

“KEEP-ing” ETHER in VOGUE: Nathan Cooley Keep and William Morton

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This paper was presented originally at the 150th celebration of the first demonstration of ether anesthesia, Massachusetts General Hospital .

For anyone connected with dentistry, celebrating the demonstration in 1846 by Boston dentist William Morton, is a memorable event. It is especially meaningful for those of us gathered here this evening in the historical Ether Dome. Particularly interesting in the Ether story is the role of Nathan Cooley Keep, an anesthesiologist and the first Dean of the Harvard Dental School. Furthermore, it will be enlightening to trace the estimable record of dentists and oral and maxillofacial surgeons in the administration of ambulatory anesthesia, a continuum of Morton’s watershed demonstration.

Nathan Cooley Keep, who received an M.D. degree from the Harvard Medical School in 1827, was the leading dental practitioner of his era in Boston. He was born in Longmeadow, Massachusetts, a suburb of Springfield, in 1800. As a child, he was noted to have extraordinary mechanical skill. This ability was explained by The Historical and Genealogical Register (April 1878), in its memorial minute upon Dr. Keep’s death, as being inherited from his father who had “great ingenuity and mechanical skill.” Keep’s admirable humane qualities and his biological curiosity were also noted and ascribed to his mother, in the same document which stated: “... his own knowledge of disease; his fertility in suggesting relief in the sick room and his willingness and ability to lend personal help in relieving suffering in all forms, were a kind of natural inheritance from his mother.”

Because of his skill with tools, young Keep was apprenticed at the age of 15 to a New Jersey jeweler. He remained there until a lack of business forced the jeweler to downsize. Keep returned home, and after a short time decided to pursue a career in

dentistry, another profession to which his native manual dexterity and skill were suited.

There were, as yet, no formal dental schools in the country. The Baltimore College of Dentistry, the first school of dentistry, was not established until 1839. Dentists were either physicians who chose to practice dentistry or young men who learned the “trade” through an apprenticeship with an established practitioner. Keep worked under the tutelage of Dr. John Randall, a Harvard Medical School graduate who had become a distinguished Boston dentist. At the same time that he was learning dentistry, Nathan Cooley Keep attended the requisite lectures at the medical school and received the M.D. degree from Harvard, in 1827. He then opened his own dental office.

He was a gifted practitioner who invented numerous instruments that were used by several generations of dentists. He also developed a process for making porcelain teeth, a tremendous improvement over what was currently being used in dentures. His flourishing practice and ingenious ways attracted young dentists to him and he allowed some to work in his laboratory and learn his methods. Among those who did so were Horace Wells, of Connecticut, and William Thomas Green Morton.

Morton and Wells, who was Morton’s junior and actually his apprentice, became partners in a Boston dental practice in 1843. During this period both had access to Dr. Keep’s laboratory, as tuition paying tutees. Their partnership was, however, short-lived and was dissolved in less than a year when Wells became disillusioned by Morton’s instability. The Wells-Morton professional and personal relationships are important and relevant to the Ether story as will be clarified further in this account. At the time of their break up, Wells wrote to his mother, “I very much feared that he would become a drunkard” and “aside from that, he was the most deceitful man I ever knew, he would not scruple to tell a falsehood when he knew that he must be detected in a lie within a few

hours.” Wells also commented about Morton’s marriage, “He has married a fine girl and I fear she has found her mistake ere this time.” Another interesting facet of the Morton marriage was published in 1943, in the Connecticut State Medical Journal in a paper “Prelude to Surgical Anesthesia” by Albert H. Miller. He wrote, “When T.G. Morton proposed marriage with Elizabeth Whitman, the beautiful young daughter of a prominent and well-connected citizen of Farmington, Connecticut, the Whitman family objected because of Morton’s lack of prospects. The marriage was eventually approved on condition that Morton takes the course of study at the Harvard Medical School and become a regular practitioner. In November, 1844, Morton therefore, matriculated at the Harvard Medical School, choosing Dr. Charles T. Jackson as his preceptor, while continuing his successful dental practice, his manufacturing of artificial teeth and his study of dentistry with Dr. Nathan C. Keep.” Morton, however, dropped out of Harvard two months before graduation because he had become completely absorbed by his experimentation with ether. He never received the M.D. degree.

Morton’s successful demonstration of surgical anesthesia on October 16, 1846 has been described as “the single most consequential event in human history.” It certainly had a profound effect on surgical practice and the public’s health. How it came to be that Morton, a rather untutored, unscientific, entrepreneurial person became the “discoverer” of inhalation anesthesia is a fascinating and well documented, albeit controversial tale. Was Charles T. Jackson, the chemist, whose advice Morton sought, the true discoverer of ether as an anesthetic, as he claimed, or did Morton alone recognize ether’s potential? The controversy is no longer relevant. The facts about the event of October 16, however, are well documented and should be briefly noted as a prelude to speculating about Nathan Cooley Keep’s role as “Keep-ing Ether in Vogue.”

Morton experimented with ether while working in Dr. Keep's laboratory. He had, unquestionably, sought advice from Jackson and it was probably from him that Morton learned the readily available commercial product was not effective. Rather, sulphuric ether was required to produce anesthesia. After experimenting on insects and animals, Morton finally used ether to anesthetize Eben H. Frost. Frost was a businessman patient from whom Morton painlessly extracted a tooth on September 30, 1846. Whether by chance or design, Morton had a witness present at the Frost procedure. Albert G. Tenney, a newspaper reporter reported the event in the Boston Daily Journal the following day. Dr. Henry Jacob Bigelow, an MGH surgeon, read the account and went to Morton's office. After observing several painless extractions during the next few days, Bigelow invited Morton to administer his secret preparation to a surgical patient at the hospital. Morton agreed and, on October 16, 1846, using an inhalation device he constructed with Jackson's help, he gave the memorable demonstration that has been memorialized in the famous painting by Robert C. Hinkley.

Even though the demonstration was described in the famous words, "This is no humbug," there was still some skepticism about the effectiveness of Morton's secret substance which he called Lethion. On the following day, he again successfully administered anesthesia for the removal of a lipoma from a patient's arm. The two relatively minor surgical procedures continued to generate doubt and the senior surgeons at the MGH refused to allow another, more critical demonstration unless Morton divulged the composition of his Lethion. He did so reluctantly and on November 7, 1846, Dr. George Hayward performed a below knee amputation with the patient anesthetized and experiencing no pain. This was the definitive demonstration of successful ether

anesthesia and the beginning of Morton’s erratic, short career.

With considerable historical material available, it is now appropriate to both describe and speculate about Nathan Cooley Keep’s contributions to ether anesthesia. Recall that Morton had experimented with ether in Keep’s office. Furthermore, Morton had been a pupil, and briefly, a partner of Horace Wells, who also studied with Keep. Wells, a very bright and ingenious man, had introduced nitrous oxide as an anesthetic in 1844. He noted its pain-masking effect on Gardner Colton, a member of the audience at a public demonstration of the exhilarating effects of sniffing the “Laughing Gas” in Hartford, Connecticut. Wells successfully used nitrous oxide for anesthesia – or probably more accurately, sedation – on numbers of patients having dental work and extractions. In 1845, he came to Harvard Medical School, at the invitation of Morton, to demonstrate nitrous oxide to a group of students. Unfortunately, he failed to anesthetize the medical student patient and was laughed out of the room. The incident devastated him and even though he continued to use nitrous oxide successfully. He was despondent about not being credited with having introduced anesthesia, Morton having achieved that and in, 1848, at age 33, Wells committed suicide.

Keep, Wells and Morton all knew about the exciting effects of sniffing nitrous oxide and ether. Laughing gas parties were common among students in England and the United States. In 1799, the English chemist, Humphrey Davy noted the analgesic properties of nitrous oxide (N_2O) and suggested it might be useful in eliminating surgical pain. However, nothing came of this. In 1808, James Woodhouse, Professor of Chemistry at the University of Pennsylvania, duplicated Davy’s experiments with N_2O on students. One of his students, William P.C. Barton wrote a dissertation on “... the exhilarating effects of

N₂O.” He also noted that the gas had the effect of masking pain. Again, no application to surgery was made. Jacob Green, the editor of a “Textbook of Chemical Philosophy” culled the term “Laughing Gas” as he observed the exhilarating effects of its inhalation. It was not until Wells witnessed the Colton “Laughing Gas Show” and noted that Colton experienced no pain when banging his knee while N₂O intoxicated, that the use of an inhalant agent as an anesthetic was born.

Morton, Wells and Keep all appreciated the need to eliminate, or at least obtund, the pain of dentistry. After Wells’ disastrous demonstration of nitrous oxide, at Harvard Medical School, Morton probably decided to try another agent, and I believe he was encouraged to do so by Keep, his greatly respected dental mentor. It is also likely that Keep may have helped to enlist the aid of Jackson, the chemist.

In any event, within days of the successful amputation operation, Nathan Keep and William Morton signed a ten-year partnership agreement and placed an advertisement in the Boston Evening Traveler announcing that patients would have pain free dental treatment in their office. Within a few weeks, however, Keep terminated the partnership but, having used anesthesia very effectively, he continued to do so in his own practice.

One can only speculate about the precipitous break-up of the Keep/Morton alliance not unlike the unsuccessful Wells/Morton partnership. Morton was known to be impulsive and very materialistic. He had applied for a patent for his anesthetic within days of the October 16 demonstration and allegedly said to Keep that “I want to make money out of it.” Being a righteous, and highly respected leader of the Boston dental profession, Keep probably wanted to be dissociated from Morton who had become a pariah in the dental community.

What is particularly interesting and evidence of Keep's importance in the history of anesthesia, was a paper he published in the Boston Medical Surgical Journal of April 3, 1847 entitled "Inhalation of Ethereal Vapor for Mitigating Human Suffering in Surgical Operations and Acute Diseases." Keep meticulously described the preparation and administration of ether using an apparatus of his own design. Of particular importance, in our Keep-ether thesis, is the following portion of the article: "In the last 200 cases, [note that this was only a few months after Morton's historic demonstration] nearly all highly intelligent persons capable of accurate observation, I have not known one who was not conscious of existence of time, and of the operation that was being performed, but though the intellect was nearly or quite undisturbed, the sensibility to pain has been uniformly greatly diminished, and generally entirely lost." Furthermore, he wrote, "I am firm in the belief that this will be a valuable addition to dental surgery, for I am fully persuaded that this is a better mode of treating these cases than any we have yet been acquainted with."

Further along in the paper, the following words are prophetic and may have been the forerunner of the Harvard Anesthesia Guidelines: "I entertain the opinion that the inhalation of vapor of ether, when administered in a proper manner, by a person understanding it, and capable of regulating its quantity and power, as every person using it should be able to do, is safe, and will greatly mitigate, and in most cases take away all pain in dental and surgical operations, and that it may be relied on for relief in most cases of intense physical suffering from acute disease of short duration."

Further evidence of Keep's important role in the introduction of anesthesia, is his activity as the earliest itinerant anesthesiologist. On April 7, 1847, Nathan Cooley Keep administered the first obstetrical anesthesia in the United States. He gave anesthesia to

Fanny Longfellow, wife of Henry Wadsworth Longfellow, for the delivery of their daughter in their home, Craigie House, in Cambridge.

The event was thus recorded in Longfellow’s journal. “Wednesday 7. This morning at twenty minutes past ten was born in the Craigie House a girl, to the great joy of all. Fanny heroically inhaled the vapor of sulphuric ether, the great nepenthe, and all the pain of labor ceased, though the labor itself went on and seemed accelerated. This is the first trial of ether at such time in this country. It has been completely successful. While under the influence of the vapor, there was no loss of consciousness, but no pain. All ended happily.

Thursday 8. Fast Day. Went to town to see Dr. Elliot about my eyes. Stopped in to Dr. Keep’s, the dentist who administered ether yesterday, to report favorably and had the stump of a double tooth extracted under the ethereal vapor.”

Keep’s credentials as an anesthetist are further supported by the following statement in his paper in The Boston Medical Surgical Journal: “On the night of the 18th, I was called to administer the vapor of ether to a particular friend of mine (under the direction of Dr. Homans, his family physician, and Dr. Ware) who was suffering intense pain in the abdomen. The particulars of this case, so full of interest, will be given to the public by Dr. Ware.”

When one reflects upon the following historical facts, Dr. Keep’s important role in providing credibility for ether as an anesthetic agent seems both justified and realistic. He was certainly well aware of the origins of the use of ether by Morton. He began to use it, extensively, almost as soon as Morton did. He was not only a prominent dentist in Boston, but was known nationally and was, unlike Morton, both admired and respected by both

dental and medical colleagues. His endorsement of ether in his extensive clinical practice, as reported in the distinguished medical journal, had to give credibility to Morton's initial demonstrations. Also, the fact that he was called upon, by very prominent medical colleagues, to administer anesthesia in just the two cases we have cited, is further substantiation of the thesis that Nathan Cooley Keep was important for the acceptance of ether as the substance that eliminated pain from surgery.

Before closing out the Keep story, several other interesting events in his life should be mentioned. He opposed Morton's appeal to the U.S. Congress, in 1848, for \$100,000 compensation for his "invention" of ether anesthesia. Keep testified against Morton and supported the claim by Charles Jackson that "he played a significant part in the development of either anesthesia." He crossed swords, again, with Morton in the famous Webster murder trial.

Dr. John White Webster, Erving Professor of Chemistry at HMS was alleged to have killed Dr. George Parkman, editor of the Boston Medical and Surgical Journal. Webster killed Parkman and disposed of the body in the laboratory furnace. Some bones, including the lower jaw and a dental plate, were all that was recovered.

At the trial, in 1850, Keep's evidence was the key to positive identification of the body as being Parkman's. Webster and Parkman were both friends and patients of Keep who had made an unusual gold prosthesis to fit Parkman's unique and prominent lower jaw. Both its peculiar construction and artificial teeth, which were invented by Keep, made it possible for Dr. Keep to make positive identification of the denture as being Dr. Parkman's. Morton was the defense's only expert witness and he contradicted Keep but finally, to his embarrassment, he had to admit that the denture could only have been

Parkman's.

Nathan Cooley Keep's career was a paradigm of that triad of interests and efforts we celebrate in academia: research, teaching and clinical practice. Keep was an innovator, a gifted instructor and a superb clinician. From his earliest days, he championed the case of formal dental education and the need for colleges to train dentists.

In 1865, he was a founder and first President of the Mass. Dental Society. In his Presidential address to the Society, he said, "My own predilections would favor a thorough and united dental and medical education. I should hope in such a case that the degree of M.D. would be the lawful appendage to the names of those young men who enter our specialty. If this, however, is not yet attainable, it may not be entirely out of place to inquire whether Harvard University might not appoint professors of dentistry and confer upon proper candidates the degree of Doctor of Dental Surgery. We are admonished, also, that the time has come for a chair of dentistry in our hospitals." His dreams soon became reality.

In 1867, the Harvard Corporation, upon the recommendation of a committee of the Faculty of Medicine, voted to establish the Harvard Dental School, the first university affiliated dental school in the country. Dr. Keep was elected Dean, a position in which he served until his resignation in 1871. Parenthetically, the first clinical experience dental students had was in the outpatient department of the Mass. General Hospital!

Keep's visionary words about dental education in 1865 were, in fact, rather prophetic. In 1939, Harvard's President Conant, concerned about the paucity of biological research in dental schools, appointed the "Burwell Committee" to study the problem of

dental education at Harvard. Acting on the recommendation of the Committee in 1940, Conant changed both the name and curriculum of the dental school. It became the Harvard School of Dental Medicine with an innovative five year curriculum that granted graduates both the DMD and MD degrees. It is interesting, parenthetically, that Keep's first class of 1867 accepted five students; the first class of the School of Dental Medicine enrolled nine.

Although the two-degree program was abandoned after a decade, for numerous reasons, the Harvard two-degree Oral and Maxillofacial Surgery residency program, approved by the Faculty of Medicine in 1971, has been a model for oral and maxillofacial surgical training in this country since its inception.

The work and publications of Monheim, Hubbard, Olson, Bullard and Krogh must be cited. Lundy introduced Pentothal in 1934, these men taught their peers its use in the early 1940s. Krogh and Hubbard, in particular, conducted clinics throughout the country, usually in dental schools, from 1953 to 1956. In 1968, the Southern California Society of Oral and Maxillofacial Surgeons established a program to evaluate in-office anesthesia and emergency management of its members' patients. In 1972, participation in office evaluation became mandatory for continued society membership.

The American Association of Oral and Maxillofacial Surgeons followed suit and published the first of its Office Evaluation Manuals in 1971, which have been updated several times since. These Guidelines of the American Association of Oral and Maxillofacial Surgeons have been the template for regulations that now exist in almost all states that govern the administration of anesthesia in dental offices.

In 1989, Lytle, having done several surveys of Southern California oral surgical

offices, reported that “Over the 20 year period from 1968 through 1987, seven deaths occurred in more than 4,700,000 anesthetics given, a rate of one death in each of 673,000 anesthetics administered.” Lytle’s figures are consistent with other studies published, previously, by Driscoll and Allen. The essence of dentistry’s commitment to anesthesia quality is captured in the AAOMS preface to its 1975 Office Evaluation Program: it is “designed to assure that each active member maintains a properly equipped office and is prepared to use accepted techniques for managing emergencies and complications of anesthesia in the treatment of oral and maxillofacial patients in the office or outpatient setting.”

In reviewing the history of Morton’s introduction of ether anesthesia, it is reasonable to conclude that Nathan Cooley Keep was a significant contributor to its acceptance by both the medical and dental professions. His scientific, clinical, academic and ethical stature gave support to the use of ether to alleviate surgical pain. On the 150th celebration of Morton’s demonstration in the Ether Dome, homage was paid to Nathan Cooley Keep.

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Dr. Guralnick was elected to the Royal College of Surgeons in England and into membership of the Institute of Medicine of the National Academy of Sciences, both in 1996. He received the Harvard Medal in 2005, and in 2009 received the Arnold K. Maislen Award at New York University and the Gavel Prize of the Forsyth Institute.

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Dr. Kaban is author or co-author of over 200 scientific publications and five books, including the text *Pediatric Oral and Maxillofacial Surgery*.