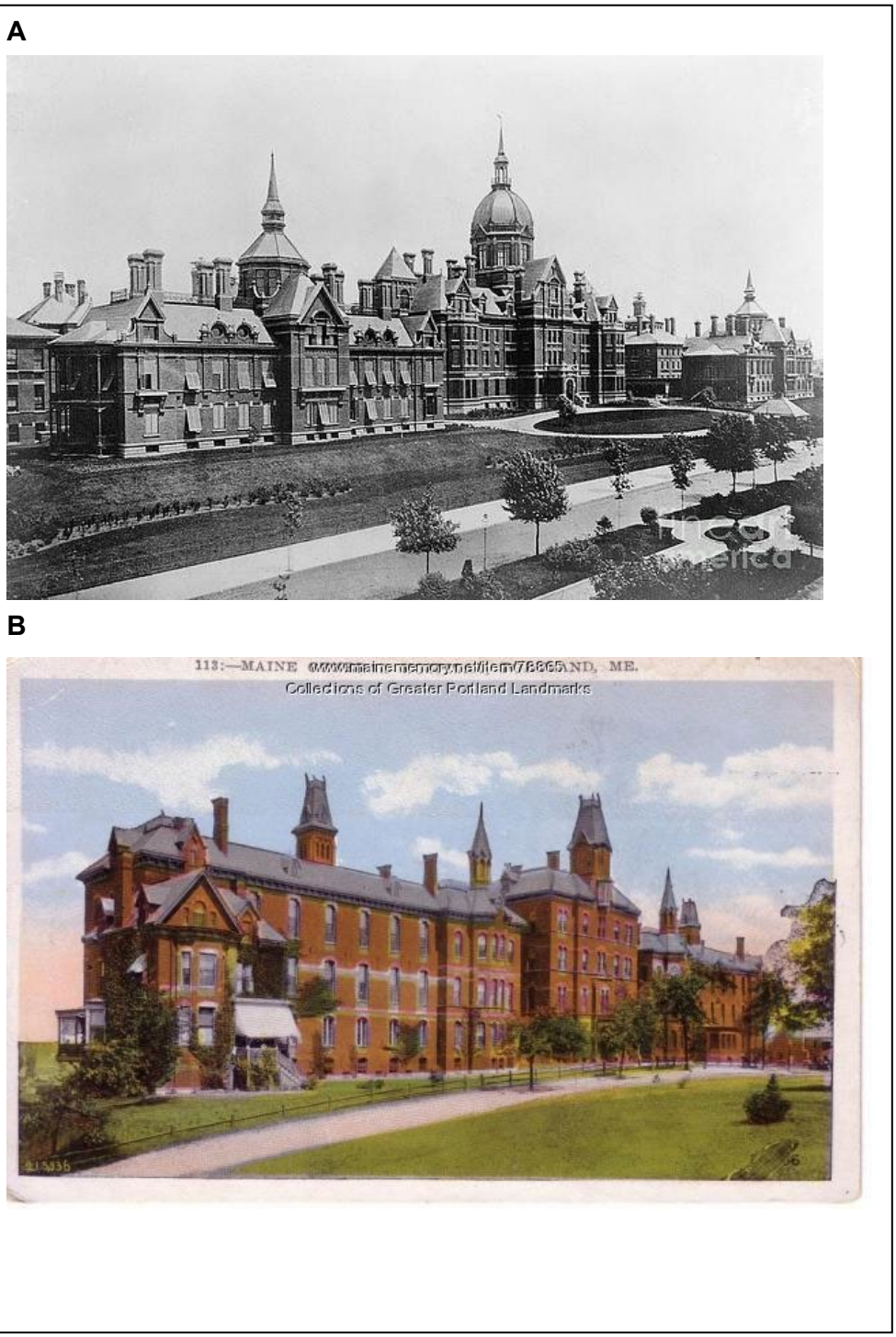


Figure 6. Remarkable architectural symmetry between The Johns Hopkins Hospital, Baltimore, MD (circa early 20th century) (A); and Maine General Hospital, Portland, ME (circa 1906) (B). In 1951, merger launches of Maine General, Maine Eye and Ear, and Maine Children's Hospital and completed in 1956 as Maine Medical Center, Portland, ME.