The History and Development of Posterior Denture Teeth—Introduction, Part II: Artificial Tooth Development in America Through the Nineteenth Century

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PART I of this series of articles traced the development of artificial denture teeth from the late fifteenth century through the early nineteenth century. Examples of the earliest known complete dentures from both Europe and the Far East were illustrated.

The development of functional complete dentures originally evolved in eighteenth-century France. The sophisticated French dominated the discipline of prosthodontics through the early nineteenth century. At that time, terro-metallic teeth (or "French bean" teeth)[1,2] gave way to the much higher-quality porcelain teeth produced by Claudius Ash in London and Samuel S. White in Philadelphia.[3] By the early nineteenth century, Paris, which had been the birthplace of porcelain denture teeth, had very few mineral tooth producers left. Among the last was Louis Alexander Billard.[3] As explained in Part I, this was still a time when early porcelain teeth were in direct competition with carved (ivory) teeth and the so-called "Waterloo" teeth. It was not until 1893 that Continental Europe again saw significant production of mineral (porcelain) teeth that could compete commercially with the American and British teeth. That year, Friederick August Wienand of Phorzheim founded the first continental dental manufacturing company that produced high-quality porcelain denture teeth.[3]

By the mid-nineteenth century, America was the world's leader both in the innovative development of dental treatment techniques and in the manufacture of high-quality dental equipment and supplies. Part II of this series concentrates specifically on artificial tooth development in early America from colonial times through the late nineteenth century. Before the late eighteenth century, the only dental treatment available in the American colonies was that of "tooth drawing," that is, tooth extraction.

Introduction

Robert W. Woofendale of Sheffield, England, immigrated to America in 1766.[1,3] That same year, he fabricated a set of complete dentures for William Walton, Esq. of New York. These are believed to be the first dentures fitted in America. Woofendale was a former student of Thomas Berdmore, the well-known court dentist of King George III. After practicing in New York for 2 years, Woofendale returned to England in 1768 to seek better financial rewards for his services. In 1783, he published the popular book *Practical Observations of the Human Teeth*.[1] This important publication is considered the first dental publication by an American dentist. Woofendale eventually returned to New York and practiced for 2 more years before retiring to the country near Jamaica, Long Island (Fig 1 *A-D*).

William Walton may have been the first complete-denture wearer in America, but George Washington was undoubtedly the most famous. The first President was plagued with dental problems his entire adult life. He suffered through various forms of ligated partial dentures and finally a number of sets of complete dentures from his early forties until the end of his life. He used dentures made by several dentists, but favored those made by dentist and well-known artist John Greenwood (Fig 2 *A-D*).

George Washington's various dentures were all fabricated from materials available at the time, including bone, ivory, human and animal teeth, and several different metals used for base fabrication. All of the organic materials used for complete den-

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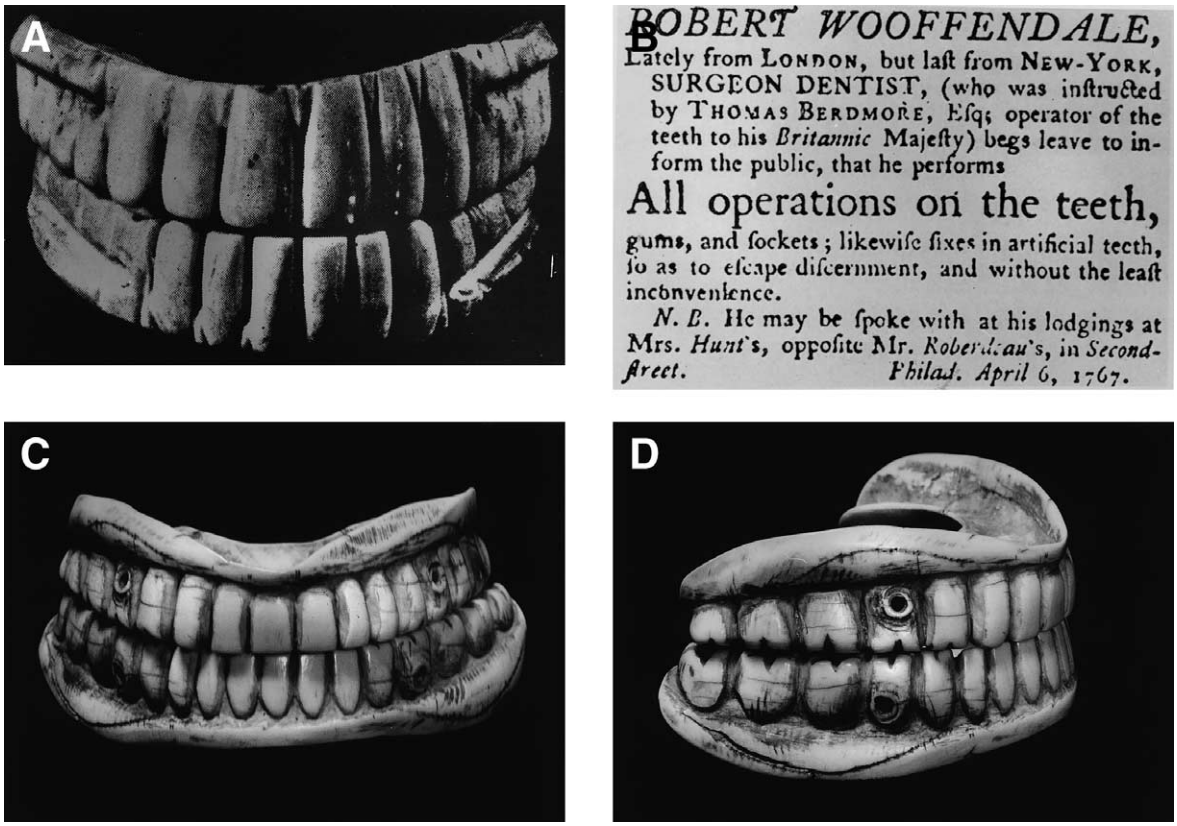


Figure 1. (*A*) A set of complete dentures fashioned from Hippopotamus ivory by Robert W. Woofendale (circa 1768). (Reprinted with permission.[4]) (*B*) An advertisement for the services of Woofendale, who is believed to have made the first set of complete dentures fitted in the American colonies (circa 1767). (Reprinted with permission.[3]) (*C*, *D*) A set of carved ivory complete dentures from the late eighteenth century. These dentures are typical of those made in early America before the development of individual porcelain denture teeth (circa 1790s). (Courtesy of the University of Texas Dental Branch collection.)

ture fabrication were prone to deterioration in the oral environment. Washington liked to soak his dentures in port wine to kill the horrific odor and taste of the deteriorating ivory. This practice, however, severely stained his dentures. Interesting letters still exist between Washington and Greenwood that clearly illustrate some of the former President's denture problems along with Greenwood's solutions to those problems and his hygiene instructions for the President's dentures.[4,6]

Pause must be taken at this point in this introduction to consider the nineteenth-century level of the various elements of dental technology that traditionally support complete denture therapy. Phillip Pfaff of Berlin described a sectional wax impression technique in 1756.[7,8] William Rae produced plaster of Paris casts from 1-piece wax impressions by 1782.[7] In 1820, Antoine Delabarre of France was the first to recommend the use of an impression tray to support the soft impression wax and to protect it from the pressures of the cheeks and tongue during the impression procedure.[3] There is general consensus that the use of plaster of Paris as an impression material was an American innovation from sometime in the 1840s. However, several individuals have been credited for this important development, including Wescott (who actually credited Dunning in 1844), Levi Gilbert, and W. H. Dwinelle (1844).[3,7] Later in 1853, Chapin Harris, celebrated cofounder of the world's first dental school (Baltimore College of Dentistry in 1839), claimed plaster impressions as his own innovation.[3]

It was during the early nineteenth century that dental articulators began their evolution from simple cast relators (eg, Jean Baptiste Gariot in 1805) to simple hinge articulators (eg, the Hovarth and Ladmore articulators of the 1830s). The originator of the Barndoor hinge articulator is unknown, but

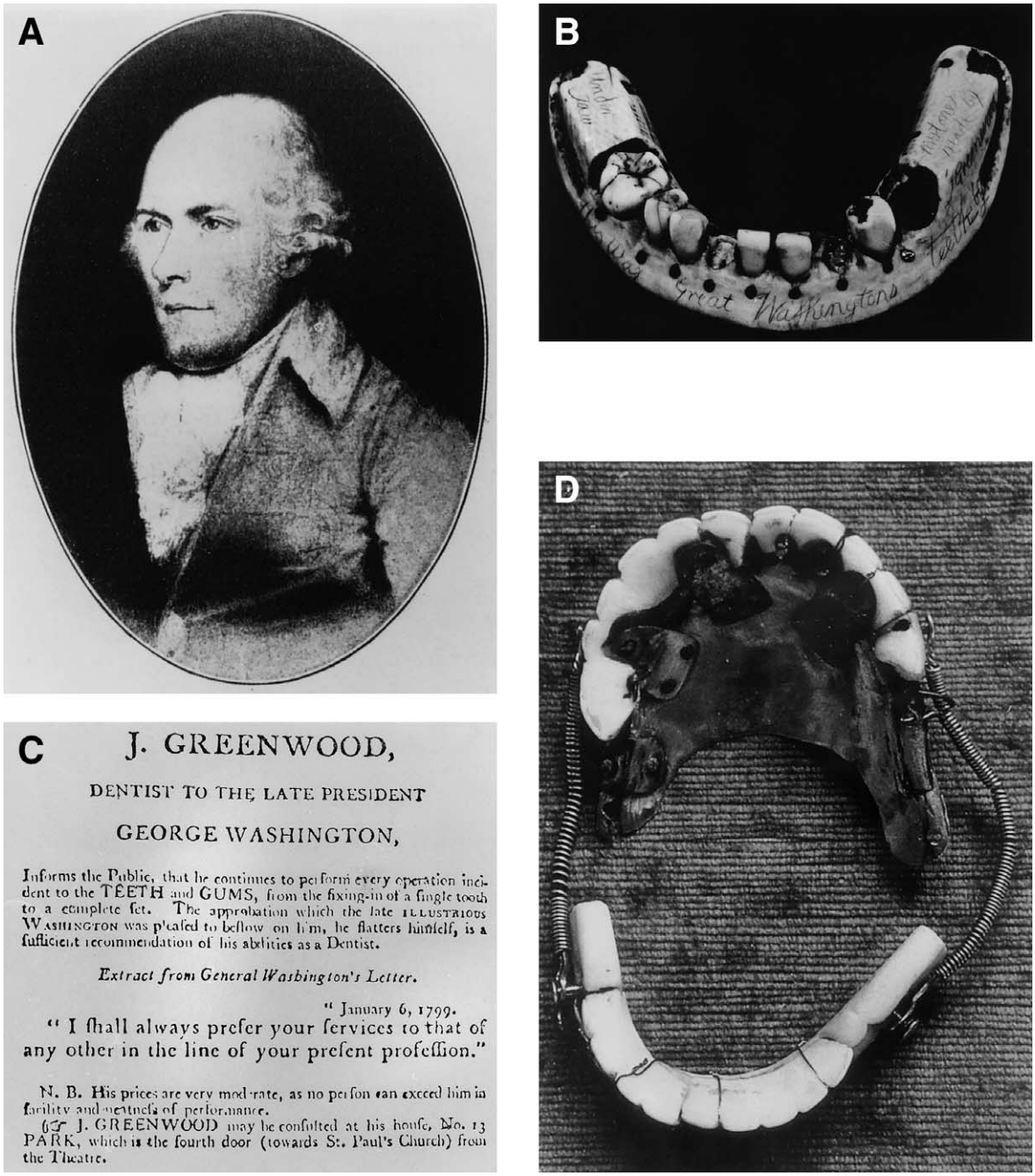


Figure 2. (*A*) John Greenwood was a well-known early American artist and the most favored dentist of President George Washington. Greenwood was the son of a dentist and member of a family that produced many dentists in the late eighteenth century and early nineteenth century. The Greenwood dental dynasty had a significant impact on dentistry in early America. (Reprinted with permission.[3]) (*B*) A set of dentures that Greenwood fashioned for President Washington from hippopotamus ivory and human ("Waterloo") teeth (1789). (Reprinted with permission.[3]) (*C*) One of Greenwood's period advertisements identifying him as "dentist to the late President George Washington" (1800). (Reprinted with permission.[4]) (*D*) President Washington's last denture, made by Greenwood of carved ivory teeth riveted to a swaged gold base. The springs were made from steel. (Reprinted with permission.[5])

this device was in widespread use by the end of the 1830s. Instruments capable of simple mandibular movement appeared in the 1840s, including devices developed by Daniel T. Evens (1840), James Cameron (1840), and Thomas Evans (1848-1849).[9]

Another very important discovery made in the early nineteenth century was how to apply the principle of suction or atmospheric pressure to retain dentures. Even though Fauchard made 3 successful sets of dentures without retention springs, the concept of atmospheric pressure for retaining complete dentures eluded him.[1,3,6,7,10] The use of springs to retain complete dentures remained the state of the art through the 1830s. Denture wearers often complained that the retention springs caused a dropping of the lower jaw and that the springs often became tangled. Hygiene was a problem with the springs, as was corrosion if the springs were made from a base metal. The springs also presented a repair and maintenance problem for the dentist. Despite these shortcomings, denture patients demanded the springs and lacked confidence in dentures without them. It is curious to note that there was never a need or thought to reline or rebase these early dentures, because the springs always kept them adapted to the ridges (under positive pressure) despite any bone resorption that may have occurred.

Dentist and former naval physician Jacques Garadette (Fig 3), who immigrated to America in 1778 and settled in Philadelphia in 1784, is credited for having discovered the principle of denture retention by suction.[3] After very carefully fitting a patient's denture to the cast by means of drills and engraving instruments, Garadette allowed the patient to try the dentures for a few days before he added the retention springs. The patient did not return for several months, however. Much to Garadette's surprise, when the patient did return, she was doing extremely well with her springless dentures and emphatically did not want Garadette to add any springs. Even though this discovery was indeed an accidental one, Garadette, who was an astute observer, realized its importance. By 1835, the concept of springless dentures had established itself in England and America. A United States patent for an atmospheric pressure-retained denture was eventually granted in 1848 to a Connecticut confectioner.

There were many American advertisements for springless dentures during the 1860s and 1870s. Around this same time, "suction chambers" began

Figure 3. Jacques Garadette is credited for having discovered the principal of denture retention by atmospheric pressure (circa 1784). (Reprinted with permission.[3])

to appear in maxillary denture bases to enhance retention (Fig 4).[1] Two American dentists claimed credit for inventing the suction chamber, Chapin Harris of the Baltimore College of Dentistry and Levi Gilbert of New Haven.[1]

Artificial Tooth Development in the Nineteenth Century

The first individually fired porcelain denture teeth appeared during the dawn of the nineteenth century. In 1808, the Italian dentist Guiseppangelo Fonzi (Fig 5 *A*) presented his "Terro-Metallic Incorruptible" teeth to the Athenaeum of Arts and the Academy of Medicine in Paris (Fig 5*B, C*).[2,5,6] Fonzi's contribution was the quantum leap necessary for complete denture therapy to progress beyond its primitive beginnings in the eighteenth century to become a treatment for the masses, and not just a privileged few. Fonzi's teeth eventually became known as "French bean" teeth due to their bean-like shapes. Although these teeth were a giant step in denture tooth development, significant improvements in shade, form, and durability were needed.[2]

Mineral (ie, porcelain) teeth were first introduced in the United States in 1817 by Parisian

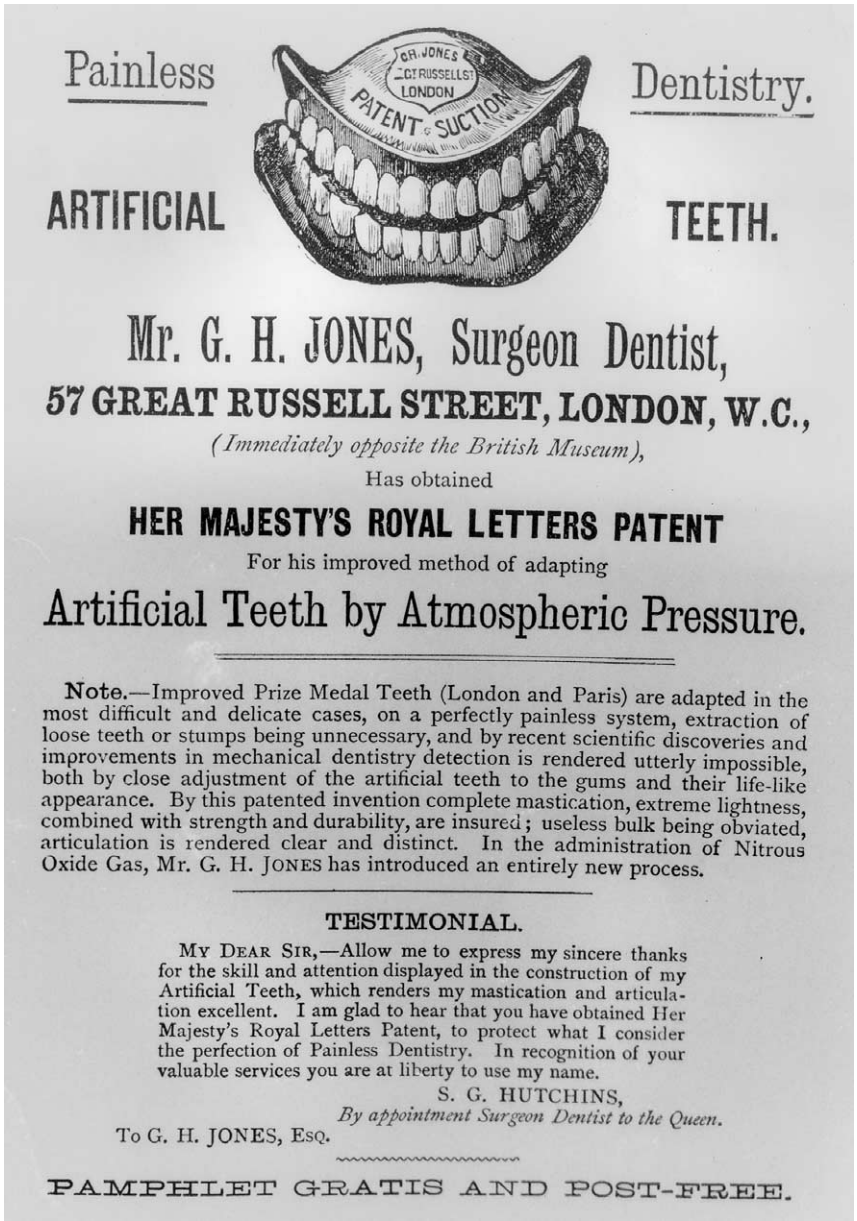


Figure 4. American advertisements boasting "springless" dentures and "suction chambers" were common in the 1870s. (Reprinted with permission.[1])

dentist Antoine A. Plantou. These teeth were typical of the French bean teeth of that era. Plantou was the first individual to manufacture artificial teeth in America. He also trained others to make these teeth and sold "kits" containing all of the materials needed to do so. In 1822, Charles Wilson Peale, a very accomplished Philadelphia artist, began experiments to improve Plantou's artificial teeth. Being edentulous, Peale fashioned himself an ivory set of dentures. He made one of George Washington's existing sets of dentures from human and animal teeth attached to lead bases. Springs were used to retain them. After learning about "mineral teeth," Peale experimented and fabricated dentures with porcelain teeth for himself and his son. He is believed to be the second American manufacturer of porcelain denture teeth after Antoine Plantou. In his experiments he sought to improve the shade, form, and strength of Plantou's teeth.[1,4]

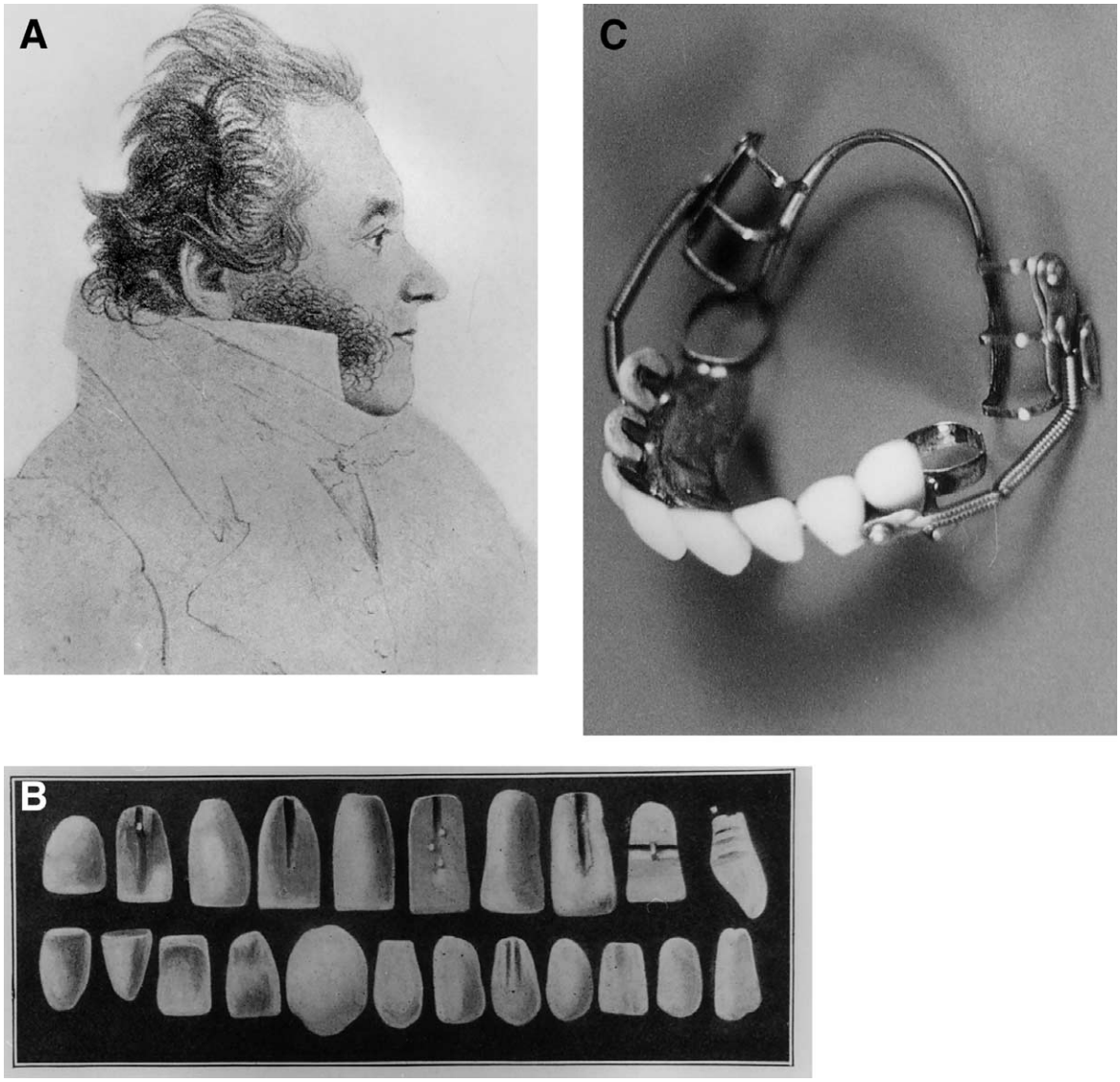


Figure 5. (*A*) Guiseppaugelo Fonzi developed the first individually fired porcelain teeth in 1808. (Reprinted with permission.[2]) (*B*) Fonzi's "Terro-Metallic Incorruptible Teeth" became known as "French bean" teeth due to their bean-like shapes. (Reprinted with permission.[6]) (*C*) This partial maxillary denture, made circa 1830, was fitted with Fonzi's Terro-Metallic teeth. (Reprinted with permission.[5])

The first improved porcelain denture teeth to gain general acceptance and be produced in significant numbers in America were those of Philadelphia jeweler and dentist Samuel W. Stockton. Stockton began his experiments to develop improved porcelain denture teeth in 1825. By 1844, he claimed to be producing 500,000 artificial teeth per year. His dentures had swaged gold bases. The artificial teeth, which were fired with gold retention pins, were soldered in place on the denture bases.

Other American dentists who pioneered improvements in the porcelain teeth of the early nineteenth century included:

- Joseph E. McIllhenny (1826)
- D. C. Ambler (1828)
- J. R. Spooner (1828)
- Josiah F. Flagg (1830), the first American-born dentist and inventor of the first dental chair[5]
- Shearjushub Spooner (1831)

Figure 6. (*A*) London goldsmith Claudius Ash began the manufacture of high-quality porcelain denture teeth in 1837. (Reprinted with permission.[3]) (*B*) In 1840, Ash developed the "Tube Tooth." (Reprinted with permission.[3])

- Daniel Harwood (1833)
- Joshua Tucker (1833)
- James Alcock (1835)
- John Allen (1835)
- Elias Wildman (1837).[11]

At the beginning of the nineteenth century, Claudius Ash (Fig 6 *A, B*), a London goldsmith, was approached by a local dentist who asked him if he could produce a dental appliance.[3] Ash did this so skillfully that he soon found himself inundated with work requests from many other London dentists. He became one of London's first "dental mechanics." Because he disliked handling dead men's teeth (so-called "Waterloo teeth"), Ash set out with his own experiments to improve the "French bean" teeth. By 1837 he had succeeded, and that year began his own manufacture of mineral teeth in several shades of gray. These were considered the best porcelain teeth available up to that time.[3] The demand for these teeth was overwhelming. Ash industrialized dental kilns and founded the international firm of Claudius Ash, Sons, and Co. In 1840 he developed the "Tube Tooth," which was held firmly in place on a denture base by means of a post.[3] Claudius Ash, Sons, and Company sponsored *Ash's Quarterly*, later titled *Ash's Monthly*. In 1919 this fine journal became *Dental Magazine*, and in 1924 the title was changed to *Dental Magazine and Oral Topics*.

No discussion of the evolution of denture teeth in the nineteenth century could be complete without a review of the outstanding contributions of Dr. Samuel S. White of Philadelphia (Fig 7 *A*).[11] In his text, Guerini[6] praised Dr. White as follows: "The credit of having introduced many new improvements in the manufacture of Mineral Teeth belongs to the Americans. Among those who particularly distinguished themselves in this department of dental art, we may note: Charles W. Peale, Samuel W. Stockton, James Alcock, and Elias Wildman. But the most brilliant results, as is well known, were obtained by the celebrated Samuel S. White, who by an intelligent and persevering activity, dedicated almost exclusively to improving Min-

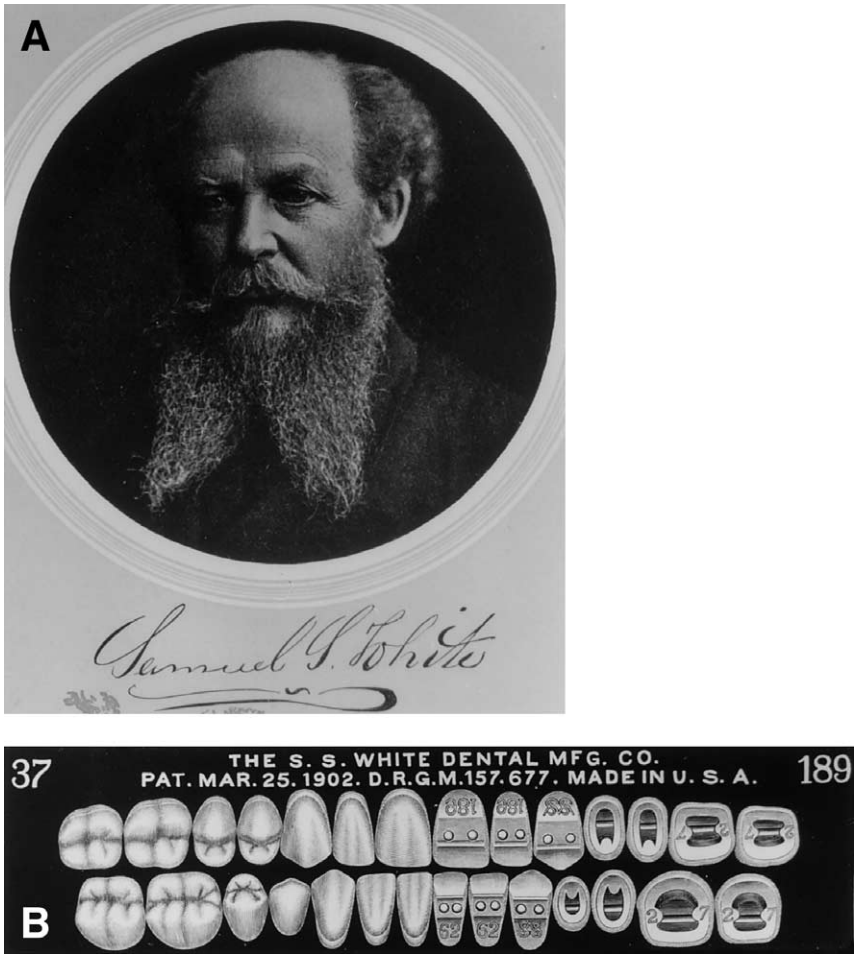


Figure 7. (*A*) Samuel S. White of Philadelphia made numerous contributions to dentistry. He founded his company in 1844, and that company soon became the world's leading manufacturer of dental supplies and equipment. (Reprinted with permission.[11]) (*B*) This illustration from an early S. S. White catalog clearly shows the double pins and diatorics that were added to ensure retention by the vulcanite. (Reprinted with permission.[12])

eral Teeth and to bringing them into general use, contributed vastly to the progress of Modern Dental Art."

Before the development of Samuel S. White's porcelain denture teeth, the best teeth available in America were those of Samuel W. Stockton of Philadelphia, who was Samuel S. White's uncle and mentor. By the late 1830s, Stockton was struggling to keep up with the demand for his teeth, and he decided to take on 2 of his nephews as apprentices. And so, in 1838, Samuel S. White, at age 16, began a 5-year indentureship with Stockton. White finished his apprenticeship in 1843 and that year went into practice with his uncle. Over the next year, White carved his own molds for porcelain teeth, which he fashioned after natural teeth for improved esthetics. He assigned distinct shapes for different anatomic facial types. He also considered age, sex, complexion, race, and physical peculiarities in fabricating his teeth. He worked at denture setups to make them look more natural and less "false." His molds deviated from the norms of the day. His teeth offered improved translucency and less bulk and weight while maintaining strength; they were denser and consequently had better resistance to absorption and temperature changes. In addition, White improved the design of the pin attachment system that enabled the use of his teeth with various denture base materials. White began selling his improved porcelain denture teeth to other local dentists in 1844. By 1846, his business was growing so fast that he decided to give up his dental practice

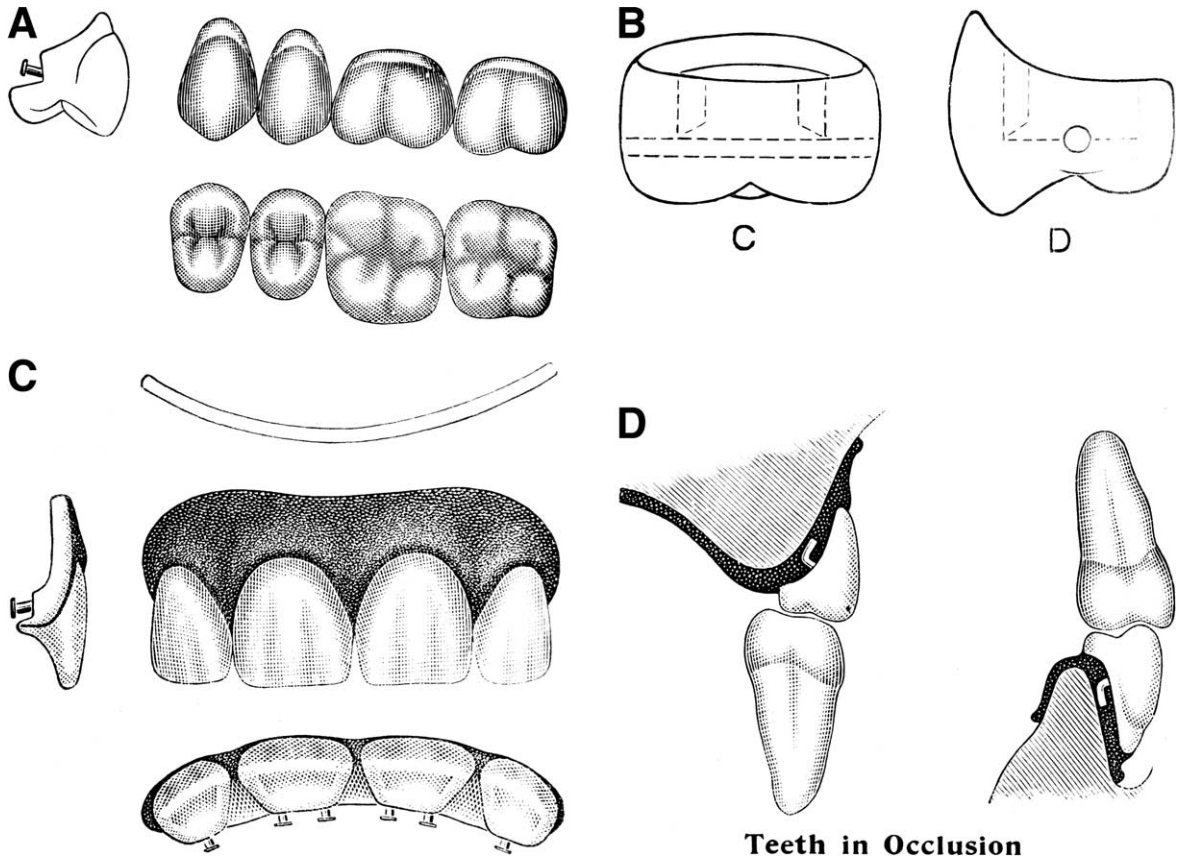


Figure 8. An illustration from an early S. S. White product catalog showing artificial denture teeth meant for different situations and having different retention mechanisms. (*A*) Pin retention for vulcanite. (Reprinted with permission.[12]) (*B*) Diatoric design for vulcanite use. (Reprinted with permission.[12]) (*C*) Continuous gum teeth pinned for vulcanite use. (Reprinted with permission.[12]) (*D*) Earlier bent-pin design for vulcanite use. (Reprinted with permission.[12])

and devote his time solely to the manufacture of his improved denture teeth. During that same year, he moved his operation several times to larger facilities and took on investors to accommodate the incredible demand for his product. White's denture teeth were typically stocked by druggists, jewelers, and other agents in the late 1840s (Fig 7*B*).[12] As the S. S. White Dental Manufacturing Company grew, it quickly developed a wide product line of dental equipment and supplies. Eventually, White's company became the world's largest manufacturer and supplier of dental products. In 1846, White opened the first of his many "branch houses" in New York City. These branch houses eventually spanned America and were also established abroad. Unfortunately, the S. S. White Company ceased all manufacturing of denture teeth in 1937. This was strictly a business decision based on the inflated cost of platinum (used for the retentive pins) during and after World War I. While phasing out tooth manufacturing, the company concentrated its efforts on more profitable equipment and supply product lines.[1,11]

Throughout the nineteenth century, the S. S. White Company received many gold medals and testimonials for its outstanding artificial teeth. Besides the many important technological contributions that he and his company made to dentistry, White founded the *Dental Newsletter* in 1847 while still in his twenties. This periodical evolved into *Dental Cosmos* in 1859. *Dental Cosmos* ceased to be published as a separate journal after its merger with the *Journal of the American Dental Association* in 1937.

As the nineteenth century progressed, S. S. White's teeth (Fig 8 *A-D*)[12] were modified to facilitate their attachment to new denture base materials that emerged during that time, including

gutta percha by Edwin Trumin in 1851; vulcanite, patented by Nelson Goodyear in 1851; cast aluminum bases by J. B. Bean in 1870 and W. H. Atkinson in 1881; and celluloid by I. S. and J. W. Hyatt in 1870. Vulcanite endured as the principal denture base material until 1937, when acrylic resin denture base materials emerged. A flexible, hard rubber, vulcanite is now an obsolete denture base material.[13] It is a combination of caoutchouc and sulfur that hardens in the presence of suitable heat and the application of high-pressure steam. A number of processing units were made specifically for this purpose. The vulcanite process was protected by several patents issued to the Goodyear Rubber Company, which became very wealthy through its strategy of selling vulcanite only to dentists licensed by the company. Goodyear charged these dentists a licensing fee (based on the size of the practice), as well as a royalty on each denture produced. Goodyear employed investigators who traveled about intimidating and suing dentists who did not pay the royalties. These brutal collection practices finally stopped in 1879, when Josiah Bacon, Treasurer of the Hard Rubber Company, was murdered in a San Francisco hotel by an irate dentist who had twice been in trouble with Goodyear for using vulcanite without a license. Goodyear's patents on vulcanite expired 2 years later.

Vulcanite dentures looked very flat and unnatural. Often, for the sake of esthetics, labial porcelain "gum" was added as an extension of the teeth to veneer the vulcanite. Initially, the porcelain gum had to be added and fired by the dentist, a laborious and unpredictable technique.[14] Despite its esthetic shortcomings, however, vulcanite was inexpensive, readily available, and easily worked to produce accurate, well-fitting dentures. The ready availability of vulcanite and porcelain denture teeth ushered in the era of dentures for the masses. This serendipitously occurred at the same time that the introduction of ether by Crawford Long in 1842 and nitrous oxide by Horace Wells in 1844, along with improved oral surgical techniques and instruments, made full mouth extraction a common dental treatment. The mid to late nineteenth century saw an overwhelming demand for complete dentures. By 1902, the S. S. White Company's catalog offered 8 different rubbers for vulcanite dentures.[12]

D. W. Neal of Camden, New Jersey was another early American tooth manufacturer and a competitor of S. S. White. He and White used the same machines to produce the retention pins for their denture teeth. From time to time during the 1850s, Neal's machines were serviced at a Philadelphia machine shop by a young German immigrant machinist named Henry D. Justi (Fig 9). [15] The tooth molds used by the pin machines were also serviced in the same machine shop by another employee. Justi was fascinated by the molds and devised an ingenuous technique and molds for the porcelain gum intended to veneer the vulcanite base material. Justi first presented his molds to the Orum and Armstrong Tooth Company, which was founded in 1854. The company was impressed with Justi's work and promptly hired him as a mold cutter. Due to the immense success of his teeth, Justi was very soon made a partner in the company. Within a few years, he bought out his partners and expanded the company. The H. D. Justi Company was founded in 1864; by 1880, it had built an impressive tooth manufacturing facility in Philadelphia. Justi's teeth soon became the most widely used "vulcanite

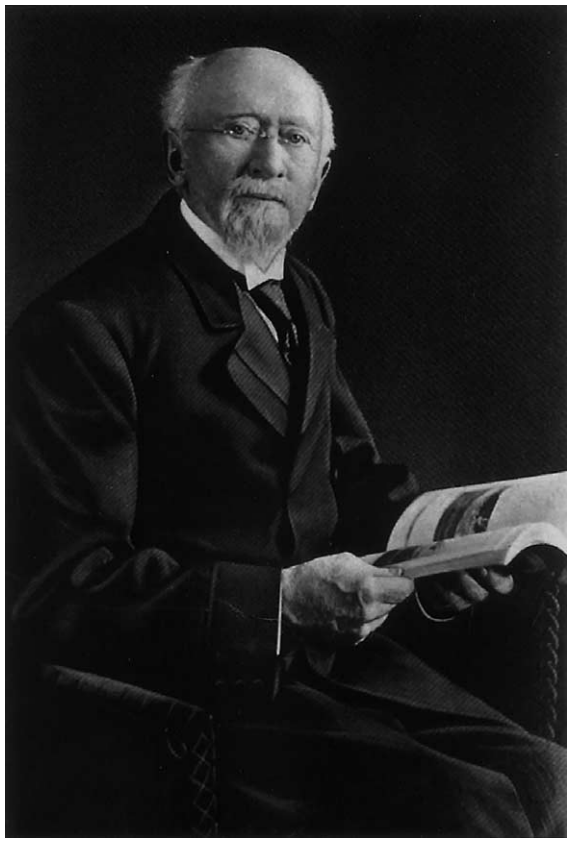
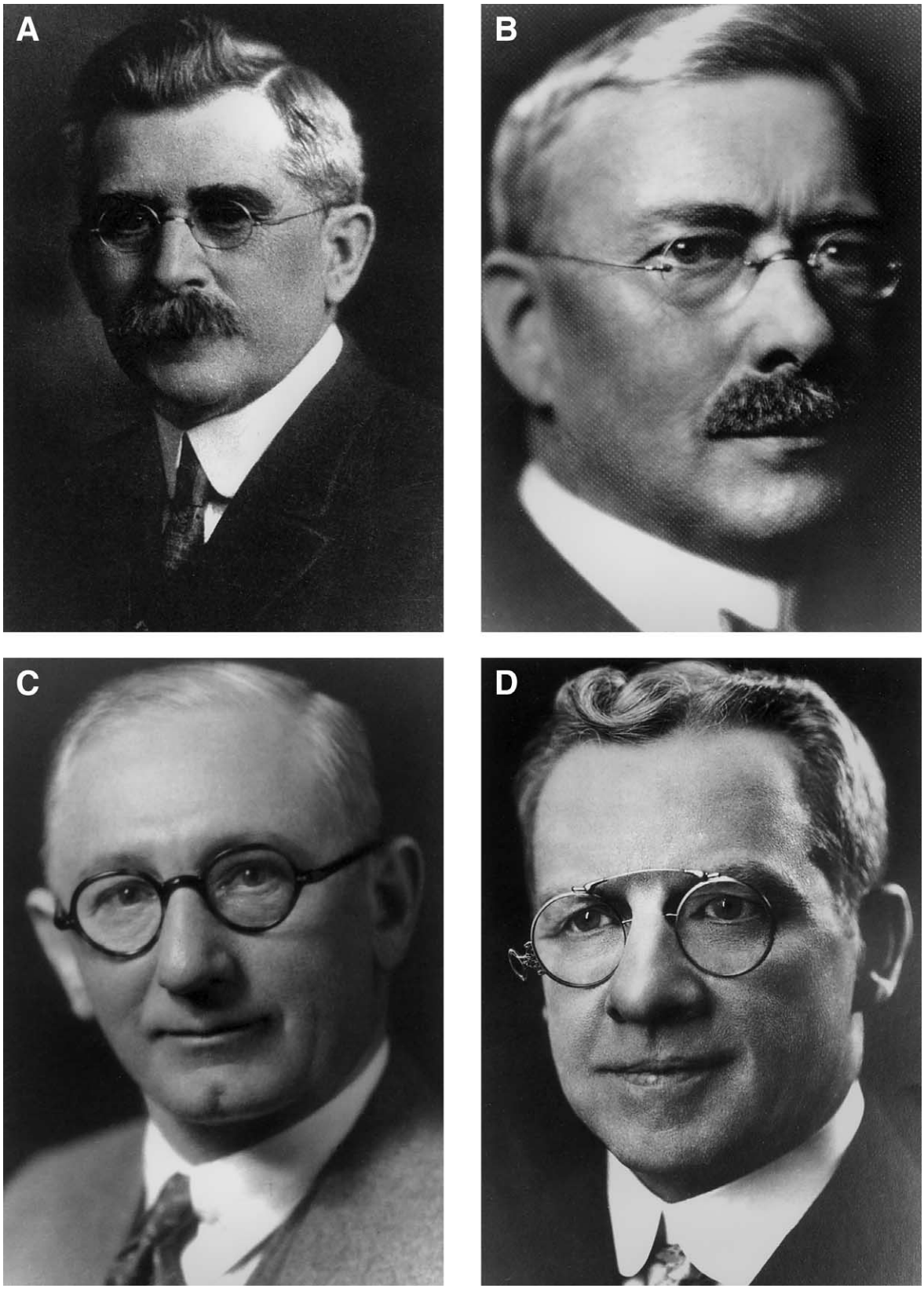


Figure 9. Henry Daniel Justi founded his Philadelphia-based company in 1864. (Reprinted with permission.[15])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teeth" in America.[14,16] Justi published another respected dental journal, *Dental Review*, starting in 1889.

Justi employed a chemist, Andrew J. Funk, who produced the finest porcelain of the day. Funk eventually passed his secrets to George H. Whiteley of the Dentists' Supply Company of New York. For several years, Whiteley had been associated with Dr. J. F. Frantz and the Consolidated Dental Manufacturing Company. Frantz was the former manager of the Wilmington Dental Manufacturing Company until its demise during the financial panic of 1893. In 1899, Whiteley and Frantz, along with two other Consolidated Dental Manufacturing Company associates, J. R. Sheppard and D. C. Osborne, resigned and formed the Dentists' Supply Company of New York, which initially produced platinum pin denture teeth (Fig 10 *A-D*).[14,17,18,19] By the late nineteenth century, there was significant competition among the manufacturers and suppliers of artificial porcelain teeth. The Wilmington Dental Manufacturing Company of Philadelphia, incorporated in 1882, offered a wide variety of quality porcelain teeth in direct competition with the S. S. White Dental Manufacturing Company. It also had branch houses in New York and Chicago. This company evolved from a modest, Wilmington, Delaware, tooth factory that was established in 1865. In 1873, Dr. J. F. Frantz (Fig 10*A*) became a partner and the first manager.[17] That same year, the company became the J. R. Tantum Company of New Jersey. The company later purchased the company of Dr. T. B. Welch and Sons and by 1890 had consolidated with the American Dental Manufacturing Company of New York, at which point it became the Wilmington Dental Manufacturing Company. After the failure of its banks during the panic of 1893, American Dental Manufacturing Company was forced to cease manufacturing and to permanently close its doors. Of particular interest is that this company also sponsored a popular professional dental journal, *Items of Interest*. This dental periodical first appeared in 1878 and was originally published by T. B. Welch and Son. When that company was purchased and consolidated into the Wilmington Dental Manufacturing Company, publication of the journal continued. When this company failed during the 1893 panic, J. F. Frantz carried the journal with him to the Consolidated Dental Manufacturing Company and continued its publication. By 1890, *Items of Interest* was the largest and most widely circulated dental journal in the world.[20]

By 1893, the Morrison Brothers Dental Depot of Nashville claimed to be publishing the "largest and most complete dental catalog in the world."[21] They also published the then-popular dental journal *Dental Headlight*. Their catalog emphatically stated that artificial porcelain teeth comprised their most important product line, and further boasted that no other company in the country had a better selection of artificial teeth or as much capital invested in this particular product inventory. They limited their stock to the porcelain teeth manufactured by the world's top 5 manufacturers (S. S. White, H. D. Justi and Sons, Gideon Sibley, Wilmington Dental Manufacturing, and Claudius Ash and Sons), but they did stock the complete artificial tooth line offered by each of those 5 manufacturers. The teeth of S. S. White, Wilmington, and Justi were comparably priced. The imported teeth of Claudius Ash and Sons for the most part were approximately 20% more expensive; Gideon Sibley's teeth, around 20% less expensive.

Two additional noteworthy nineteenth-century American contributions to denture tooth development were John Allen's invention of the continuous

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Figure 10. (*A*) In 1873, Jacob F. Frantz, MD, became the first manager of a modest Wilmington, Delaware tooth company that had been in business since 1865. The company was renamed the J. R. Tantum Company of New Jersey that same year. That company later purchased the companies of Dr. T. B. Welch and Sons and The American Dental Manufacturing Company of New York and consolidated under the new name of The Wilmington Dental Manufacturing Company in 1890. When the company failed to survive the "panic of 1893," Dr. Frantz moved on to The Consolidated Dental Manufacturing Company. In 1899, he became 1 of the 4 founders of The Dentists' Supply Company of New York. (Reprinted with permission.[17]) (*B*) George H. Whiteley was associated with Dr. Frantz at The Consolidated Dental Manufacturing Company of New York. Whiteley had acquired the closely guarded secrets of porcelain manufacture from a brilliant H. D. Justi Company chemist, Andrew Funk, who reportedly produced the finest porcelain of the time. In 1899 Whiteley also became 1 of the 4 founders of The Dentists' Supply Company of New York. (Reprinted with permission.[17]) (*C, D*) J. R. Sheppard and D. C. Osborne were associated with Frantz and Whiteley at The Consolidated Dental Manufacturing Company. In 1899, the 4 of them formed The Dentists' Supply Company of New York. (Reprinted with permission.[17])

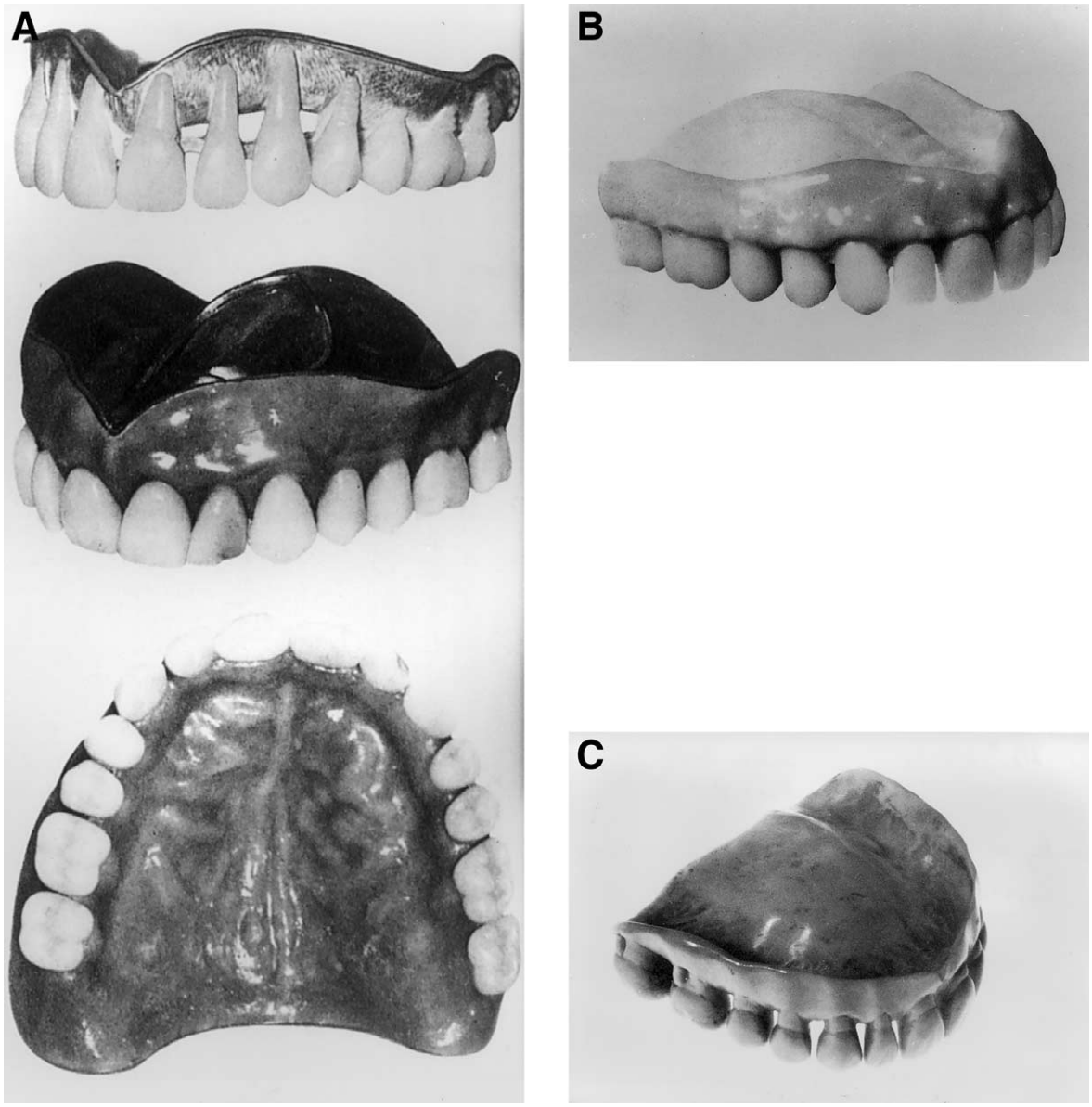

Figure 11. (*A*) The continuous gum denture was invented by John Allen in 1844. (Reprinted with permission.[22]) (*B*) The all-porcelain denture was resurrected and improved by Mahlon Loomis in 1854. (Reprinted with permission.[22]) (*C*) Another all-porcelain denture (circa 1868). (Reprinted with permission.[5])

gum denture in 1844 and Mahlan Loomis' resurrection of the all-porcelain denture in 1854 (Fig 11 *A-C*).[5,22]

At the turn of the twentieth century, the profession had no system for classifying the many available molds of denture teeth. Consequently, manufacturers were forced to maintain huge and confusing inventories in order to compete. The profession would have to wait until 1911 for Dr. James Leon Williams to develop a usable system. Moreover, at this time, all of the occlusal anatomy of the commercially available denture teeth was an arbitrary creation. Despite the development of early average-value mandibular-movement articulators in the mid-nineteenth century and the promotion of theories of articulation by such innovators as W. G. A. Bonwill, no one created molds for anatomic denture teeth that could be set to balance and be in harmony with average articulator settings. That great innovation would have to wait for

the eminent Dr. Alfred Gysi, who will be discussed later in this series of articles.

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