REFERENCES:

Churchland, P. S., (1981). *On the alleged backwards referral of experiences and its relevance to the mind-body problem*. Philosophy of Science, 48, pp. 165-181.

Deecke, L., P. Scheid and H. H. Kornhuber. 1969. Distribution of readiness potential, pre-motion positivity, and motor potential of the human cerebral cortex preceding voluntary finger movements. *Experimental Brain Research* 7: 158-168.

Dennet, D., (1991). *Consciousness Explained*. New York: Little, Brown and Company.

Eccles, J.C., *The Effect of Silent Thinking on the Cerebral Cortex*. Truth Journal.

Flanagan, O. *Manuscript*

Fuster, J. M., (1981). *Memory in the cerebral cortex.* Cambridge, MA: MIT Press.

Gazzaniga, M. S., (2000). *Cerebral specialization and interhemispheric communication: Does the corpus callosum enable the human condition?* Brain, 123, pp. 1293-1326.

Grey, W. W. 1963. Presentation to the Osler Society, Oxford University. In *Consciousness Explained*, by D. C. Dennet: New York: Penguin. 167.

Harnad, S. (1982) *Consciousness: An afterthought.* Cognition and Brain Theory, 5: 29 - 47.

Hyder, F., Phelps, E.A., Wiggins, C.J., Labar, K.S., Blamire, A.M., and Shulman, R.G. (1997). *"Willed action": A functional MRI study of the human prefrontal cortex during a sensorimotor task.* Neurobiology, vol. 94, p. 6989-6994.

Morse, S. J., *the Guilty Mind:" Mens Rea,* In: *The Handbook of Psychology and Law* (D.K. Kagehiro and W.S. Laufer eds., 1992).

Libet, B. (1973). *Electrical stimulation of cortex in human subjects and conscious sensory aspects.* In: *Handbook of Sensory Physiology, Vol. II: Somatosensory System*, Iggo A, ed. Berlin: Springer-Verlag.

Libet, B. (1978). *Neuronal vs. subjective timing for a conscious sensory experience.* In: *Cerebral Correlates of Conscious Experience*, Buser PA, Rougeul-Buser A, eds. Amsterdam: Elsevier/North-Holland Biomedical Press.

Libet, B., Wright, E. W., Jr., Feinstein, B., and Pearl, D. (1979). *Subjective referral of the timing for a conscious sensory experience*. Brain, 102, pp. 192-224.

Libet, B. (1981). *The experimental evidence for subjective referral of a sensory experience backwards in time: Reply to P.S. Churchland.* Philosophy of Science, 48, pp. 182-197.

Libet, B., Wright E. W., Jr., Gleason, C.A. (1982). *Readiness-potentials preceding unrestricted "spontaneous" vs. pre-planned voluntary acts.* Electroencephalography and Clinical Neurophysiology, 54, pp. 235-242.

Libet, B., Gleason, C.A., Wright E. W., Jr., Pearl, D. K., (1983). *Time of conscious intention to act in relation to onset of cerebral activity (readiness-potential): The unconscious initiation of a freely voluntary act.* Brain: A Journal of Neurology, 106, pp. 623-642.

Libet,B. (1989). *Conscious subjective experience vs. unconscious mental functions: A theory of the cerebral processes involved.* In: *Models of Brain Function,* Cotterill RMJ, ed. New York: Cambridge University Press.

Libet, B., (1996) *Commentary on "Free Will in the Light ofNeuropsychology".* Philosophy, Psychiatry, & Psychology, 3.2, p. 95-96.

Raye, C. L., Johnson, M. K., Mitchell, K. J., Reeder, J. A., Green, E. J., (2002). *Neuroimaging a single thought: Dorsolateral PFC activity associated with refreshing just-activated information*. NeuroImage, 15, pp. 447-453.

Schacter, D. L., (1999). *The seven sins of memory: Insights from psychology and cognitive neuroscience.* American Psychologist, 43no3, pp. 182-203.

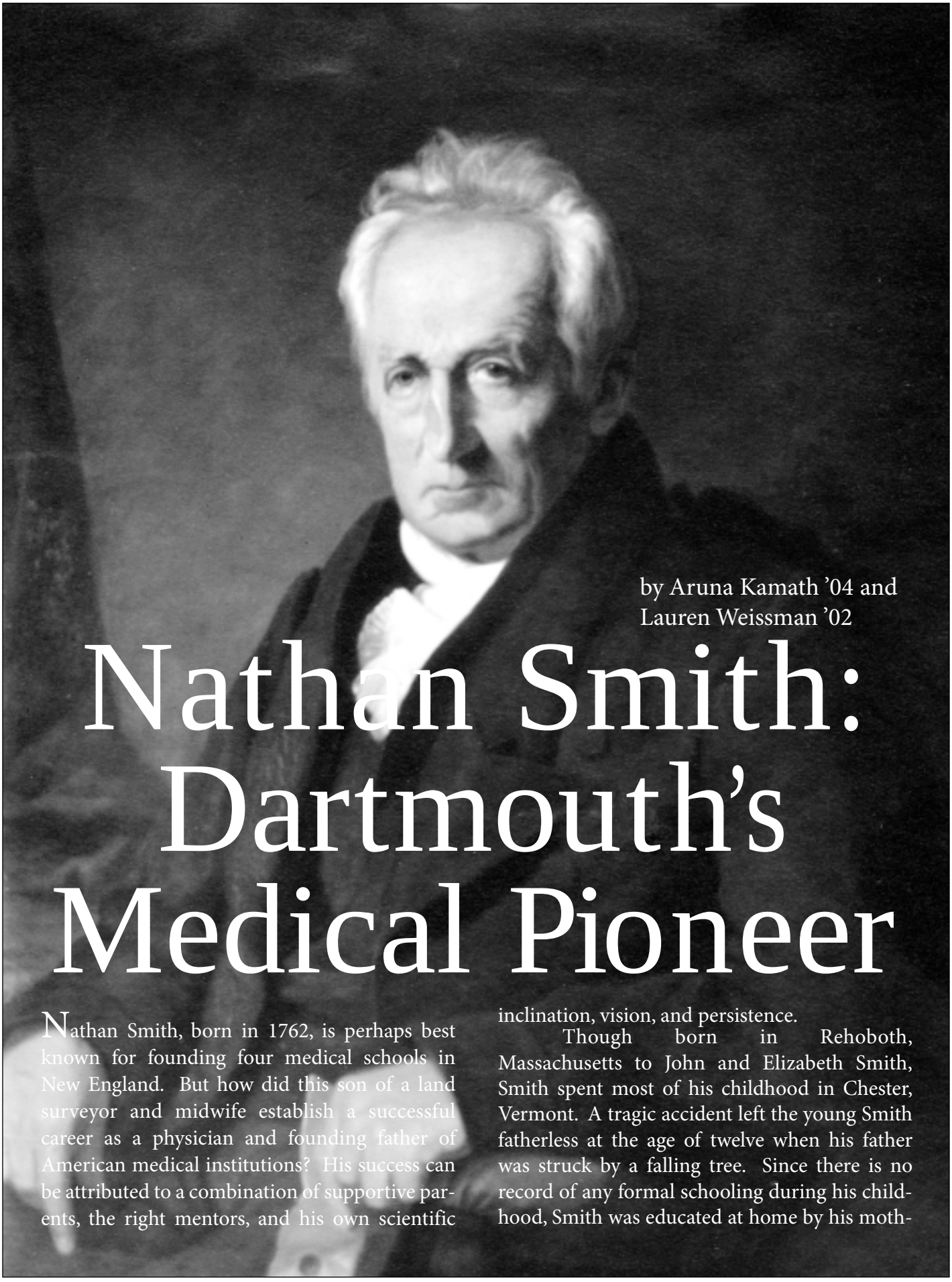
Schopp, R. F., (1991) *Automatism, insanity, and the psychology of criminal responsibility: A philosophical inquiry*. Cambridge: Cambridge University Press.

Spence, S., (1996) *Free will in light of Neuropsychology*. Philosophy, Psychiatry, & Psychology, 3.2, p. 75-90.

Spring, R. L., (1998). *The return to mens rea: Salvaging a reasonable perspective on mental disorder in criminal trials.* Int'l J. of Law and Psychiatry, 21no.2, pp. 187-196.

Waldbauer, J. R., and Gazzaniga, M. S., (2001). *The Divergence of Neuroscience and Law*, Jurimetrics J., 41, pp. 357-364.

Walter, H., (2001). *Neurophilosophy of Free Will: From Libertarian Illusions to a Concept of Natural Autonomy*. Cambridge, MA: MIT Press



by Aruna Kamath '04 and
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Nathan Smith: Dartmouth's Medical Pioneer

Nathan Smith, born in 1762, is perhaps best known for founding four medical schools in New England. But how did this son of a land surveyor and midwife establish a successful career as a physician and founding father of American medical institutions? His success can be attributed to a combination of supportive parents, the right mentors, and his own scientific inclination, vision, and persistence.

Though born in Rehoboth, Massachusetts to John and Elizabeth Smith, Smith spent most of his childhood in Chester, Vermont. A tragic accident left the young Smith fatherless at the age of twelve when his father was struck by a falling tree. Since there is no record of any formal schooling during his childhood, Smith was educated at home by his moth-

er. It is unclear whether she educated him in the practice of midwifery, but it is certain that her own experiences in the field laid the foundation for her son's interest in medicine.

During his late teens and early twenties, Smith taught at a local school until he had the transformative experience of witnessing and participating in a leg amputation performed by newly-trained surgeon Josiah Goodhue, only three years senior to Smith. Later accounts of the event reveal a young Smith actively pursuing the practice of medicine. A witness of his work describes Smith's "unflinching steadiness of nerve," which allowed him to tie "the arteries…and did so without a tremor." Dr. Goodhue saw great promise in Smith's ability and interest and advised him to seek a more formal basic education from local reverend Samuel Whiting. After spending several months with Whiting, Smith was then apprenticed to Dr. Goodhue who taught him the practice of medicine.

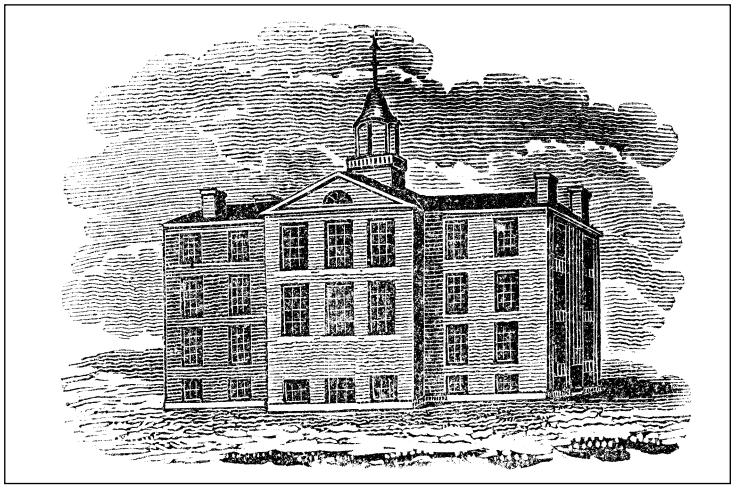
By 1787, Smith had started his own practice in Cornish and Claremont, New Hampshire. After practicing for three years, Smith realized the limits of his medical knowledge and pursued advanced training at Harvard. In two years in Cambridge, Massachusetts, he completed his dissertation on "Spasm and Fevers," and became the fifth graduate of Harvard Medical School when he received his Bachelors in Medicine in 1790.

Smith next resumed his practice in Cornish, New Hampshire, and acquired apprentices of his own. Admiring and recognizing his genuine talent for teaching, Smith's students urged him to "procure a Library" so they could "commence the study of Physic" and "finish their education at Cambridge." Smith soon realized that in time, with much energy and persistence, he could provide his students with the most up-to-date and accurate medical knowledge without their ever needing to leave the state of New Hampshire. According to historians Oliver Hayward and Constance Putnam, "the idea that Smith might affiliate himself with an educational institution and then not need to send his students on to Harvard to 'finish their Education' seems to have occurred to him at least as soon as the mid 1790s."(Hayward 1998) He set his sights on the only institution nearby: Dartmouth College. In August 1796, he submitted a written proposal to the Dartmouth Board of Trustees requesting that he garner the College's fourth appointment to the professor-rank, giving him the means to teach medicine to students who would benefit from the merits of a formal degree. To demonstrate his own commitment and seriousness, Smith made clear to the Board that he would travel to Edinburgh, Scotland, at his own expense to study further and affirm his ability to take on the responsibility of a profession of medicine.

Dartmouth denied his proposal in 1796, indicating that it would revisit the idea the following year. Despite the discouraging news, Smith, still committed to the idea, pursued his studies in Edinburgh. Upon returning the following September, the proposal was accepted and Smith began teaching almost immediately. It was at this time, in November 1797, that Dartmouth Medical School came into existence, even though it was not formally sanctioned by the Board until their next annual meeting in August 1798. At that time, Smith was "unanimously chosen" as the medical professor. Though he did procure help in giving his lectures and keeping his laboratories, Smith was responsible for the oversight and teaching of everything from anatomy to "chemistry and material medica," and "the theory and practice of physik." Interestingly, all of this was done without the credentials of a Doctorate in medicine. Dartmouth eventually awarded him an M.D. in 1801.

Nathan Smith's presence at Dartmouth allowed the institution to take its place among several "firsts" in the New England medical community. At the behest of Smith, Dartmouth saw the completion of the construction of the first building in New England solely dedicated to medical school instruction. The building, opened in 1811, housed the first amphitheater in New England designed to teach students more effectively in the practice and mechanics of surgery. The state-of-the-art facilities allowed the

school to instruct 124 students—a dramatic increase from its earliest years when it graduated two students in 1797 and three in 1798. Two years prior to its construction, Smith successfully asked the state legislature for $6000. The only precedent for such a demand was that set by Benjamin Franklin in 1751 when he received state money to match the money he was able to raise privately for the building of the first hospital in the United States, Pennsylvania Hospital. Dartmouth's medical building replaced the two rooms Smith was using for instruction in the basement of Dartmouth Hall. The building served the School well until it was forced to be torn down in 1963. At that time, it was "the oldest building in continuous use for medical education in the country" (Lunardini 1997).



Smith's actual teaching was not always a smooth endeavor. Across the country, the teaching of anatomy was a difficult undertaking since bodies were not particularly easy to procure. Many schools resorted to the practice of grave-robbing. In the tight-knit and small community of Hanover, there was no way for such a practice to be anything but blatant and obvious. When medical school affiliates would dig up graves in Hanover and the outlying communities, "anatomy riots" ensued. According to Hayward and Putnam, scandals such as these would eventually cause Smith to leave Hanover.

After leaving Dartmouth Medical School in 1813, Nathan Smith continued to play an extremely important role in the evolution of early American medical education. He offered his experience in securing three other New England medical schools at Yale, the University of Vermont, and Bowdoin College. His strong reputation as a medical educator, physician, and surgeon, was sought by many. Yale University was the first to put his talents to use. When he accepted Yale's invitation, he became one of the founders and first faculty members of its medical school. During his years there, his devotion to medical education intensified. In 1817, he "truly came into his own as a medical educator," as teaching became the sole focus of his professional activities (Hayward 1998). Shortly after, Smith left Yale to take on the responsibility of nurturing the newly established medical schools at Bowdoin (the Medical School of Maine) and the University of Vermont. Beginning in 1821, he served as a lecturer at Bowdoin and occasionally at the University of Vermont. By 1827, he again decided to devote himself entirely to his teaching career at Yale until his death at the age of 66 on January 26, 1829.

Although most remembered as a founder and leader of medical education, Smith contributed significantly to the medical field at large. Indeed, he ushered in a new approach to the practice medicine and surgery, helping to protect the much challenged integrity of his profession. Smith worked against the prevailing "heroic" treatments, including blood-letting, purging, and vomiting, as the primary means of treating illnesses. He disapproved of these medical misconceptions and the largely unregulated numbers of untrained, free-lancing physicians and quackery. Consequently, he channeled his efforts into not only creating reputable medical schools but also replacing the "heroic practice of medicine" with "rational treatment" (Hayward 1962). Throughout his medical career, he emphasized diagnosis-specific treatment in which a disease would be accurately identified and the patient treated accordingly. This set the foundation for

the modern medical approach. He paid close attention to clinical results and carefully noted the failures of treatment, which were commonly left out to improve medical care. Similarly, his approach to patient care, providing comfort at a time when such needs were not even prioritized, led the way for "today's emphasis on total care" and "good nursing" (Hayward 1998). When he practiced surgery, he upheld a conservative form of treatment. He acted by using keen and perspective techniques in assessing the needs of the patient and avoided amputation and drastic measures as much as possible. In addition, Nathan Smith pioneered surgical procedures in the fields of ophthalmology, cancer, and orthopedics. Perhaps even more importantly, he performed surgeries with "consistent success," a rarity for his times (Hayward 1998).

With every improvement in patient care and surgery, Smith made sure to pass on such advancements to his students, the future generation of physicians. He found instruction to be as important as treating patients. His emphasis on clinical experience rather than theory was in fact ahead of his time, as was evident and most recognizeable in his skillful ability to lecture. He used real life examples from his medical practice to illustrate the importance of careful patient examination in order to make an accurate diagnosis. He also enhanced learning for his students by advocating the need for certain medical equipment lacking in New England but necessary for proper medical education. The most notable advances ones were developing the first teaching surgical amphitheater in New England and advocating the legalization of cadaver use for the purpose of teaching anatomy.

Smith's involvement with the law extended into other medical matters as well. In 1825, his expert testimony vindicated two Maine physicians charged with malpractice. In addition, to help ensure the future of his medical schools, Smith won financial support from both local governments and colleges to build these institutions.

"Nathan Smith, country doctor, famous surgeon, backwoods wit, educator four thousand doctors, builder of four medical schools, politician, friend of the famous and friend of the poor, himself penniless …" (Hayward 1959). Certainly, Nathan Smith was a formidable man during his lifetime. He is most remembered by his lasting impact of founding four medical

Nathan Smith's Medical Kit

schools, three of which remain thriving medical institutions today. He made a profound effect beyond creating classrooms, as a leading, inspiring physician who brought a new perspective to medicine. He was unafraid to challenge the accepted and prescribed methods of his day, thereby helping to lay the foundation for modern medical practices.

References

Chapman, C. B. (Summer 1968). Development 1797-1968; The Next Logical Step. Dartmouth Medical School Quarterly Vol. 5, No. 1, 4-43.

Hayward, O. S. and C. E. Putnam. (1998). Improve, Perfect & Perpetuate. Hanover, NH: University Press of New England.

Hayward, O. S. (1962). The Basis in Sydenham, Rush, and Armstrong for Nathan Smith's Teaching. Annals of Internal Medicine Vol. 56, No. 2, 343-348.

Hayward, O. S. (1960) A Search for the Real Nathan Smith. The History of Medicine and Allied Sciences Vol. XV, No. 3, 268-281.

Hayward, O.S. (1959) Dr. Nathan Smith (1762-1829) –American Pioneer. New England Journal of Medicine Vol. 261, 489-94.

Lunardini, R., D. C. Grossman and J. Douglas. (1997). 200 year history of Dartmouth Medical School—timeline insert. Dartmouth Medicine Magazine. Hanover, N.H.

Putnam, C. E. (1997). To Promote Useful Science. Dartmouth Medicine Magazine Vol. 22, No. 1, 22-29.

Putnam, C.E. (1996). "The Apples of his Eye," Dartmouth Medicine Magazine Vol. 21, No. 1, 34-39.