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- Increasing interest among dentists in dental history.
- Developing a broader understanding of the facts of dental history among the leaders in dentistry in order to aid them in their attempts in solving important problems in dental education and practice.
- Encouraging dental schools to develop historical collections on dentistry, and to offer adequate instruction in dental history.
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Dental Terms in Julius Pollux’s *The Onomasticon*

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Julius Pollux’s *The Onomasticon*, a lexicographical work, contains a large number of terms on dental and oral issues; through them, we can see people’s perceptions about the dental arches and the oral cavity in the 2nd century CE. The dental arches are presented thoroughly, naming the groups of teeth and presenting their characteristics. Special mention is made of the wisdom teeth. Pollux also gives a brief description of the tooth in general, the alveolar process and the gingiva. He also refers to dental anomalies and diseases.

Introduction

Julius Pollux was a sophist, grammarian and lexicographer of the 2nd century CE. Little is known about his life; most information is drawn from either the 10th-century dictionary of Suda (or Souda), or from Lucius Flavius Philostratus’ work, *The Lives of the Sophists*. Born in Naukratis of Egypt, Pollux learned his letters and practiced in oration and rhetoric under the guardianship of his father. He continued his studies with the orator Hadrian, who held the chair of rhetoric in Athens. During the reign of the emperor Marcus Aurelius, Pollux travelled to Rome, where it is believed that he was a teacher of Commodus. According to Philostratus, Commodus was fascinated by Pollux’s melodious voice, and appointed him professor of rhetoric in Athens around 178-180 CE. However, it is more likely that Pollux received that distinguished position as a gift in return for his work entitled *Epithalamium to Caesar Commodo*, which was dedicated on the occasion of Commodus’ marriage to Bruttia Crispina in 177 CE. Pollux died at the age of 58, leaving a son.

According to Suda, Pollux was the author of a number of works, such as *Roman Speech, Trumpet or Musical Contest, Against Socrates, Against the People of Sinope, Panellenic Speech, Arcadian Speech*, etc. The only work that has survived—and only in incomplete form—is the lexicographical work entitled *The Onomasticon*.

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The Onomasticon

It is estimated that The Onomasticon was written during the reign of Commodus (180–192 CE). It is possible that Pollux started writing when he was Commodus’ teacher, but completed it later. According to the Greek historian of natural sciences M. Stefanidis, every introduction to the books of The Onomasticon, and especially those of the 4th and 6th books, show the teacher-student relationship which existed between Pollux and Commodus. In addition, Pollux always addresses Commodus the same way: [“Julius Pollux is greeting Caesar Commodus”]. He addresses Commodus as Caesar, a title which he held from the age of five; he took the name “August” at the age of 16, when he became co-emperor with Marcus Aurelius in 177 CE.

The original text of The Onomasticon possibly consisted of 10 or 17 books, according to differing accounts. Unfortunately, the only surviving copy is an epitome of the 9th century, which was in the possession of the Byzantine scholar Arethas, Archbishop of Caesarea. From that archetype were derived the four incomplete versions and, thereon, any surviving manuscript of The Onomasticon. Despite any changes, interferences or abbreviations in the original text, The Onomasticon still includes a significant volume of the original work—enough for the study and evaluation of it. It is a lexicographical work, which contains the words of the Attic dialect. The recording of the words is not done in alphabetical order, but by subject. This type of classification was used in organizing similar lexicographical works in early ancient Greek literature and was gradually replaced by alphabetical order. To make it clearer, we will give some examples of the way by which Pollux recorded medical terms at the end of the 4th book. In this classification, he includes an adequate number of words which were then commonly used in medical practice, some of them surviving until the present.

This type of recording complies with the criterion of classification according to subject:

i) Of similar words, for example derivatives of the root word ἰατρική (medicine), e.g.:  “Ἀπὸ δ’ ἰατρικής ἰατρός ἰατρεία, ἴασις, ἴασασθαι ἐξιάσασθαι, ἰώμενος, ἴασιος ἀνίατος, ἴάματα· καὶ ὁ μισθὸς ἰατρεία, καὶ τὸ ἐργαστήριον ἰατρεῖον…”10 [From medicine, physician, medical treatment, healing, heal, cure thoroughly, curable, incurable, remedies, the medical fees, the medical laboratory…]

ii) related things, e.g.: “…καὶ ἐργαλεῖα μὲν ἰατρῶν σμίλη, ψαλίς, τομεύς, ὑπογλυφίς, μήλη, ὑπογραφίς, βελόνη, ξυστήρ, ὀδοντοξέστης, ὀδοντάγρα, εὐδίαιον…”11 [“…the instruments of physicians are the chisel, scissors, carver, ear pick, probe, pencil, needle, scraper, tooth scraper, tooth forceps, clyster pipe…”]

With regard to the structure of the work, each one of the surviving ten books of The Onomasticon has an introduction with a short dedication letter to Commodus. The content varies among the books; however, broadly and from the view of the contemporary concept of science, we can consider that books 1, 3, 8 and 9 refer to terms and names of the theoretical sciences and that they include, among others, the topics of theology (Book 1); kinship and relationships (2); law and justice (8); and cities (9).
However, in the 2nd book, he lists the nomenclature of the category of “science,” for example: the parts of man; astronomy; geometry; numerics; metrology and medicine; and in the 4th book, names related to poetry; music; dancing and theatre.

In each book, he separately records the names, synonyms and derivatives which are relative to the issue at hand. For example, in the 4th book, after the synonyms and derivatives of the topic ἱατρική (medicine), there follow the synonyms and derivatives of topics related to medicine, such as θεραπεύειν (cure), νοσηλεία (nursing), ὑγίεια (health) and φαρμακεία (use of drugs). Next, the names of diseases are mentioned and the book is completed with the homonyms, synonyms and derivatives of the topic μαῖα (midwife).

Aside from merely listing names without explanation, he often introduces topics (synonyms or derivatives) in a way that does not follow any logical sequence. The case of the 3rd book is characteristic, in which he starts with the names of kin and relationships, and then follows with topics about parents, marriage, friends and enemies; but he then continues with irrelevant topics about bankers, small and great rivers, wealth, and, finally, sports. The lack of any logical sequence verifies, without doubt, that there were alterations to the original text during the creation of the later epitome.

**Naming of the Parts of the Human Body**

Perhaps the only book that presents any notable consistency is the 2nd, which refers exclusively to the parts of the human body. Clearly, it is an epitome of a larger work which probably focused on man from a purely medical standpoint.

Even the initial topics verify this: ἀνθρωπός (man), σπέρμα (semen), βρέφος νεογενές (newborn baby), νεανίσκος (child/youth), γέρων (old man).

The second book begins with an introduction to man—first to the male and then to the female—with the topics ordered in sequence according to the developmental phases of the human body. From the sperm of the man, the infant is created. Thereafter, depending upon his age, he acquires different names for each phase of development, from infancy to old age. Given the particular nature of the 2nd book, where he discusses matters of human anatomy and the parts of the body, Pollux does not list any topic without interpretation. Rather than merely listing words, topics in this volume are treated as special terms, which are interpreted for a non-specialist reader. Pollux has a unique way of using metaphors for the interpretation and explanation of terms:

[“…in each side of the nose are placed above the cheeks, what are called apples, that are the sub-eye guard of the eyes. Or they are called ‘cheeks’ as they bloom in time.”]

These explanations are examples of the detailed etymological explanations which Pollux provided for the 2nd book.

As for the parts of the human body, the description begins with the hairy part of the head, and then the parts of the face, such as the eyes, nose, ears, cheeks, lips, teeth and mouth. This way of recording anatomical data is called, according to the Roman tradition, “a capite ad calcem” (“from the head to the heel”). It is based in the anatomical classification of the parts of the human body, which begins with the hair of the head and ends with the lower extremities. This was considered as the ideal model for anatomical descriptions until the end of the Renaissance. However, The Onomasticon ends in the area of the stomach, the last described organs being the liver and the spleen. This probably means that the rest of the text about the lower extremities has not survived through the epitomes and has been lost. Nevertheless, the surviving text of the 2nd book contains an important catalogue of medical terms including dermatology and dentistry.

**Dental and Oral Anatomical Terms**

The oral and dental anatomy as presented by Pollux is of crucial importance in drawing the outline of dental knowledge during the first Christian centuries of the Roman Empire. The Onomasticon is not a medical or a dental treatise; however, through it we can see the perceptions about the dental arches and the degree of diffusion of dental knowledge among scholars of different fields, and the broader intellectual elite of that time.
In *The Onomasticon*, the anatomy of the oral region begins with the cheeks (παρειές), which were also called apples (μήλα). They are located on the right and the left from the nose. Their main role, along with the eyelids, is to protect the eyes.28 After the cheeks, the lips (χείλη) follow, while the anatomical area located inside them is called στόμα (mouth). The mouth is also called χάνος (chanos, open space/gap) as a derivative of the verb χαίνω (chainō).29 The top of the mouth is called ουρανός or υπερώα (palate) and is covered by innervated flesh, which extends from the internal surface of the teeth to the side surfaces of the tonsils. While Pollux mentions the innervation of the palate flesh, he does not make any reference to nerves or innervation in other anatomical structures of the oral region nor of the teeth. In antiquity, the first to mention tooth innervation was Galen of Pergamum.30

The oral cavity ends with the φάρυξ (pharynx) which, because of its narrowness, is also called ισθμός (isthmos, narrow passage). In the deeper part of the palate hangs the κίον or κιονίς (kiōn or kionis, uvula), which is called by some authors χόνδρος or γαργαρεών (chondros or gargareōn). When sick, it is inflamed and then it is called σταφυλὴ (stafuli, illness) or σταφυλοφόρος.31 This is also supported by Rufus of Ephesus who, in his treatise *On the Names of the Parts of the Human Body*, is the main source of many of the anatomical terms of *The Onomasticon*32 and which mentions σταφυλὴ (stafuli), not the anatomical element but the condition.33 Today, it means the opposite, since stafuli is defined as an anatomical element only and not an illness.

Lips are the gateways into the mouth. Pollux mentions that Homer called them ἕρκος ὀδόντων,34 (erkos odontōn), i.e., a fence of the teeth. They are distinguished as the upper and lower lip in the same way that the jaws are distinguished as the upper and lower jaw. In this case, the upper jaws of all animals are fixed, while the lower moves to process food. According to the author, the sole exception is the crocodile, in which the upper jaw moves while the lower is fixed.35

The lips, which are also called μύλλα (mulla) depending on their size, can be divided into ισοχειλῆ (isocheli) when displaying full or normal development and ἐπιχειλῆ (epicheili) when they are smaller than normal and with the characteristic rising of the upper lip.36 The anatomical description of the lips continues with the presentation of the external surfaces of the face associated with them. As such, the area of the face which includes the lips is called κημός (kimos). The groove that is formed in the upper lip, i.e., the subnasal groove, is characterized as φίλτρον (filtron, philtrum) while the corresponding groove of the lower lip is called τύπος or νύμφη (tupos or numph)—this is the small groove located between the lower lip and the chin, now called the mentolabial sulcus. Between the outer and inner surface of the lip stands the προχειλίδιον (prochilidion, vermillion), which is part of the lip that projects, while the joint of the lips is called προστόμιον (prostomion, oral commissure). The areas where the lips are attached to the jaws are called by Pollux χαλινοί (chalini, frenulum). In contemporary terminology, the frenulum is the delicate membrane by which the lips are attached to the oral mucosa.

The teeth, according to Pollux, number thirty two. Today this statement is unremarkable, but *The Onomasticon* is the only non-medical text of ancient Greek literature which mentions the exact number of teeth in the adult human dentition. Even among medical treatises, this fact was rare, found only in the pseudo-Hippocratic letter to King Ptolemy *On the formation of man*,38 and in one small part of the treatise *On the utility of the parts of the human body*39 from within the whole of the Corpus Galenicum. In the other texts of the ancient medical literature, the number of teeth is either not mentioned at all, or else is derived from summing up the number of teeth mentioned during the description of the dental arches, as in the case of Rufus of Ephesus.40 The lack of any mention of a definite number of teeth is probably attributable to the fact that the dental arches were not usually intact, a fact supported by a plethora of archaeological and anthropological evidence. In the ancient world, the absence of oral hygiene in combination with nutritional habits
often resulted in dental caries, periodontal diseases and other severe dental problems, which eventually resulted in alveolar bone and tooth loss.41

The thirty-two teeth which form the dental arches are attached with sixteen per jaw. The four middle teeth in each jaw are recorded with a variety of names that are associated with their role. Accordingly, they are called τομείς (tomis, incisors) because they intersect with food. This is the most common name by which the four front teeth of the dentition appear in the ancient literature. They are also classified as γελασίνοι ὀδόντες (gelasini odontes, smiling teeth), because these teeth are shown when we laugh; they are also called διχαστῆρες ὀδόντες (dichastires odontes, dissecting teeth) because of their ability to separate food. Finally, they are sometimes referred to as κτένες ὀδόντες (ktenes odontes), because they destroy anything that they grasp between them.42 (The word κτείς, plural κτένες, is derivative of the verb κτείνω, which means destroy, kill.)

The next teeth are the κυνόδοντες (kynodontes, canines). There are two in each jaw, one at each side, and they received their name after their acuteness, which gives them a form that resembles the teeth of dogs. Both the incisors and canines have a single root.43

The next category of teeth is the γομφίοι (gomfii, molars). In the works of other medical writers of antiquity, such as Galen,44 there was no distinction made between the premolars and the molars. According to Pollux, the molars are located next to the incisors, five on each side and ten in each jaw. Obviously, the molars are located on both sides of the canines, which is not clearly stated, perhaps because the reference point in the presentation of the teeth are the incisors, which are recorded first. The molars are further divided into those having two roots and those with three roots. Pollux, however, does not explicitly mention in which jaw each group is placed. In The Onomasticon, the description of the molars is completed with references to their usefulness, stressing that the μύλαι (mulai, crowns) of the molars are used for grinding food, rather like a wheat mill grinds grains.45 By the term μύλαι he refers to the part of the tooth that protrudes over the gums in the oral cavity. Galen, who was a contemporary of Pollux, mentions that besides meaning only the protruding part of the molars, μύλαι could also refer to molars as a whole.46,47

The last kind of teeth are the σωφρονιστῆρες (pl. σωφρονιστήρες, σωφρονιστήρ, wisdom tooth), which are found at the end of each quadrant of the dentition and which erupt after an individual reaches age 20. These are the third molars, also called κραντῆρες (krantires).48 Pollux seems to accept the Aristotelian notion that in certain people they may appear even after the eightieth year.49

After completing the presentation of the three types of teeth, Pollux then goes into a brief description of the tooth in general. This description reflects more the morphology of the molars rather than the incisors or canines. As such, the part of the tooth that protrudes from the gums is called the μύλη (mili, crown) which is further distinguished from a) βωμίσκος (bomiskos, altar, base), the part that is located on the side of the flesh. In other words, the side surfaces and the bulk of the crown and b) the τράπεζα (trapeza, table), the part which grinds the foods, i.e., the occlusal surface of the teeth.50

Particularly problematic is the interpretation of the terms ὀλμίσκοι (olmiskoi) and φάτναι (fatnai).50 There are two possibilities. The first, and most likely, is that olmiskoi qualifies as the bone cavities of the jaws, while the sum of them is the fatnai. Obviously these are the alveoli that support

* The word σωφρονιστήρ (sowfronisistor) is derivative of σῶφρων (sôfrôn), which means wise or prudent. The first reference to the third molars as sofrostiter is attributed to the stoic philosopher Kleanthis of Assos (ca. 330–232 BCE), who mentions that the naming is related to the period of eruption which coincides with the time when a man’s mind matures. See: Ioannes von Arnim, Stoicorum veterum fragmenta, vol. I, (Leipzig: Teubner 1903): fr. 524, pp. 12–14. It is also interesting to mention that, according to the treatise Lives and Opinions of Eminent Philosophers by Diogenes Laertios, Kleanthes died because of gum suppuration (7.176.1). This is the first recorded death due to dental disease in ancient Greek literature.

** The word κραντήρ (krantir): one that accomplishes, the teeth that complete the set, as with the eruption of that tooth by which the dentition is completed (karantiries are called the teeth that erupt later at the accomplishing and completing of age.) See: Ioannes von Arnim, Stoicorum veterum fragmenta, vol. I, (Leipzig: Teubner 1903): fr. 524, pp. 12–14.
the teeth. This interpretation supports Rufus of Ephesus, who argued that ολμισκοί and φατναί are the crevices which support the teeth.\textsuperscript{51}

However, it is also possible that ολμισκοί means the pits of the occlusal surfaces of the molar teeth, while φατναί refer to what we today call the alveoli. Galen mentions that the attachment of the teeth is made to the alveoli (φατνία, φατνία), the name of which is derived from the timbers (φάτναι, φάτναι) of the wooden troughs used for feeding animals. The alveoli are cavities in the bone which accommodate the roots of the teeth; they are part of the jaw bone.\textsuperscript{52}

Accordingly, the teeth are interlocked in the cavities formed in the alveolar process.\textsuperscript{53}

The description of the tooth is completed with the flesh that surrounds each tooth attached in the alveoli. The flesh which surrounds the outer side of the teeth is called οὖλα (ουλα, gingiva), while that of the internal surface is ἔνουλα (ενουλα). The contact points of two teeth are called ἁρμοί (αρμι, joints). The teeth placement in the jaws, contacting each other, are aligned in such a way that this arrangement of teeth is called—and remains to this day called—οδοντικός φράγμος (odontikos phragmos, dentition, dental arch), and altogether the row of teeth is called, barrier.\textsuperscript{54}

Pollux seems to accept the view of Aristotle that males have more teeth than females, and he accepts the view that people with dense teeth in close contact live longer that those who have spaced teeth. In order to make an impression on the reader, he interpolates a delightful story. According to his tale, Pyrrhus (319-272 BCE), King of Epirus and one of the greatest ancient leaders, had a unique dentition because his teeth were so dense that they gave the sense of one solid bone with only superficial groves in the shape of teeth.\textsuperscript{55}

Pollux does not fail to refer to dental anomalies and diseases. He recognizes as a disease the οδοντοφυΐα (odontofia, dentition) and the οδονταλγία (odontalgia, toothache).\textsuperscript{56} Νωδός or άνόδος/ανόδων (νόδος or anodus/anodón, edentulous or toothless) refers to someone who lacks any teeth.

Προόδων (proodón) names anyone who has protruding teeth, whilst ὀξύγενος or γένος (oxegenus or genus) is a person with a protruding mandible and lip (nowadays called prognathic).\textsuperscript{57} Finally, he mentions the medical instruments ὀδοντοξέστης (odontoxestis, tooth scraper) and ὀδοντάγρα (odontagra, tooth forceps).\textsuperscript{58} These are not the only instruments used in dental procedures,\textsuperscript{59} but they are the only ones recorded as derivatives of the word ὀδούς (odons, tooth).

**Influences During the Recording of Oral and Dental Terms**

An interesting aspect of *The Onomasticon* is the number of sources from which information was derived to write dental lexicographical findings. It is known that Pollux used numerous works, including lexicographical aids. For example, in the introduction of the 9\textsuperscript{th} book he states that he has taken into account the *The Onomasticon* of the sophist Gorgias and other similar writings. It seems, however, that he does not appreciate such works because he believes that Gorgias’ list of terms is tiring and, most importantly, that the way in which it is built reveals sketchiness, without offering something new to the extant knowledge, making its study boring.\textsuperscript{60}

As regards the second book, in the introductory letter committing the project, Pollux is absolutely clear as to what were his sources:

Julius Pollux sends his greetings to Caesar Commodus. What I could find following those who knew the correct terminology for the parts of the human body is exactly what I was ready to learn from them. But I was taught many things also by the students of the Peripatetic [school], which they have gathered by themselves, their own evidence along with the evidence of physicians: some of these we have gathered from them. Because, for these matters of which knowledge is a result of experience, the benefits of these matters come from those who have gained knowledge from experience. Be merry.\textsuperscript{61}

We see, therefore, that the collection of material for the second book was based on the works of authors who knew the correct terminology for the parts of the human body. Obviously, Pollux refers to physicians as having a good knowledge of anatomy.
The second important source was the students of the peripatetic school, whose founder was Aristotle, the giant who defined the science of dentistry.62

This study focuses exclusively on the part of the second book, where oral and dental terms are discussed, and on the influences upon Pollux in their recording. First of all, he mentions Homer, who characterizes the lips as the fence of the teeth. This expression, ἕρκος ὀδόντων, is found in three passages of the Iliad63 and seven of the Odyssey;64 Homer uses it as a common expression when he speaks of lips. Besides Homer, a multitude of authors—such as Aristophanes, Xenophon and Phrynichus the comic poet—used this expression. However, Pollux's references to these writers are not concerned with the topics of the dental scholar's terminology of that period, but rather as common terms in everyday life. For example, a toothless person is called νωδό (nōdo, edentulous) but Pherecrates, the comic poet, also calls him ἀνόδοντα (anodonta, toothless).65

Worth special mention are the references to Aristotle's work. Although Aristotle was not a physician like his father Nicomachus, he occupied himself with the study of nature and live organisms, paying remarkable attention. In particular, the History of Animals—a treatise that can be considered the first genuine dental treatise in ancient Greek literature66—Aristotle gives a significant number of descriptions regarding the special dental characteristics of several kinds of animals.67 It is therefore reasonable that Pollux draws information from Aristotle and this treatise.

Pollux is clearly influenced by the Aristotelian work and he borrows passages from it. The first reference to the Aristotelian work is made when he mentions the name κραντῆρ (krantir) for the third molar teeth and the fact that they may grow, in some cases, even after the 80th year.68 The second reference is made to Aristotle's misperception that women have fewer teeth than men. It is really remarkable that Aristotle's incorrect views on the number of teeth in women survived from the 4th century BCE, when Aristotle lived, until the middle of the 2nd century CE. However, Pollux does not extend his belief to other animals, like Aristotle, who considered that the same happened with sheep, goats and pigs.

The subject of the 2nd book of The Onomasticon is concerned solely with the presentation of the parts of the human body. Pollux also repeats the incorrect view of Aristotle about the proportional relation between dense teeth and longevity, and vice versa.69

The third and last reference is about the naming of σταφυλή (stafuli, uvula), which Aristotle also called σταφυλοφόρον (stafuloforon).70

Pollux does not make any reference to the medical works of the Corpus Hippocraticum. This observation is only about the dental terms of the second book, but not the entire second book of The Onomasticon where we find nine of the total twelve references under the name of the physician of Kos. We really must wonder as to why Pollux does not mention any of the treatises of the Corpus Hippocraticum, such as On fleshes; in chapters 12 and 13 of this treatise, the teeth and their nature are studied. Meanwhile, in other parts of the 2nd book, he refers specifically to extracts from Hippocrates' works, such as in On the Places in Man and in On Fractures. However, in the part on teeth Pollux does not mention by name either Hippocrates or any other medical writer from whom he gets dental information.

The most interesting reference to Hippocrates about teeth is made in the 9th book, where he speaks of the benefit of the quality of heat. Pollux says: “When Hippocrates mentions that cold is hostile to nerves, bones, teeth and the brain, it is obvious that he knows the benefits of heat to teeth.”71

The detrimental effect of cold on teeth is one of the main issues of ancient Greek dental theory. It is an intractable puzzle, which obsesses several Hippocratic writers and runs along the entire ancient Greek medical literature. As such, for the Hippocratic school, the quality of cold played a key role in the formation of teeth.72 Similar views survive in the doctrines of Aristotle and Galen; according to them, teeth have an earthy consistency because they are bones, and so the qualities of cold and dry dominate.73

However, the cold nature of teeth could not explain the harmful effect of cold on the teeth. The question was: how is it possible that teeth are made from cold, and yet at the same time the cold can...
be hostile to them? The same query concerns the Aristotelian writer of the treatise Problems: why are teeth so sensitive to cold and also, why is cold a source of toothache since teeth are cold by their nature? This very issue is the subject of the 18th aphorism of the fifth section of the treatise Aphorisms, where Hippocrates notes that cold is hostile to the bones, teeth, nerves, brain and the spinal cord. On the contrary, he believes hot to be beneficial to them.

From Pollux’s perspective, it is clear that he lists this aphorism in order to interpret it. However, of all of the organs which are harmed by cold he chooses to focus exclusively on teeth. In Pollux’s view, it is obvious that Hippocrates knows the beneficial effect of hot on teeth, and so the opposite quality of cold must be hostile to them. It is indeed curious as to why Pollux decides to take a clear position on such a specialized medical issue and interpret Hippocrates’ view about the effect of the quality of hot or cold on teeth. We have to assume that Pollux was aware of the dispute among physicians about the intractable problem of the harmful effect of cold on teeth, and decided to interpret the aphorism based on a philological interest.

When writing the dental-oral terms of The Onomasticon, Pollux was aware of the content of the pseudo-Hippocratic letter to king Ptolemy On the formation of man. In this letter, which is attributed traditionally to Hippocrates (although this is not true and, strangely, it is not included in Littré’s edition), it is said that the human teeth number thirty two and that the incisors are also called διχαστῆρες ὀδόντες (dixastires odontes). Besides The Onomasticon, this letter is the only other work in ancient literature that mentions the incisors by that name. Accordingly, we may assume with relative safety that the pseudo-letter was one of the sources used by Pollux to create The Onomasticon.

Though Pollux’s references to other medical treatises are limited, it is certain that he used information from Rufus of Ephesus’ treatise On the Names of the Parts of the Human Body. Rufus’ aim in that treatise was the recording of the names of the parts of the human body; Pollux’s The Onomasticon is superior to the work of Rufus at least insofar as it concerns the oral and dental parts.

The names of the several parts of the mouth and the teeth which are listed in The Onomasticon are greater in number than the corresponding ones in Rufus’s work. Furthermore, Pollux’s descriptions are more instructive. For example, Rufus mentions about gingiva: “Ὅσα δὲ αἱ περὶ τὰς ρίζας σάρκες,” [“Gingiva (is called) the flesh around the root (of teeth)”]. On the other hand, Pollux mentions with regard to the gingiva: “αἱ δὲ περιειληφυῖαι σάρκες τούς ὀδόντας, οὖλα μὲν τὰ ἔξωθεν, ἔνουλα δὲ τὰ ἔνδον αἰ δὲ μεταξὺ τῶν ὀδόντων ἁρμογαῖ.” [“The fleshes that surround the teeth (are called) in the outer side οὖλα (gingiva), and in the inner side ἔνουλα (internal gingiva), while between the teeth (are called) ἁρμογαῖ (interdental papillae)”.

Although Pollux uses as a model On the Names of the Parts of the Human Body, he does not accept everything without thought and, of course, he does not repeat its mistakes. He ignores and does not repeat the incorrect view of Rufus that all the teeth are called κραντήρες (krantires). On the contrary, he mentions in The Onomasticon, as with Aristotle and other authors, that only the third molars are called σωφρονιστῆρες or κραντῆρες. Similarly, while Rufus mentions that παρειές (pareies, cheeks) are called also γνάθοι (gnathoi) and σιαγόνες (siagones) (“αἱ παρειαί καλοῦνται καὶ σιαγόνες, καὶ γνάθοι”), Pollux does not include the name σιαγόνες, because he does not consider the two words as synonyms. For Pollux, παρειές are also called γνάθοι (“παρειαὶ δὲ καὶ γνάθοι ἂν καλοῖντο”), while he speaks about γένυες καὶ σιαγόνες referring to the upper and lower jaw in the same sense as we refer to them today.

A special issue in the course of the development of the scientific ideas of dentistry is that Rufus does not mention anything about the innervation of the palate, though he distinguished nerves from the ligaments and the tendons. On the other hand, when Pollux refers to the palate he writes clearly that it is covered with innervated flesh (νευρῶδες δέρμα). Therefore, the reference to the innervation of the palate has to come from a later source than that of Rufus, but it could not be his contemporary Galen who was the first to mention tooth innervation.
Pollux was an unknown intermediate link between Rufus and Galen, who knew the innervation of the palate but not that of the teeth.

Galen and Pollux: Contemporaries But Unknown to One Another?

In his introduction to the first book of *The Onomasticon*, Pollux claims that he had been Commodus’ teacher. Galen, on the other hand, had been Commodus’ personal physician since his childhood. So, the question arises: why does Pollux not use Galen as one of his sources and, even stranger: why does Galen not mention Pollux?

If Pollux had indeed been Commodus’ teacher, then we have to assume that he certainly knew Galen, as well as his work. Galen had reported on tooth innervation in his treatises *On bones for beginners*, and in *On the utility of the parts*, since his first stay in Rome (162-166 CE). These treatises were well known and easily accessible, and so they were available to Pollux. Moreover, Pollux, as a member of the imperial court, should have had the chance to discuss with Galen not only medical but also philological issues, since it was well known that he had a rich education and writing skills worthy of an expert. There are not many indications that Pollux used Galen’s work as a source of information, while any references are fragmentary and isolated.

Moreover, it is curious that Pollux does not mention the Corpus Galenicum, though Galen was a close friend and personal physician to the emperor Marcus Aurelius. It is true that Galen had very good relations with the entire intellectual elite of the imperial court and, especially, the teachers of the younger members of the imperial family. It is also true that Galen treated the orator and sophist Aelius Antipater, teacher of the sons of the Emperor Septimius Severus, Geta and Caracalla. Indeed, Galen must have had a close friendship with him, as Galen speaks with very complimentary words for the modest manners and the education of Antipater.

As regards Commodus’ reign, Galen avoids any reference to this, although he mentions in detail people surrounding the Caesar during these early years. For example, he says that he treated one of the sons of Sextus Quintilius, a close partner of Commodus. In parallel, it seems that he had a close relationship with Peitholaus, Commodus’ pedagogue whom the emperor Marcus Aurelius held responsible, among others, to call on Galen any time the young Commodus was sick. Characteristic of their close friendship and Galen’s appreciation to Peitholaus is the fact that he discusses with him issues about medical training. He trusts him so much that Galen does not hesitate, in one case, to instruct Peitholaus on the treatment of Commodus.

If Pollux had been Commodus’ teacher, then it should be true that Galen would not have ignored the chance to become friends with him. It is known that Galen had interests in common with Pollux besides medicine, as he was the author of works on lexicographical and stylistic issues, which have been lost. It is hard to imagine that if Galen knew and appreciated Pollux’ work, he would not be tempted to address him on philological issues similar to these he discusses in his annotations in Hippocrates treatises. Finally, we have to conclude that Galen did not know Pollux or, most probably, that he did not appreciate Pollux and his work; this is why he remains silent. Unfortunately we cannot draw any definite conclusions because Galen’s lexicographical works have been lost.

However, it is certain that *The Onomasticon* was not assessed by his contemporaries in general, as Philostratus confirms. He doubts whether Pollux should be characterized as uneducated, educated or simultaneously educated and uneducated. This criticism is focused on the style of his critical orations and especially on the use of the Attic dialect; as to the last issue, Philostratus believes that Pollux had not demonstrated anything special. Philostratus’ final blow lies in his last statement, that the educated-uneducated holder of the chair of rhetoric in Athens had a child who was uneducated and that it was probably Pollux’s own inadequate education which undermined his abilities as a father and teacher, so that he could not meet the minimum educational requirements of his son. Finally, and more severe and also demonstrating self-interest, was the criticism by Phrynichus Arabius (also known...
as Phrynichus of Bithynia), who asserted that the *The Onomasticon* did not feature genuine topics of the Attic dialect, but rather that it was mixed with topics from Homer, Hesiod and the Aeolian dialect. It would be an exaggeration to accept all of these critical accusations.

**Conclusions**

*The Onomasticon* is a lexicographical and encyclopedic thesaurus which was useful until modern times. Western scholars discovered and were interested in the thesaurus after the 15th century CE. However, the usefulness of its study is longitudinal, especially in the terminology on anatomy, because the 16th century anatomists frequently drew terms from it to replace Arabic anatomical terms. Undeniably, Pollux was a source of anatomical terms which are still in use today. Similarly, modern Greek oral and dental terminology is remarkably identical to that of *The Onomasticon*, as though 18 centuries had not passed since its writing.

In contrast to the critics, we have to accept that Pollux had a critical mind, and presented us with a valuable work which contains a precious treasure of dental knowledge in addition to its linguistic material. Through the *The Onomasticon* we can estimate the high interest in oral and dental pathology in that time. The large number of terms on dental and oral issues reflects the development of oral and dental science in the middle of the 2nd century CE. This required the development of an adequate terminology sufficient to describe the anatomical parts, dental instruments and oral and dental diseases. This is in contrast with the Latin literature of the early Christian era, in which we do not observe such verbal richness which would evince the development of dentistry. The Latin dental terminology was disappointingly restricted to only the essentials. Even the efforts of Aulus Cornelius Celsus in *De medicina* (*On medicine*) to develop Latin terms corresponding to the Greek ones were not enough to achieve a comprehensive set of dental terms and concepts.

It is for these reasons that *The Onomasticon* is not merely just another essay which enriches our knowledge of the practice of medicine and dentistry during the Roman imperial era; due to its huge volume of information, it allows us to see clearly the science of the teeth through the vision of a non-specialist but reliable observer.
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One of our Academy's most productive, talented and revered luminaries, Henry Berton “Bert” McCauley, died on October 23, 2012 of prostate cancer in his home in Maryland. He was 98.

The son of a businessman and a homemaker, Bert—he never used his first name—was born in Duluth, Minnesota. His family moved to Maryland, where he was to spend many satisfying years of his personal and professional life. He graduated from the Baltimore Polytechnic Institute in 1931 and the Baltimore College of Dental Surgery, DDS, in 1936. While at the dental school, Bert ranked second in his class and was recipient of a gold medal for his thesis entitled, “The Effects of Civilization on the Masticatory Mechanism.” He later received a Carnegie Fellowship in Dentistry, 1940-43.

The greatest portion of McCauley’s professional life was spent in Public Health Administration. Early in his career, he was in private practice and was later a full-time instructor of dental radiology at the University of Maryland. Later, he conducted research on the application of radioactive isotopes.

In 1940, Bert moved to the University of Rochester Schools of Medicine and Dentistry, where he conducted clinical investigations into the dental and non-dental effects of fluoride exposure. While at Rochester, he became a consultant in the Manhattan Project, which developed the atomic bomb.

In 1943, Dr. McCauley was appointed assistant professor of dentistry at the University of Rochester and soon became head of dental research there. In 1945, he was commissioned in the US Public Health Service and assigned to the National Institutes of Health.

In 1949, he became the first director of the newly-established Bureau of Dental Care of the Baltimore Health Department, where he initiated a full-scale preventive and maintenance dental health program for school children and all who received public assistance.

However, Bert’s crowning achievement was his crusade for the fluoridation of Baltimore’s water supply, which was inaugurated on November 26, 1952. Because Baltimore was the first large city in the United States to receive water fluoridation, this was a monumental achievement! It did not come without stout opposition, but he saw it through to completion.

Dr. McCauley had an extensive record of membership in 14 professional dental organizations; 6 leadership positions in prestigious dental groups and membership in 10 scientific and honorary organizations. He also authored nearly 50 published scientific reports and papers relating to various aspects of dentistry and public health.

Bert was also very interested in promoting dental history. Undoubtedly, he was greatly influenced by Dean J. Ben Robinson, one of our great early dental historians, with whom he had shared a private practice office.

From 1958-1988, Dr. McCauley served as historian to the Maryland State Dental Association. In 1979, he was elected secretary-treasurer of the American Academy of the History of Dentistry, an office he held until 1988, when he became our organization’s vice president. During this same year, Bert received the Academy’s highest honor, the Hayden-Harris Award. Finally, Dr. McCauley served as President of our Academy from 1990-1991.

On a personal note: when I first met Dr. McCauley over 30 years ago at one of our Academy meetings, I asked him what I should call him. He told me simply, “My friends all call me Bert.” For the rest of our times together, I did the same. I had the satisfaction and opportunity to interact with him on numerous occasions. He was a great man, a good friend and an outstanding human being. He will be sorely missed.

—Arden G. Christen, DDS, MSD, MA
Professor Emeritus of Oral Biology
Indiana University School of Dentistry
The Use of Gold in Dentistry
An Historical Overview
by Dr. J. A. Donaldson

Gold was first used in dentistry over 2,500 years ago, and its dental applications have increased steadily, especially during the past 100 years, to the point where they now absorb over 80 tons of gold per annum. The course of these developments is outlined in this review.

Where and when gold was first used in connection with the care of the teeth as opposed to their decoration are matters of doubt and disagreement. A plausible hypothesis by Humphreys (1) proposed that man’s change from a way of life entirely dependent on hunting to one dependent on food production from crops and herds, extended his life span by one or two decades so that the loosening of incisor teeth as a result of degeneration of surrounding tissues—a feature of advancing age—became a problem. Humphreys suggested that with the development of early gold metallurgy the possibility arose of holding loose incisor teeth in place by gold wire which was twisted around them and the firmer canines.

Early Use of Gold Wire
Several dental historians have referred to the discovery by Junker (2), in 1914, in a burial shaft at Giza, of two molar teeth held together by a gold wire, along with articles that he believed to date from the late 4th or the 5th Dynasty in the third millennium B.C. (This item is now in the Pelizaeus Museum in Hildesheim (3)). Some have based on this one discovery a belief in the existence in ancient Egypt of prosthetic dentistry; others, such as Flice Leek (4) who suggested that the find might be part of an amulet, have disagreed. A recent re-examination of the available evidence by Hoffmann-Axthelm (5) indicates that such examples of binding teeth with gold wire as have been found in skulls excavated from Egyptian burial grounds were not the result of treatment on living persons but rather the consequence of steps taken in the course of preparing corpses for embalming. Other examples of teeth bound together by gold wire were found in a pre-Columbian tomb at Esmeraldas, Ecuador, and in Etruscan burials (6).

The Etruscans appear, on such evidence as exists at present, to have been the first, as early as the seventh century B.C., to insert a substitute tooth by replacing the gold wire by gold bands in front of and behind the incisor teeth on each side of the gap, drilling a hole through both bands and the new tooth, and inserting a gold wire as a rivet. Many examples of such prostheses can be seen in museums in Italy and elsewhere. In some cases the ‘artificial’ tooth is the lost tooth with its root cut off; in others it is a portion of a tooth from a calf or cow. In a few instances, an artificial tooth has been fashioned from gold.

Few examples of Roman dental prostheses for which gold was used have survived, owing to the widespread Roman custom of cremating the dead. However, the fact that the Law of the Twelve Tables, written in Rome during the fifth century B.C., specifies at the close of a rule prohibiting the burial of gold articles with corpses the exception that ‘... it shall not be unlawful to bury or burn it with the gold with which the teeth may perchance be bound together’ is widely taken as supporting the view that prosthetic dentistry was practised at the time (6). Indeed, the Romans inherited many arts and crafts, including those of dental prosthesis, from their Etruscan neighbours who during the sixth century B.C. ruled Rome. Celsus, in his De re medica, describes the use of gold wire to bind to adjacent firm teeth those teeth which had been damaged by a blow or other accident.

The Greeks also practised cremation and little evidence of their use of gold for dental purposes has been found. However, the few dental appliances exhibited in Greek museums are strikingly similar to Etruscan work.

The practice of providing support for incisor teeth that had become loose was known to the Arabs and was described by Albucasis who lived in the latter half of the eleventh century A.D. His treatise on surgery exists in several manuscript versions and contains references to diseases of the teeth and gums, as well as a recommendation that when teeth have
become loose after a blow or fall, so that the patient cannot bite his food with them, they should be bound with gold or silver wire to make them firm. Albucasis states that gold is to be preferred as being unalterable, while silver turns green in a few days. It was for this reason that gold was used in the mouth by the Etruscans and the other peoples mentioned above: its chemical inertness enabled it to withstand the corrosive action of the oral fluids which would have been so evident when other metals and alloys known at the time were used.

**Later Use of Gold Wire**

Other early writers on dentistry have described applications of gold wire in the mouth. Ryff (7) illustrated its use to reduce and fix a fractured mandible. Paré (8) recorded the attachment by gold or silver wire of an artificial tooth made of bone or ivory to adjacent natural teeth. Fauchard (9), in his important work which may justly be called the first scientific book on dentistry, described how 'loose teeth can be tightened by turns of gold wire' and gave detailed instructions for annealing the wire in the fire, throwing it into vinegar to restore its colour and for its careful application to the teeth. Mouton (10) in the first book devoted to prosthetic dentistry, gave an account of his method of retaining small dentures carved from ivory by spring clasps of round gold wire which encircled adjoining teeth.

Gold wire continued to be used for purposes such as temporary splinting of teeth loosened accidentally until well into the present century and it was applied during World War I for inter-dental wiring in the treatment of jaw fractures. During the past 40 years, however, it has been increasingly replaced by stainless steel wire.

**Filling Teeth with Gold Foil**

The first printed book on dentistry, entitled *Arzney Büchlein* ('The Little Pharmacopoeia'), was published by Michael Blum in Leipzig in 1530. Under this title or as *Zene Artanei* ('Dental Medicine') it appeared in some fifteen editions issued by various German publishers in the sixteenth century. It is largely a compilation from earlier manuscript works by several authors. Chapter 5 of the 1536 edition which is kept at the British Dental Association Library, after a description of 'corrosion' or decay of the teeth, advises on its treatment:

'Scrape and clean the hole and the area of decay with a fine small chisel or a little knife or a file, or with another suitable instrument, and then to preserve the other part of the tooth, fill the cavity with gold leaves'.

This advice is attributed to Mesue, one of those from whose writings the book is compiled, but there is doubt as to his identity and no existing work by a person of this name is known in which reference is made to the use of gold foil to restore decayed teeth. However, that the procedure described by Blum was indeed widespread in the Renaissance period is confirmed by Giovanni d'Arcoli (11), who wrote that teeth could be filled with gold leaf after cleansing of the cavity with acid, and by Giovanni da Vigo (12) who referred to the use of gold foil for this purpose.

**Nineteenth Century Advances**

Methods of restoring carious cavities in teeth by means of gold foil did not progress appreciably, however, from the period of these references until the nineteenth century. Then, first as a result of a better knowledge of the structure of teeth and the process of their decay, and secondly as a consequence of the invention of mechanical means for cavity preparation, advance was rapid.

Robert Arthur, who practised in turn in several American towns, made many improvements to the art of filling teeth with gold. In the opening chapters of his "Treatise on the Use of Adhesive Gold Foil" (13), he presented a critical account of the common
methods of the period. The foil was cut into strips which were used as such, or rolled into ‘ropes’, or folded into ‘tapes’ and placed round the circumference of the cavity. More strips, ropes or tapes were added from the centre and space was made for further additions by pushing a wedge-shaped instrument into the partially filled cavity to force the gold against the walls until a degree of compaction was achieved that was considered satisfactory. Other dentists cut the ropes or tapes into short lengths or small pieces. One such piece was forced into a corner at the bottom of the cavity, and others were placed around it, one by one, to cover the bottom; the filling was then built up, layer by layer, from further pieces.

‘Sponge’ or ‘crystal’ gold was another form of dental gold, then only recently introduced, which was examined by Arthur in his critique before he went on to describe the superiority of his own ‘adhesive foil’. Material of the former type originated in England and was dismissed by Arthur as useless. Another variety was invented by A. J. Watts in the U.S.A. and is described in a patent specification as made by dissolving the mercury from a fluid amalgam of gold by means of nitric acid. This left the gold in a finely divided, easily manipulated state that could be bonded into a solid mass by pressure. The aim of Watts’ invention was to reduce the tedium of filling large cavities piece by piece or strip by strip with foil, by inserting gold in the new form in bigger portions and compacting it rapidly. In practice, the technique was difficult and, as Arthur rightly pointed out, pressure applied to a large piece of the sponge or crystal gold compacted it only superficially, leaving soft, weak areas beneath its surface. However, the use of gold in these or related forms was not then discontinued. Similar products made by a number of methods were introduced from time to time and continued to find application almost to the middle of this century.

Arthur’s principal contributions to the technique were based upon his exploitation of the cohesive properties of clean, annealed gold foil. He passed each portion of foil through a flame before inserting it in the cavity and devised methodical routines for filling cavities of different shapes with metal of consistent density by using plugging instruments with small working ends and thus exerting high pressures to compact the gold and weld it into a solid mass. Arthur was not the only dentist to exploit the cohesive properties of annealed gold foil, others did so at about the same time. According to Boyes (14), for example, James Hogue, an Edinburgh practitioner, was using it in 1850. Nevertheless, to Arthur belongs the credit of developing a well thought out practical method, of demonstrating this to a professional society in 1855 and of publishing a book on the subject in 1857.

Pure gold of many descriptions — sponge, crystal, matt, cohesive and non-cohesive among others — inserted in small portions and laboriously built up to plug the cavity continued to be used for the next hundred years. Each operator chose the form best suited to his skill or the type of cavity he had to fill. The presidential address by C. Spence Bate at the 1883 annual meeting of the British Dental Association, in Plymouth, entitled ‘A Review of the Scientific Progress of Dental Surgery from 1771 to 1883’ (15), contains the passage:

‘We must congratulare ourselves on the great improvement that has taken place in the power of retaining diseased teeth and restoring to usefulness such as would, a few years ago, have been considered hopelessly irrecoverable. The extent of this process of repair can best be understood by saying that, independent of amalgam and cement stoppings, 20 000 ounces [620 kg] of fine gold is annually used in filling teeth ...

Unfortunately, there is no indication whether this
was the amount used world-wide or whether it was only that used in Britain.

As a cheaper form of restoration than one entirely of pure gold, for use in four-walled cavities (that is, those involving one surface of a tooth), some operators placed a sheet of tin foil between two sheets of non-cohesive gold foil and rolled their ropes or cylinders from the composite material.

**Gold Foil Filling Instruments**

While a limited number of forms of gold was developed for the filling of cavities, dentists indulged their noted individualism by designing plugging instruments until a vast armamentarium existed and some dental depots, at one time, stocked hundreds of patterns. The need was to apply a high compressive load per unit area to the foil and, naturally, methods were devised to increase this load by impact and to speed the process by mechanical means. In the late 1850's, John Tomes, in England, introduced his simple mallet, made for him by the dental instrument-maker Jean Evrard. To judge from the number surviving in museums and private collections, it must have had considerable popularity. It
was followed by many other mechanical hand mallets in Britain, on the Continent and in the U.S.A. Most used the principle of a weight pulled against a spring, sometimes through a system of levers, and then suddenly released to strike a plugging instrument or point.

It is reputed that it was hearing a Morse telegraph sounder working that led W. G. A. Bonwill to design his electromagnetic mallet which, in a form much improved by M. H. Webb and introduced in 1877, enjoyed large sales in many countries. A description of Webb at work, written by his patient W. H. Trueman, another dentist, and cited by B. L. Thorpe (16) gives some idea of the endurance required of both patient and operator:

"Dr. Webb ... did in my mouth his last but one heavy job, filling four upper incisors using four books, one half ounce of gold foil. I went to Lancaster, arriving on a Monday afternoon; he had done the preliminary work in Philadelphia. He began the next morning and for two days I was in the chair, my mouth dammed from 8.30 a.m. to 5 p.m. I did not get out and Webb was at me all the time except fifteen minutes for lunch. I went hungry, not even a sip of water as we were both anxious that there should be no mishap. Another day he worked on me from three to five hours and finished about ten o'clock Sunday morning, altogether six days to fill four teeth."

Not only did the introduction of the foot engine (or 'foot drill') in 1871 stimulate the invention of forms of chuck called 'handpieces' in which burs, drills, abrasive wheels, discs and points, and small revolving tools of other kinds could be used at different angles to prepare teeth for restoration, but it also stimulated the invention of engine-driven mallets for gold foil compaction. Bonwill designed such a mallet wherein a small cylinder of hardened steel set in the circumference of a wheel, with its axis at right angles to the plane of the wheel and protruding slightly beyond its edge, struck once in each revolution the end of a long plugging instrument that passed through the handle of the appliance. When its patents expired, this mallet was widely imitated and many other mallets were produced which used various means to translate rotational energy into impact energy. Pneumatic mallets were also developed, usually operated by a pedal that either compressed a rubber bulb or worked a small bellows or a small air pump. One German instrument used the pedal and flywheel of a dental foot engine to drive a small double-acting air pump. In all instances, the air was led by a small bore tube to the mallet in which it generally forced a weighty piston along a cylinder to strike the end of a plugging instrument.

The disadvantages of gold foil fillings lie in their conspicuous colour and, in live teeth, their capacity to conduct heat, although the effect of the latter can be greatly reduced by lining the cavity with dental cement. Among their advantages are the inert nature of the material, the way in which it can be forced against the cavity edge to make a good seal and the fact that fillings can easily be polished and burnished to a very smooth surface finish. Some years ago, correspondents to a dental journal reported gold foil fillings which had remained sound for several decades.

In the U.S.A. there are still enough proponents of the art or skill of filling cavities in teeth with mechanically compacted pure gold foil to support the activities of a Society of Gold Foil Operators.

The Search for an Alternative to Gold Foil

The arduous and time-consuming process of filling a cavity with gold foil involves much stress for both patient and operator, especially if the filling extends into more than one surface of a tooth. During the last two decades of the nineteenth century and the first few years of this century, a number of dentists therefore sought to devise some alternative means of using gold to achieve the same result.

A method of inlaying gold into cavities appears to have been the aim of several experimenters in the U.S.A. A procedure of this type was seen as having the advantages that the inlay might be made in the absence of the patient, and possibly by a 'mechanic' rather than the dentist, to fit a model taken from an impression of the prepared cavity. The finished inlay could be cemented into place at the patient’s next visit. For some years, porcelain inlays had been made by swaging a thin platinum foil directly into the cavity or into a plaster model of the cavity, lifting out this so-called platinum matrix and filling it with porcelain powder which was then fused in a furnace. Attempts were made to adapt this method by making a similar platinum matrix, melting gold solder into it to fill it and cementing the resultant inlay into place. However, the method was suitable only for cavities involving one surface of a tooth and these were the easiest to fill with gold foil.

Another intricate method that was proposed, used a gold matrix swaged against the walls of the cavity and filled with a material resembling sealing wax, the exposed surface of which was carved to the shape of the missing external surface of the tooth. From this, a die and counter-die were made and used to reproduce this surface shape in thin gold plate. This shape and the gold matrix were then soldered together to make a hollow inlay.

Lost Wax Casting

Others attempted to use lost wax methods with varying degrees of indifferent success. B. F. Philbrook, dissatisfied with the way in which his
W. H. Taggart’s development of the lost wax process for casting dental prostheses and the machine that he designed for this purpose are often seen as constituting the basis of modern practice. The widespread adoption of investment casting in dentistry and as a major manufacturing technique for gold jewellery bear witness to Taggart’s ingenuity.

Amalgam fillings crumbled, attempted to make soft, fusible metal inlays by a lost wax process. In 1896, he fitted several white metal inlays and one gold inlay and the following year he read a paper about his method to a local dental society (17). George B. Martin demonstrated in 1897 gold dummy or artificial teeth, called ‘pontics’, for use on fixed bridges; these were soldered to gold crowns on the abutment teeth. He carved his pontics out of wax to fit between the abutment teeth on a plaster model, attached a flat gold sprue and invested them in a two-part mould made of plaster and asbestos. This was so shaped that when the sprue had been removed, the wax burned out and the gold melted in a depression above the resultant void, pressing the mould to close it would push the molten gold into the void. About 1900, J. G. Schottler used a method to restore the biting edges of front teeth by placing a platinum wire in the root canal, building the required shape on the tooth with wax, inserting a warmed pin into the surface of the wax to lift it out and placing it in a bulk of investment. When the investment was set he carved a depression around the pin until the wax was reached, withdrew the pin and burned out the wax. Gold was melted in the depression and pushed into the void with a metal implement or a carbon rod. Also, John A. Lenz devised a method for lost wax casting a gold chewing surface onto a gold band made to fit around a tooth and obtained a patent for it in 1906.

Taggart’s ‘New and Accurate Method’

However, to a meeting of the New York Odontological Society on January 15, 1907, William H. Taggart of Chicago read a lecture entitled ‘A New and Accurate Method of Casting Gold Inlays’ in which he described a lost wax technique which can truly be said to have revolutionized restorative and prosthetic dentistry (18). The process used no new principle and some aspects of it had been anticipated by other dentists, but, by careful experiment over a period which he stated later was 15 years, Taggart had overcome a variety of physical and technical problems to attain great precision. He described and then demonstrated this process in full that evening. It has remained fundamentally unchanged since then, although it has been improved in some respects as new knowledge has been acquired. Contemporary accounts of the meeting describe the fascination of the audience, the prolonged applause and the admiration voiced by participants in the discussion for what he had put before them (19).

The apparatus used by Taggart employed a nitrous oxide and gas blowpipe to melt gold very rapidly to what he described as ‘the boiling stage’, at which point a lever was pulled down, switching off the blowpipe and applying compressed nitrous oxide to the molten metal to force it into the mould. In addition to devising his casting machine, Taggart introduced a number of ingenious features of his own invention. The wax with which the model of the inlay was made in the prepared cavity in the tooth was of selected composition and had been repeatedly filtered while molten to remove particles of foreign matter. The wax model was removed from the cavity with the aid of a wire inserted into it while it was in place. The wire was then inserted into a dome-shaped boss in the centre of a metal disc, and a metal cylinder of suitable size was placed around it and filled with an investment material mixed with water. This material was devised by Taggart after much experiment and contained a high proportion of graphite. When the investment had set hard, the domed disc was removed, the wire warmed and pulled out of the wax and the metal cylinder carefully warmed until the wax was melted and absorbed into the investment. This left a void the shape of the inlay with a sprue way leading down to it from a depression in which the gold could conveniently be fused.
The simple casting apparatus (top), developed by Solbrig, utilized steam pressure which was released when a moist asbestos pad, fitted into the lid, was lowered onto the hot mould to force the molten gold into the cavity.

The simplified hand-held version (bottom), akin to pliers and relying on the same principle as the bench-top model, was developed for the production of small gold castings such as inlays.

The response of the dental profession was rapid. As news of Taggart's method and the account of it in the journals spread, dentists from all over the U.S.A. ordered his casting machine. He was a skilful mechanic and a painstaking experimenter satisfied only with the best results he could achieve but, unfortunately, he had neither facilities to manufacture his machine in quantity nor the ability to organize them, even though he had patented both the machine and the process. While he was endeavouring to make suitable arrangements with a manufacturer, dentists impatient to produce gold castings for inlays, bridges and dentures invented other forms of casting apparatus and used them. When at last he was ready to sell his machine, Taggart found that the market for it had gone and, disappointed by the loss of the profits he had hoped for, he entered into long and complicated litigation aimed at forcing dentists to pay him for a licence to use the method. Powerful opposition to him was organized among American dentists and the credit that he rightly deserved for his great achievement was largely denied him.

A pinch of powdered borax should be added to the gold when it is melted, but not before it is melted.

A modern cast gold alloy bridge with the working model of the patient's teeth. Photograph by courtesy of Professor J. Bates, Dental School and Hospital, Cardiff, and the Metals Society, London.
Other Lost Wax Casting Apparatus

Taggart's results immediately stimulated interest in lost wax casting of gold and new developments followed. Thus, a centrifugal casting machine was invented by A. Jameson and was on sale by 1910. Several machines were also produced which used a tank of compressed air in place of Taggart's nitrous oxide to force the metal into the mould. Two air-pressure machines were produced in Great Britain, the first of them, that of the Dental Manufacturing Company, being patented in 1908. In a variant of the compressed air method, introduced in the U.S.A. by L. E. Custer, the casting cylinder was enclosed in a glass dome and the gold was melted by means of an electric arc. As soon as the gold was molten, compressed air was admitted to the dome. Other machines depended for their action on the application of a partial vacuum to draw the air from the mould and to assist the molten gold to flow into it as a result of the pressure differential.

At about the same time that Taggart was engaged in the experiments that led to his announcement in 1907, a Dr. Solbrig, in Paris, was also studying the production of gold inlays by a lost wax method (20). Solbrig produced a machine in which a pad of moist asbestos in a metal cap could be brought down on to the top edge of the hot casting cylinder as soon as the gold was molten, when the pressure of the resulting steam forced the gold into the mould. Taggart used a cool mould and Solbrig appears to have been the first to cast into a hot mould. The latter author stated that the moment to fuse the gold and bring down the damp asbestos pad was when the glow viewed down the sprue hole was a bright red. Before the end of 1907, Solbrig also introduced his casting pliers which achieved enormous popularity for the rapid production of small inlays.

Improvements to Dental Casting

J. G. Lane (21), having observed that castings made by Taggart's method were consistently too small, attributed this to contraction of the gold on cooling. He developed an investment material containing a high proportion of silica which, when heated to about 750°C, expanded and compensated for the shrinkage. Although accuracy of casting was much improved by Lane, the method was less successful than he claimed. The next improvement was made by C. S. van Horn who reviewed progress to date and described (22) his method of warming the wax pattern to a temperature at which its expansion was sufficient to compensate for the subsequent contraction of the gold, immersing it in investment mixed at that temperature and maintaining the temperature constant until the investment was fully set.

Subsequent research by many workers has produced better machines, waxes, investments and gold alloys which have led to the reliable methods of the present day and their precisely predictable results. In the late 1920's, cobalt-chromium alloys were first introduced for casting dentures by the lost wax method and their proponents suggested that they would be cheaper and that dentures made of them would have better physical properties, in particular greater strength, than those made of gold alloys. However, about 20 years passed before some of the difficulties of casting cobalt-chromium alloys with consistent accuracy and of finishing the castings were solved. By that time, the expense of the method was such that gold alloy castings could often be produced more cheaply. Although subsequent increases in the cost of gold have made cobalt-chromium alloys more formidable rivals for denture work amongst dental practitioners and patients, gold alloys are still the materials of choice for inlays, crowns and bridges.
Much is to be learned about the use of gold in connection with artificial teeth during the eighteenth century, from the works of French dentists. In 1699, a law was passed in France which limited the practice of dentistry to persons who had received specific training. Although the provisions of the law could be avoided without difficulty, its implementation led to a need for education in dentistry and for text-books. It was this need that stimulated Pierre Fauchard (8) to produce ‘Le Chirurgien Dentiste’, in which he displayed a much more scientific attitude than any previous dental author. Moreover, it is clear from the text that he wrote from extensive clinical experience.

Fauchard’s book describes the use of ox bones and of teeth from humans, hippopotami, sea-horses or oxen for the construction of dentures and the use of gold wire, bands and springs to attach these to neighbouring teeth or to press them into place. Advice is given on the assembly of suitable natural teeth to fill a space and how to mount them in front of a strip of gold by means of rivets. Although Fauchard does not mention the use of gold bases for dentures, he devotes chapters to the construction of obturators to cover or block defects of the palate, for which such bases were also used.

Fauchard, and other eighteenth century dentists who discussed dentures, gave very little detail of how they worked or shaped that surface of the prosthesis that fitted or rested against the soft tissue of the mouth and it is not possible from the information given to attempt confidently to reconstruct their methods. It has been suggested that dentists of the period relied on measurements taken with such calipers or dividers as were used by sculptors and that they may have worked freehand and in reverse from a wax impression of the mouth, or of that part of it that the denture had to fit. Matthias Gottfried Purmann, a seventeenth century German surgeon, has been credited with taking wax impressions, but it seems more likely that he made freehand models of the jaw in wax and fitted his artificial substitutes to them (23).

It was Philipp Pfaff (24) who first suggested in 1756 the use of a (positive) plaster of Paris model, made from a (negative) impression of the mouth taken in what he describes as ‘sealing wax’ previously softened in hot water. Once the idea of making a hard and accurate model from an impression had begun to circulate, the way was open for the development of methods to improve the accuracy of the fit of dentures and for the use of gold plates as denture bases.

**Gold as the Denture Base**

In his *Recherches et Observations sur Toutes les Parties de l’Art du Dentiste* of 1757, Etienne Bourdet (25) described and illustrated an artificial denture with a gold base which was enamelled to conceal its conspicuous colour. Commenting on this, Hoffmann-Axthelm (23) pointed out that Bourdet’s goldsmith worked from a negative wax impression (modèle en cire) after the manner that Purmann had already suggested in the seventeenth century and that Pfaff’s positive model method, although contemporary with Bourdet’s work, remained unknown in Paris for some decades.

Following this, a number of authors, including Delabarre (26) referred to, and in some cases illustrated, more or less similarly contracted dentures with gold bases, but not one gives sufficient detail to make it possible to understand exactly how the metal was struck or otherwise worked to the shape required. However, by the time Delabarre’s handbook was published in 1820, or a little later, someone had conceived the idea of making a negative impression in fine foundry sand of a positive plaster model of a mouth and pouring a positive model of lead or some other metal which was then used as a die for striking of the gold plate. The next advance was to cast the model or die in zinc, to cast a counter-die to it in lead and to swage the gold plate between the die and its counter-die.

The British Dental Association Museum has in its possession a small swaged gold partial denture reputed to have been made by Isaac Wilson, a dentist who practised in Bath at the beginning of the nineteenth century for William, Duke of Clarence. However, this one item cannot be regarded as more than circumstantial evidence that the method of swaging was used at the time. More certain evidence that the method was common by the late 1840’s is derived from the workshop book of John Tomes, in which are recorded details of the dentures that he supplied to patients from 17 January, 1848, to 21 December, 1874, including the mass of gold in those that had gold bases, the number and types of teeth or...
bone blocks, the types of clasps used and the name of the technician involved. This book is now kept at the British Dental Association Library, in London. The extreme secrecy prevailing between dentists in the early nineteenth century and the jealousy with which each guarded the details of his technique — disclosing it only to apprentices whose parents were frequently charged extortionate premiums — may go some way to explain the absence of contemporary records of the introduction of swaging for the working of gold. However, the organization of dental education and dental societies, in the U.S.A. in the early 1840’s and in Britain in the 1850’s, provided a need for textbooks and encouraged the exchange of knowledge and experience. Only then were the methods of casting dies and counter-dies and swaging gold plate with them written down, but the authors wrote about these techniques in a style that suggested that they were already widely used.

Swaging of gold plates as denture bases persisted for over a century. It was still being taught to dental students and they were still required to be able to pass a practical examination on it in Great Britain until the 1940’s, although it had been gradually superseded by lost wax casting since 1907 when the new methods of Taggart, Solbrig and others became known. The processes involved in swaging gold plates — the sand moulding and casting of metal dies, the design of the plates and the stages of swaging them on a succession of dies, and the making and soldering of bands or fastenings — together with the tools needed and the organization of the workshop have been detailed by Pearsall (27) who wrote in the heyday of their use.

Gold Crowns

It has been suggested by some writers on dental history, including Weinberger (28), that gold shell crowns were made and used in Roman times, but the assumption needs to be re-examined and re-evaluated as no specimen appears to be known.

The story of a sixteenth century hoax involving a gold crown is reliably supported, but it was a single occurrence and there is no indication that crowns were being made at that time for the treatment or protection of damaged teeth. A few days before Easter, 1593, a Silesian boy, seven years of age, was observed to have a tooth of gold. All the other teeth that should have been present at his age were there except for one adjacent to the gold tooth. News of the ‘miracle’ spread; examination showed that the tooth was indeed
Donaldson

Gold. Jacob Horst, professor of medicine at the Julius University of Helmstedt, investigated the case and sought to interpret its significance. In due course, he published a book about the case, calling it ‘the world’s greatest wonder’ and stating that the golden tooth was created by some supernatural power at a moment of special astrological importance and deducing from the occurrence a number of omens and portents (29). In time, the stresses of biting and chewing wore through the gold and exposed the tooth substance beneath. The fake was discovered, and the unfortunate child went to prison.

Claude Mouton (10) was the first to describe in some detail the use of gold cap crowns for the repair of extensively decayed teeth, especially back teeth, and if they were far enough forward in the mouth to be seen, he recommended enamelling them as ‘every eye would take offence at the loud colour’.

Toward the end of the nineteenth century and in the early twentieth century, a variety of techniques was developed for producing gold cap crowns. Seamless crowns could be made from 0.22 mm thick discs of 22 or 20 carat gold alloy drawn with a drawpress or by some method of swaging to make a ‘blank’ (or ready-made blanks could be used). The blanks were driven into a suitably shaped hollow mould with pine-wood punches and small pieces of hard rubber until the metal was adapted to it and the chewing surface was finally sealed and strengthened with gold solder. To make the mould, either a rubber tooth of suitable size and shape, sold for the purpose, was chosen or a positive model of the tooth was made in plaster or clay from an impression. The rubber tooth or the model was fixed to a base, an iron ring was placed around it and low melting fusible metal was poured into the ring. When the metal had cooled, the mould was knocked out of the ring, split longitudinally to release the rubber tooth or model and the two halves were put together and forced back into the iron ring. Alternative methods included the cutting of a 0.22 mm thick strip of 20 or 22 carat gold alloy, long enough to form a band around the tooth, soldering the ends together, placing the band around the tooth (or a model made from an impression) and shaping a wax pattern of the appropriate chewing surface. The wax pattern was then cast in gold by the lost wax process and this casting was soldered to the band.

All these early methods that relied on swaged blanks or manipulated bands were open to the objection that a high proportion of the crowns so made were liable under the stresses of mastication to develop leaks, often undetected until too late, around the periphery. These permitted seepage of oral fluids and bacteria so that decay developed beneath the crown. However, the introduction in the last three or four decades of increasingly precise impression techniques using a succession of new materials, the electrodeposition of copper or silver inside the impression and the filling of the impression inside the electrodeposited lining with a hard plaster to produce an accurate copper- or silver-plated model has made it possible to cast gold crowns with correspondingly greater precision.

At least as early as the first half of the eighteenth century, post crowns, or ‘pivots’, were known as a means of restoring teeth of which the roots remained. Using these, a substitute or artificial crown was fixed to a wire post which is inserted into the pulp canal, and Fauchard (8) describes and illustrates the use of a natural human tooth retained by a gold post. A vast number of methods of constructing post crowns was introduced during the ensuing 250 years. Early in the nineteenth century, natural human teeth were replaced by teeth of porcelain in various forms. For instance, solid porcelain teeth were made with a central hole or tube that could be fitted over a post, and

![Sharp's draw-press for making tubular blanks of predetermined size from 0.22 mm thick discs of gold to fit the circumference of a tooth. These blanks were then used to make cap crowns. The model dates to about 1900](image-url)
Crowsns as Bridge Abutments
Most types of crown — cap or post — have been used as abutments to support fixed bridges that replace missing teeth. The so-called and widely advertised ‘American dentistry’ of the late nineteenth century, which made great use of bridges supported by multiple post crowns on pulpless teeth, fell into ill repute after the publication in 1911 by a physician of a paper attributing the cause of a wide variety of general diseases to ‘septic foci’ associated with such teeth. The then new, but rapidly developing, science of dental radiography supported the suggestion that septic foci were associated with ‘dead’ teeth and, in many cases, if a dark shadow was shown surrounding the apex of the root of such a tooth in a radiograph, the tooth was condemned to extraction. The introduction of lost wax casting of gold inlays in the same period, however, made possible the design and construction of bridges which were supported by cast inlays and crowns on live teeth which remained healthy for many years. Recently, with a much increased understanding of the treatment of pulpless teeth, as well as the development of very accurate methods of impression-taking and casting, there has been some return to the use of such teeth as bridge abutments.

Precision Attachments
Also in recent years, roots have been kept in the jaws, after appropriate treatment against sepsis, to serve as retainers for dentures in certain difficult cases. Into the prepared root canals are fitted ready-made gold alloy posts which have a head so shaped that it will clip into, or otherwise stay firmly in, a hollow portion that is accurately located in the denture during its manufacture. The denture can be removed by its wearer for cleaning and replaced by him. The ‘precision attachments’ help to keep it steady.

Another class of retainer or precision attachment which had its origin in the U.S.A. as long ago as the 1890’s, but in recent decades has become largely the specialty of Swiss firms that work precious metals, consists of pairs of male and female portions that can be embodied respectively in bridges of partial dentures and in gold inlays in selected abutment teeth. The advantages of these very expensive techniques are chiefly hygienic, as the prostheses can be removed for cleaning and care of the adjacent oral tissues and then replaced by the wearer.

Gold in Orthodontics
An account of the development of the use of gold in dentistry would be incomplete without some reference to the applications of the metal and its alloys in orthodontics, the specialty concerned with the correction of faults in the regularity and, therefore, function and appearance of the teeth.

Fauchard (8) is credited with describing the first orthodontic appliance which was variously named the ‘bandeau’, ‘bandolette’ or ‘band’. A strip of precious metal, silver or gold, which he stated should be neither too stiff nor too flexible, of a width less than the height of the teeth, was bent to the regular arch that the teeth should follow and placed behind them.
Holes were drilled at appropriate places, through which wires could be passed and tied to the teeth; by tightening from time to time the wires around the irregular, displaced teeth, they were drawn into line with the arch. Bourdet (25) illustrated an appliance similar to and probably derived from Fauchard’s, which was shaped more accurately to fit against the molars and he specified that gold should be used to manufacture the device, as silver blackens in the mouth. Delabarre (30) invented a number of improvements in orthodontics, including the use of a gold band for better anchorage of a device intended to move displaced teeth, gold caps and a lever to rotate teeth, and the extension as far as the back teeth of a shaped strip of gold for the expansion of the arch of the teeth.

The establishment in 1839 of the first dental journal, *The American Journal of Dental Science*, and a year later of the first dental school, the Baltimore College of Dental Surgery, and of the American Society of Dental Surgeons, stimulated the exchange of professional knowledge among dentists in the U.S.A. and there was considerable discussion of orthodontics. However, although gold is mentioned by some as a component of appliances, the lack of illustrations in early dental journals makes it difficult to ascertain their designs or to determine to whom priority for particular ideas should be attributed. The introduction of vulcanite to prosthetic dentistry led to its use for orthodontic plates and Tomes described the use of a vulcanite plate with a gold wire bow around the outer surfaces of the teeth, which could be adjusted by a nut.

The art of orthodontics developed in the U.S.A. during the second half of the nineteenth century at the hands of many dentists, until by the turn of the century a large variety of appliances, fixed or removable and very often of empirical rather than scientific design, was in use. Most removable appliances relied on the use of tinned piano wire springs in vulcanite bases. The fixed appliances used German silver anchor bands fixed around molar teeth by screw clamps and connected by *arch* wires of German silver that passed around the front of the teeth. These arch wires were tensioned so as to move displaced teeth directly or had spurs or hooks soft-soldered to them, from which small rubber bands provided means to move the teeth. The replacement during this period of German silver by alloys of gold and platinum with small quantities of other metals, for both the bands and for the arch wires and their attachments, led to an enormous advance in the effectiveness with which the teeth of children could be moved. These alloys were specially formulated by precious metal refiners and dealers to have high melting ranges so that component parts could be united by hard solder. Other properties improved by skilful gold alloy formulation included stiffness, so that the alloys could be manipulated to form springs or other devices of predictable performance, response to heat treatment to restore stiffness after hard-soldering and response to annealing to facilitate manipulation.

At a time when there was a great diversity of orthodontic techniques, with many practitioners empirically designing individual fixed appliances of varying degrees of complexity for each patient, E.H. Angle (31) introduced a single appliance which he held as adaptable to bring about most of the desired tooth movements. This he developed on the basis of a simple observation of the normal relationship between upper and lower first molar teeth. The appliance was patented in due course and was supplied in sets comprising coils of band material.

An orthodontic fixed appliance for the upper teeth made from gold and platinum alloys. In spite of about thirty gold-soldered joints in its construction, it retained adequate resilience to impart the appropriate gentle stresses to the teeth to be moved. Photograph by courtesy of Mr Herbert E. Wilson.
The Use of Gold in Dentistry: An Historical Overview

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Oral Hygiene in the Shari’ah: A Thousand-Year-Old Conversation Between Islam’s Schools of Legal Thought

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By examining Islam’s jurisprudential literature about oral hygiene, this paper traces the scholarly discussions of jurists in the years after the Prophet Muhammad’s passing until the present day. While previous inquiries into this subject have focused on the novelty of the Prophet’s use of a tooth-stick, the focus of this effort is not to serve as a material history of tools. Rather, this paper focuses on the reasons for the religious mandate in Islam to maintain optimal oral hygiene. It does so by triangulating the various theories of oral hygiene expounded by jurists over time and geography.

“Why do we brush our teeth?” Though each person may respond with a multitude of reasons, Islam’s vast legal and spiritual tradition took this question with unparalleled vigor and interest. Though the question is simple in form, it yields a much more engaging answer than expected.

Brushing teeth and maintaining oral hygiene has been discussed within scholarly circles and texts since the time of the Prophet Muhammad. His regular use of the siwāk or tooth stick/brush (Fig. 1) is recorded in numerous narrations (hadith). He encouraged his companions with words that came short of a binding legal obligation. The Prophet Muhammad is reported by a number of his companions to have said, “If it were not for the fact that I would overburden my community, I would have ordered them to make use of the siwāk for every prayer/with every ablution.”¹

In the years following Muhammad’s passing, the process of recording and codifying his life began—everything from the protocol he used in the restroom to the broader ethical principles he stood for. The subject of the siwāk or tooth stick/brush earned the attention of many subsequent generations of scholars. These scholars made aspects of the Prophet’s life, including the seemingly mundane, explicit in legal terms.

As the codification of Islamic law progressed, various methodological approaches to the law formally became schools of jurisprudence. Among the many different approaches to deducing the law, four rose to prominence and remain so to the present day. Each one’s name derives from the name of a central figure in that school. For example, the jurisprudential school (madh’hab) adhered to by much of South Asia’s Muslim community as well as communities in Central Asia is called the Hanafi madh’hab after Imam Abu Hanifa,
an Iraqi scholar and silk merchant born seventy years after the Prophet Muhammad’s passing. It was he who famously said, “Brushing teeth is one of the fundamental acts of religious practice.”² The other three Sunni schools—the Maliki, Shafi, and Hanbali—will be addressed in this paper. As Figure 2 (following page) shows, the influence of each school has its own approximate geography.

In the conversations between these schools of jurisprudence, or madh’hab, tooth brushing is described as an act of purification; while for others it is referred to as an act of devotion toward upholding the Prophet’s practice (Sunna), either for the purpose of physical hygiene or spiritual purity. The two primary sources of law are the Qur’an and the Sunna, which includes sayings of the Prophet, as well as other reports from his companions.

Scholars of religion and medicine, who in previous centuries were often one and the same, sought to understand and unearth the principles of Muhammad’s hygienic practices to be able to answer questions asked by their students and constituencies in subsequent periods. By investigating the true nature of brushing, which lends itself to the philosophy of dentistry, there is a possibility of understanding the paradigm shared by Muslim communities about oral health and its connection to other aspects of life. These perspectives persist to the present day.

Religious debates are important for their historical value in integrating streams of knowledge; in this case, demonstrating a model of being both scripturally based and scientifically informed. This is especially true in the case of Islamic jurisprudence, since it is possible to use enduring and consistent legal methodologies to understand how thought and practice varies over time in the broader Islamic world. Additionally, with a focus on the written record, historians are afforded a unique opportunity to observe how the written word can drive social change.

Though a number of historians have written about the tooth stick/brush or siwāk, their approaches have limited the scope of sources used, and focused more on what people brushed with than why they brushed. A broader approach and more relevant range of sources is necessary to address the topic of dental care in Islam—both as a religious prescription as well as in its practical manifestations in various Muslim communities across the world.

* The word siwāk has been translated here as “toothstick,” I will also use it to refer to “brushing teeth” as an act. Though I will use siwāk interchangeably, the intended translation will always be mentioned. An explanation for the difference in translation will be explained shortly.

Figure 1. The siwāk or tooth stick/brush. Photo: Ali Kemal Ergelen.
The two most recent articles describing the history of the tooth stick/brush were written by Professor Gerrit Bos, a historian of medieval Judeo-Islamic medicine, and Professor Vardit Rispler-Chaim, a historian of Islamic ethics and medical culture.

Rispler-Chaim states that, “in contemporary Islamic ethics, of which the fatwa literature (legal responsa) is only one example, the siwāk has regained recognition and is often praised as the preferred means of dental care.” However, examining a “contemporary” fatwa without a focused historical review of the literature falls short of delivering an understanding of the enduring history of the siwāk (brushing teeth/tooth-stick) debate.

The importance placed on maintaining oral purity by the Islamic tradition is amply demonstrated by the multitude of monographs written on the subject by some of the most celebrated scholars of Islamic law. Each was in conversation with one another, often across broad geographies, and each sought to expand upon previous conceptions of why, how, and when to care for the oral cavity. As if the monographs were not sufficient, more than thirty didactic poems were composed in honor of the siwāk/brushing teeth as a duty, of which the verses of Ibn Ḥajr al-Asqalānī are the most well known.

By limiting their research to a narrow range of sources, both Vispler Chaim and Bos were not able to comment on the lively discourse between scholars regarding the essential purpose of oral hygiene. They focus on disproving contemporary claims of novelty that the Prophet Muhammad invented the siwāk/toothstick, to the extent that these historians do not capture the uniqueness of a living literary tradition about oral hygiene which spans the topics of etiquette, jurisprudence, and medicine.

In using the jurisprudential/fiqh literature, though in a limited way, Rispler-Chaim was able to catch the tail-end of a conversation that started over a millennium ago, but was not able to convey the path of that conversation. For example, when discussing the appropriate places to brush one’s teeth, Rispler-Chaim cites a single legal source, and concludes from it that brushing is “definitely viewed as a personal and private activity.” On the contrary, if the full range of jurisprudential sources on oral hygiene is consulted, it is clear that the view she cites is but one position born out of a legal interpretation of the Prophet Muhammad’s practice, and is contrasted with other contrary views.

The debate within the legal literature over where brushing teeth should be done is unique in its ability to offer insight into medical understanding as well as social etiquette. While the focus of
The philosophy of law, and sensitivity to the nature of legal sources. Within Sunni Islamic law (Shari’ah), there are four major schools of jurisprudence in interpreting the sources. Each is known by the eponyms of their founders: Hanafi, Shafi, Maliki, and Hanbali. For any claim that speaks for Islamic law, the range of sources must be representative of the tradition in its true diverse and expansive state.

The consequence of their limited approach is that definitions are misunderstood—which is ironic in light of the attentiveness of medieval and modern Islamic legal scholars to documenting their lexicon. For example, in the Hanafi legal work of the Damascene Ibn Abideen, the issue of brushing is clarified from its very definition. He outlines two possible definitions understood from the Arabic word siwāk, which we have thus far translated as toothstick and brushing teeth. The word itself is in the form of the verbal noun, which linguistically/lexically could either refer to the stick used to brush or the act of brushing. The scholar comments: “This latter meaning is what is intended here so there is no need to stipulate the usage of a toothstick.” This type of rigor with definitions is critical if modern historians are to attempt a relevant and authentic engagement with the topic at hand.

Though Rispler-Chaim’s stated goal is to compare the benefits of the tooth-stick in terms of how Islamic knowledge weighs against modern scientific data, her focus is actually different. In reality, she is more interested in the fact that people were brushing than the full complexity of why they were brushing. She writes more about what people did than why they did it, which serves merely as a helpful general introduction. Similarly, Bos points out that the Arabs were not the only ones to use the tooth-stick, nor were the Muslims the first to use it.8 In limiting his claim to these two points, Bos, like Rispler-Chaim, is acutely intent on disproving a small subset of modern claims.

Another major issue with the approaches of previous historians has been the mistake of generalization. Both Bos and Vispler rely on al-Muwashshā, a text which vividly describes the social scene in 10th-century Baghdad.9 Even though it is quite historically and geographically specific, they do not recognize it as such. Their concluding statements are about Arab or Muslim culture as a whole, generalizations which require much more evidence if used in a historical claim. A better approach is to analyze and compare a variety of legal works. This is absolutely essential to making an overarching claim about an entire society’s practice, or at the very least, their shared understanding of oral hygiene.

A final point of consideration when analyzing histories of objects is to use caution in conjecturing reasons for change. Bos states that the educated elite limited the use of the siwāk to certain times and places, while the physicians cautioned against its overuse.11 A brief reading of the legal literature across the Muslim world shows that the process of codification was not at the whims of an educated elite; rather, it was a scholarly process of seeking a fuller understanding of the Prophet Muhammad’s approach to oral health. The siwāk's spread among Muslim communities may have prompted elites in some areas to codify its etiquette; but to ignore the widespread scholarly effort across the jurisprudential schools is a grave omission. Jurisprudence in Islam is not simply reactionary literature responding at random; it is a literature which aims at preserving an understanding of the Prophet’s practice, or Sunna.

As was noted, the word siwāk refers to both the tooth-stick and the act of brushing teeth—a distinction not highlighted in previous histories. The legal discussion of the siwāk considers a number of ancillary questions regarding the types of brushing devices, the methods of brushing, and the times and places of its use. By exploring the enduring debate whether brushing teeth is an act of devotion or an act of purification, we will gain an insight into the underlying assumptions of the discussion and the enduring importance of oral hygiene to Muslim beliefs. The three conversations explored here are: which hand to brush with; when to brush; and whether to brush in public. What is gained from these topics will present a paradigm in which oral health is integrated into overall systemic health, physically and spiritually—a concept not too difficult for modern practitioners to appreciate.
Brushing Etiquette: Right or Left Hand?

To understand the subtleties of this discussion, let us consider the following question: Is brushing primarily a means of ridding ourselves of filth, like using the restroom? Or is it primarily a means of purifying oneself, a spiritual cosmetic, like donning beautiful clothes or wearing a rich fragrance? This is the foundational concern of the questions considered. The issue of using the right hand or left hand to brush depended on how one conceptualized the act. The principle derived from the Prophet Muhammad’s practice prioritizes the right hand for eating, purifying, and other dignified activities, while assigning the left hand the task of blowing one’s nose (imtikhāṭ), washing oneself in the restroom (istinjāʾ & istijmār), and other activities involving waste.

With this principle in mind, the challenge of deciding which hand to use for brushing came down to deciding whether the purpose of brushing teeth was to remove filth, or to accentuate the purity—physical and spiritual—of the individual.

Ibn Taymiya was a 13th-century logician from the town of Harran (in present-day Turkey) and jurist of the Hanbali school of legal thought. He was known for his exceptional positions on matters of law and theology. He was once asked, “Is using it [the siwāk] with the left hand more appropriate than the right hand or is it the other way around? Is the one using the left hand liable to be blamed? Which of them is better?”12 His fatwa or legal response is recorded over several pages in his Fatāwā al-Kubrā.13 After stating his position that the left hand is superior, he begins to detail the reasoning and evidence behind his answer.14

And that is because the istiyyāk, the act of brushing, is from the category of removing filth. So, it is like blowing one’s nose and the like which involves removing some sort of filth or harm. That is done with the left hand just as the removal of filth in the restroom is performed with the left hand. Removal of filth is obligatory and using the left hand is preferred.

In his conception, dental hygiene is likened to the collection of rulings regarding clearing one’s nose of mucus and cleaning of one’s private parts after using the restroom. Just as the left hand is the specified hand in those cases, based on the explicit practice of the Prophet Muhammad, by analogy, cleaning one’s mouth requires the same protocol since it shares in the principle of clearing filth. In answering this question Ibn Taymiya also acutely responds to the more dominant view, which held the act of brushing to be a devotional act of purification.15

Each of the early successors denied this. For istiyyāk [the act of brushing] has been ordained only for the purpose of removing filth from the inside of the mouth. This ʿilla, or underlying legal principle, is agreed upon by all scholars. For that reason, it has been legislated to be used during changing circumstances with regard to the mouth like sleep and fainting.

He cites the recommendation to use it after activities which might lead to a change in one’s oral state as evidence that the ultimate reason for its use is none other than hygienic in nature. As stated earlier, this position was not shared his predecessors nor successors.

Ibn Hajar al-ʿAsqalānī, the 9th-century Cairene Shafi scholar whose work in hadith was widely recognized and esteemed by all legal persuasions, believed that the siwāk should be used with the right hand for the very reason that it is a purifying act.16 Shaykh ʿAbdul Fattāḥ Abū Ghudda, a renowned late 20th-century Hanafi jurist, clarified this position:17
Since this issue of using the right hand to brush one's teeth is not stated explicitly in the sources [Qu’ran and Hadith], the issue returns to the essential purpose of the action. If the underlying point of the action is one of purity and beauty, then the method of using it should be with the right hand...The prophetic traditions (hadith) indicate that brushing teeth is considered to be both a cleansing act and an act of adornment by the accepted fact that the Prophet Muhammad brushed his teeth in front of the his companions in various situations and times without seeking to conceal it, abstaining from it, or expressing shame in using it. This all affirms the underlying meaning of purification.

The Maliki school of legal thought, whose realm of influence historically included Spain and north and west Africa, took positions on both sides of the debate as well, but also provided a middle way:18

If the brushing is intended for cleaning the mouth, for someone waking up from sleep or removing the remnants of food, then it will be done with the left because it is removing what may be harmful. And if the brushing is done with objective of following the Prophetic practice, then with the right because it is merely a qurba [an act of gaining nearness to God]...This issue is open to possibilities because of the absence of clear and explicit texts. In the absence of explicit texts indicating exactly which hand to use—unlike for other hygienic issues like blowing the nose and cleaning the private parts—the discussion remains one based on circumstantial reasoning. This is why the introduction and application of germ theory to oral hygiene in the 19th century, while reforming the dental educational process, significantly refined Muslim jurists’ approach to the debate over brushing.19 It is no coincidence that much, if not an overwhelming majority of the research on the antibacterial and biological effectiveness of the tooth-stick siwāk has been performed and funded in places where the Hanbali school of legal thought represents the majority, such as in Saudi Arabia.20

**Times of Brushing Teeth: for Others or for God?**

While the question of which hand to use was of concern to the likes of Ibn Taymiya, the question about when to brush was more pressing and more widely discussed. To understand the concerns of this discussion, we turn to a difference of opinion between the Hanafi and Shafi schools of legal thought, whose influence happens to overlap with Indo-Turkic and Arab communities, respectively. Some narrations of the hadith cited in the introduction, after emphasizing the importance of brushing, specify the time of prayer, and others the time of washing before prayer. The Shafi jurists stood by the narration of the hadith indicating brushing at the time of prayer. Any diligent adherent of the Shafi legal school will read how it is “especially desirable to use the toothstick for every prayer.”21 Hanafi scholars, on the other hand, believed that it is best used at the time of the ablution: the ritual washing of the arms, face, and feet before prayer.

Ibn ‘Abidin, the most well known Hanafi jurist of the 19th century and a resident of Damascus, summarized the reasoning behind this ruling for followers of his school of legal thought. He indicated that the Hanafis gave priority to the hadith narrations that mention brushing at the time of the ritual washing. Citing the reasoning of Siraj al-Hindi, the 14th-century Hanafi chief judge of Egypt, Ibn ‘Abidin concludes that the use at every prayer would not be practical because of the likelihood of blood flowing—an impure substance which would require one to repeat the ritual washing.22 However, he argues against those in his own school of legal thought who adhere so tightly to this interpretation that they disregard the merit of brushing at the time of prayer, “How can it not be preferred for prayer which is the conversation with the Most Exalted Lord, while it is preferred to use it in gatherings of people?” The reasoning underlying his point shows how the oral cavity, in a manner of speaking, mediates one’s relationship with the divine. In other words, how can we brush for the benefit of other people, but cannot brush for God?
This interpretation accords with the second hadith included by Mullā ʿAlī al-Qārī al-Harawī, the 15th-century Persian Hanafi jurist, in his hadith collection on the topic. “Brushing teeth is purifying to the mouth and pleasing to the Lord [al-siwāk maṭharat lil-fam mardātun lir-rabb].”23 The oral cavity is more than a source of personal satisfaction; it is a bridge between oneself and God. Writing in the 19th century, the Damascene ʿAbd al-Ghanī al-Maydānī further concluded, based on this hadith, that the act of brushing teeth is far beyond merely removing what may be harmful.24

The coincidence of brushing teeth at the time of ritual prayer, and the required washing just before, is the reason why the act of brushing teeth has been understood by Muslim communities as more than an act of hygiene—also an act of devotion to God. Imam Abū Ḥanifa, 8th-century Kufan jurist, after whom the Hanafi legal school takes its name, understood brushing in connection to ritual washing, but also opined it to be one of the fundamental acts of religious practice.25 It was devotional insofar as the frequency of its use at any time.

Writing in the 20th century, the Syrian Shaykh Abdul Fattāḥ Abū Ghuddah explains the practical merit of the Prophetic practice. He says that we are instructed to use it for the five daily prayers, which means we are using it at least five times per day. Comparing this to the current recommendation for people to brush twice or thrice per day, he argues that the Prophetic practice is more thorough and systematic.26 This latter example reveals the subtleties that previous historians have overlooked. In assessing popular claims whether the tooth-stick is more efficient biochemically, they missed the significance of the siwāk’s contribution to the culture and paradigm of oral hygiene.

**Brushing in Public:**
**Indecent or Encouraged?**

Having discussed aspects of how and when to brush, the question remains of where to brush. Should brushing teeth be done in front of other people and in public places like the mosque? For much of the world, toothpicks enjoy acceptance of their utility in public view, whereas toothbrushes do not. While toothpicks are also discussed in the hadith,27 the focus of this discussion is on the dynamics which determine public versus private decorum of brushing teeth. Previous investigations drew from discussions important to certain legal schools of thought, with brief reference to the Maliki school, dominant in North and West Africa.

A 20th-century Maliki scholar from Mauritania included a couplet discouraging the brushing of teeth in the mosque in his didactic versification explaining the etiquette of the mosque.28 Qāḍī Iyāḍ, the chief judge of 11th-century Granada, substantiates this position. “Anybody with decency will not do it [brush their teeth] in front of people, nor in the mosque due to the spray of filth [from the mouth].”29

Though this the predominating position, there were scholars who took a different position. Their arguments are illustrative of why this was a matter for scholarly discussion. Jaʿfar bin Idrīs al-Kittānī, born in 1828 in Fes, Morocco, though a Maliki, took a contrary position in his monograph titled “Persistence on those Matters Related to the Siwāk.”30 He argued against the conception of the toothstick as a remover of filth, using another set of evidence. “If it is said to someone, ‘Leave the mosque to brush your teeth where nobody can see you,’ that would lead to incredible hardship, whereas there is no narration of the early generations leaving the mosque just for the sake of brushing their teeth.” He qualifies this position by saying it should be “done in a subtle gentle way so that the mosque does not become filthy nor does it disgust other people.”31 He both responds directly to the concerns of Qāḍī Iyāḍ writing nine centuries prior, and points to the absence of textual sources asking worshippers to exit the mosque to brush their teeth.
Perhaps his strongest appeal is based on the hadith he cites referring to instances where companions in the presence of the Prophet Muhammad used the siwāk without being discouraged. “If it is permissible to do it [brushing one’s teeth] in front of the Prophet, it must permissible in front of other gatherings, for other gatherings could not possibly be more worthy of dignity, respect and decorum than the Prophet himself.” As a point of agreement, al-Kittānī notes that there are people who do not frequently brush their teeth, and it is disliked for them to brush their teeth in public since they will be primarily removing filth than maintaining purity.

The Hanafi position on this issue was a natural extension of seeing the act of brushing teeth as a frequent habit to maintain oral hygiene, with God in heart, of course. ‘Abd al-Ghanī al-Maydānī, a student of the Damascene Ibn ‘Ābidīn, writes in the conclusion of his book on brushing teeth, “The place of his [the Prophet’s] siwāk is by his ears just as the place of the reed is by the scribe’s ear.” While the position is more directly related to its conception of brushing teeth, the same principle does not apply to the Hanbali position discussed at the outset. If we recall Ibn Taymiya’s insistence on using the left hand, it might be surprising to learn that he finds no reason why it cannot be done in public. If it can be used at the time of prayer, and it is permissible to clear the mucus out of one’s nose in public, he does not see why it should be disliked to brush one’s teeth in the same location, sacred or public.

Based on the connection between the way brushing teeth is conceived and how decorum is decided, one might expect the Malikis—who believe that brushing teeth is a specific trait of the purifying ritual washing—to be overwhelmingly in favor of brushing in public. However, this is not the case. This fact shows the complexities of these discussions, in which various understandings of the Prophet Muhammad’s practice, contemporaneous medical knowledge and cultural norms—whether in Morocco, the Arabian peninsula, or Persia—shape the direction of legal thought.

While other histories of oral hygiene in Muslim societies have focused primarily on disproving the claims of “firstness” and describing the behaviors of specific societies, this modest introduction seeks to present excerpts from the discussion within the Islamic legal tradition, which extends over a millennium. This introduction certainly does not purport to present all of the nuances of the issue, but rather seeks to present a more historically and geographically informed overview of how brushing teeth has been thought about.

The question of which hand to brush with showed how legal scholars debated over categorizing the act of brushing primarily as purifying, like wearing a fragrance, or filth-removing, like washing one’s private parts. The question of when to brush teeth, either at the time of prayer or at the time of cleansing oneself before prayer demonstrated how the underlying reason for brushing was multifold, affecting both the physical and the spiritual. The final question of where to brush showed how brushing affects others, both in its action and its consequence.

The multitude of legal attitudes and approaches are not merely historical, but are embedded in the heritage lived by Muslim communities around the world today, whether or not those communities are aware of this fact.

The legal and theological import of brushing teeth may seem like a curious discussion to continue for over a thousand years, but its relevance to understanding the values and beliefs about oral hygiene of nearly a fourth of humanity is key, historically and clinically.

Oh God, Cleanse my mouth! Illuminate my heart and cleanse my body and make my body untouchable by the fire and Enter me by your mercy amongst the ranks of the righteous.

—anonymous prayer
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4. Ibid., 17.


6. Ibid., vols. 1, pf 84.


11. Ibid., 79.


15. Maydānī & Ghuddah. Tuḥfa al-Nussāk fī Faḍl al-Siwāk. 76.

16. Ibid., 75.

17. Ibid., 88.


24. Maydānī and Ghuddah, Tuḥfa al-Nussāk fī Faḍl al-Siwāk, 11. Much has been written regarding the benefits of brushing including the strengthening of gums, whiteness of teeth, memory, illumination of the face, and the possibility of remembering God in one’s last breaths. Abū Ghuddah notes that a number of benefits which “are neither grounded legally nor sound medically because it distorts what has been related by the honorable Divine Law or confirmed by rigorous medical science.” The topic requires more research, without a doubt.


Oral Hygiene in the Shari'ah: A Thousand-Year Old Conversation Between Islam’s Schools of Legal Thought

27. See al-Dimyāṭī. Ḥḵām al-Siwāk fī al-Sha‘rī‘ah al-Islāmiyya, 63.


31. Ibid., 98.

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32. Ibid., 99.

33. Ibid., 108.


35. al-Dimyāṭī. Ḥḵām al-Siwāk fī al-Sha‘rī‘ah al-Islāmiyya, 64.

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History of Techniques for Increasing the Zone of Attached Gingiva and Deepening the Vestibular Depth

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Introduction

The term mucogingival surgery was first suggested by Friedman in the 1950s as a generic term for surgical procedures which deal with the mucogingival junction and its relationship to the attached gingiva, the alveolar mucosa, frenulum and muscle attachment and the base of the oral vestibule.1

Goldman2 was the first to point out the limitations of mucogingival topography upon periodontal surgery. In 1953, he described three special problems which, in his opinion, called for inter-relating gingival, mucosal and vestibular surgery: 1) the extension of pocket depth beyond the attached gingiva into the alveolar mucosa; 2) the extension of the frenum attachment into the marginal gingiva and 3) a shallow vestibular trough resulting from surgical pocket reduction procedures. He emphasized particularly that a shallow vestibule leads to food impaction against the gingival margin and into the interproximal spaces, which at the same time makes it difficult for the patient to place the toothbrush properly and cleanse the area. From its inception, therefore, the concept of mucogingival surgery encompassed two intimately associated aims: namely, the alteration of vestibular fornix depth, and the production of a new and wider zone of attached gingiva.1

Although Hirshfield3 first drew attention to the high frenum as an etiologic factor in periodontal disease in 1939, it was not until 1954 that Stewart4 and Gottsegen5 introduced surgical methods for its elimination. Additional modifications of frenum surgery were described by Robinson and Grupe in 1956.6

Gottsegen,5 Stewart,4 Robinson,7 and Hileman8,9 each published papers and made additional suggestions for surgical procedures in this area. The frenulectomy moves the insertion of the midline frenulum apically and is adequate to relieve tension on the gingival margin. However, in the mandible, it is usually associated with an inadequate zone of attached gingiva, very frequently due to high muscle attachments.1

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Fox devised an operation to solve the problem of pockets that traverse the zone of attached gingiva. After making a gingivectomy incision and removing the attached gingiva, he detached the incised edge of tissue from the bone and elevated a mucoperiosteal flap. The flap was pushed apically, exposing a wide strip of bone from the alveolar crest to the edge of the flap. Osseous surgery was done as indicated and Telfa and periodontal surgical dressing were applied over the exposed bone and the incised margin of the flap. After healing, there was a wide zone of attached gingiva where alveolar mucosa existed pre-operatively. Fox called this the “push-back” operation and in conjunction with osseous surgery it was successful in eliminating pockets and creating a new and wider zone of attached gingiva.

In 1956, Schluger modified the “push-back” to deepen the vestibular trough in the mandibular molar region in addition to increasing the zone of attached gingiva. To accomplish this, he dissected the mucoperiosteal flap of the “pushback” apically and inserted the periodontal dressing material between the flap and bone instead of over the cut edge of the flap. The dressing was pushed apically between the mucoperiosteal flap and bone. The result was a wide zone of new attached gingiva and a pouch-like extension of the vestibular base, placing the marginal gingiva on a vertical plane instead of at or near the bottom of the vestibular trough. Schluger called this the “pouch” operation. Goldman, Schluger and Fox later published a description of these operations and called the combination of the “pushback,” the “gingival extension operation,” and the “pouch” together the “local extension of the vestibular trough.”

In 1962, Bohannan made a brilliant study of the depth of the oral vestibule in the anterior region of the mandible before, during and after healing of various surgical procedures designed to deepen it. He used three surgical procedures which he termed (1) complete denudation, (2) periosteum retention and (3) vestibular incision. He used the cephalometer and made serial cephalometric roentgenographs to record the position of No. 7.5 lead shot identically positioned at the base of the vestibule preoperatively, immediately postoperatively and at established intervals over a 26-week period. He found that vestibular depth could be increased by all three methods but that complete denudation (bone exposure similar to the “pouch” procedure) gave the most consistently successful result. There was no significant difference between the vestibular extensions achieved by other methods which retain or replace the periosteum. One of his findings was that in the presence of an adequate zone of attached gingiva, shallow vestibular depth did not interfere with gingival health.

In 1963, Edlan and Mejchar described the Vestibular Extension technique. The procedure was as follows:

The operative field was outlined. Starting at the junction of the gingival margin and attached gingiva, a vertical incision was made at each end of the operative field, extending approximately 12 mm from the alveolar margin into the vestibule. These vertical incisions were joined with a horizontal incision. A mucosal flap was separated and elevated to expose the periosteum of the bone. Starting at the crest of the facial bone, just under the elevated flap, the periosteum and attached muscle fibers were separated from the bone and were transposed to the lip. The mucosal flap was folded down over the bone and sutured to the inner surface of the periosteum. The fornix of the vestibule was then formed by the junction of the mucosal flap and the transposed periosteum. The upper edge of the periosteum was sutured to the mucosa of the lip or vestibule where the horizontal initial incision was made. According to Edlan and Mejchar, the periosteum was covered with epithelium within 7 to 10 days and the mucous membrane attached to the bone in 2 to 3 weeks (Figs. 1a to 1e, following page).

The disadvantages of the “pushback” and “pouch” procedures were prolonged healing, postoperative pain and reabsorption of exposed marginal bone. In an effort to retain the advantages of these procedures and eliminate some of their
disadvantages, Ochsenbein\textsuperscript{13} in 1963 divided the mandibular mucoperiosteal flap by separating the alveolar mucosa and submucosa from the periosteum. He replaced the periosteum over the bone to within a few millimeters of the alveolar crest (denuded the bone for a few millimeters). Ochsenbein called his procedure the “double flap.” It was performed in the following manner:

After the attached gingiva had been removed, the incised margin was detached from the bone with the tip of a No. 4 curette and a mucoperiosteal flap was elevated to provide access to the areas requiring osseous surgery. After the osseous defects had been corrected, an oblique vertical incision was made in the alveolar mucosa to the periosteum but not through it. This incision was made just beyond the mesial or distal extension of the mucoperiosteal flap. It was made in tissue that was not detached from the bone with the flap, but where the attached gingiva was removed, because attached gingiva would not have separated into distinct layers of tissue. The elastic fibers in the submucosa retracted the margins of the incision. This retraction was enhanced by pulling out and down on the lip. A blunt instrument was inserted in the incision at its base to begin the separation of the alveolar mucosa from the periosteum. The separation was extended apically by blunt dissection to deepen the vestibular trough. The free periosteum was adapted to the bone, leaving about 4 mm of marginal bone exposed to create an adequate zone of new attached gingiva. Periodontal surgical dressing was applied over the periosteum and marginal bone to the base of the surgically created vestibule. Healing occurred rapidly as compared with the “pushback” and “pouch” procedures and with much less postoperative discomfort.

Ochsenbein reported that alveolar mucosa formed over the periosteum of his “split flap” and gingiva over the exposed bone. After observing that the new zone of gingiva was approximately equal to the width of the exposed marginal bone, Ochsenbein postulated that exposed bone induced the formation of attached gingiva. In discussing this theory, Sicher conjectured that the dividing line between movable and immovable tissue would probably determine
the position of the mucogingival junction, with gingiva forming over the immovable exposed bone near the alveolar margin and alveolar mucosa over the movable periosteum.

In 1966, Nabers developed a technique with free gingival grafts of masticatory mucosa membrane in periodontal surgical procedures that aimed to create bands of attached gingiva, enlarge them and change the extension of vestibular fornix.

A modification of the principle of periosteal replacement which exposed a narrow strip of bone at the base of the surgically created vestibule instead of at the marginal crest was then introduced by Tortorelli in 1968. This procedure was named Modified Double Flap.

This procedure was used to deepen the vestibule in the mandibular incisor region when there were no deep marginal osseous defects. The marginal lesion was eliminated by gingivoplasty or osteoplasty and a mucoperiosteal flap was not raised. An incision was made at the mucogingival junction through the alveolar mucosa to the periosteum and the mucosa was dissected apically to increase vestibular depth. Maintenance of part of this vestibular extension after healing was secured by severing the periosteum at the base of the surgically created vestibule and separating it to expose a strip of bone 3 or 4 mm wide. This procedure delayed healing in the area of exposed bone and severed all attachments of the exposed periosteum to movable tissue in the vestibule, releasing tension from elastic fibers that cause movement in the retained periosteum. Attached gingiva was formed over the periosteum where there was no movement. A similar procedure was previously done independently by Robinson in 1961 and Corn in 1962. Robinson called it “periosteal fenestration” and Corn called it “periosteal separation” (Fig. 2 a, b and c).

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**Fig. 2.** Fenestration operation showing bone denuded of periosteum at the base of fornix resulting in scar tissue formation.
Techniques for Increasing the Width of Attached Gingiva

In 1954, C.L. Nabers used an approach to the problem of eliminating the pocket that extended apical to the mucogingival junction. He, too, pointed out the failure of the gingivectomy because the alveolar mucosa could not function as marginal gingiva. Therefore, in such cases he retained most of the existing attached gingiva by making a vertical incision and positioning the flap apically by sliding the free end apically and suturing it. All pocket epithelium and loose connective tissue were removed from the inside surface of the flap. Thus, he eliminated the pocket and retained a ribbon of gingiva as marginal and submarginal tissue. He called this procedure “repositioning the attached gingiva.” In 1957, Ariaudo and Tyrell modified Naber’s “repositioning the attached gingiva” operation. They made two vertical incisions which made the flap easier to manipulate and placed the flap apical to the crest of the marginal bone. The zone of attached gingiva was increased because new band of gingiva was formed coronal to the apically positioned gingiva (Fig. 3a and b).

In 1962, Friedman proposed the term “apically repositioned flap,” instead of the term “attached gingiva repositioning,” initially proposed by Nabers in 1954.

In 1963, Bjorn used the free soft tissue graft from the palate to increase the zone of attached gingiva. His procedure was as follows:

The free graft was used to increase the zone of attached gingiva, to eliminate the tension of frenula and muscle attachment on the gingival margin and to extend the vestibular fornix. Gingiva or masticatory mucosa is suitable for grafting and the hard palate is usually the source of donor material. The thickness of the graft is important. A full-thickness graft contains all of the lamina propria, but split-thickness grafts contain only a part of it. The graft must not contain any fat, since fat will prevent diffusion and vascularization. The graft should be thin in order to prevent excessive primary contraction. The transplant must survive by diffusion until circulation is established by capillaries from the graft bed. This usually takes about three days and a thin graft has a better chance for survival than a thick graft. However, a thicker graft is better able to withstand the stresses of function after healing; therefore, in areas of great functional demands, a slightly thicker graft should be used.

The recipient site was prepared by making a horizontal incision at the mucogingival junction and exposing the periosteum by sharp dissection to the base of the vestibule. All epithelium, connective tissue and muscle fibers were removed, leaving a smooth immobile periosteal surface for the graft to rest on. Periosteum formed capillaries rapidly for revascularization of the graft. Adequate hemostasis was achieved and pressure was applied to the graft bed while the donor site was prepared.

The mesiodistal dimension of the graft bed was measured with a probe or millimeter gauge and marked on the palate. The width was measured in the same manner. The incision for the graft bed extended laterally and vertically beyond the edge.
of the graft, but it was not necessary to incise the periosteum as is done in the periosteal fenestration procedure. The graft was outlined by making an incision with a Bard-Parker blade number 12 or 10 A; the depth of the incision should correspond to the desired thickness of the graft (usually about 1.5 mm). The graft was undermined with the Bard-Parker blade and the free end was held with smooth surface tissue forceps and lifted away as the remaining portion of the graft was freed. The tissue was dried with a sterile sponge and examined. The surface should be smooth; grooves and pits provide space for blood clots which prevent diffusion and interfere with capillary ingrowth for revascularization. The graft was trimmed if it was uneven, too thick or contained fat.

The graft was tried on the recipient site and then returned to the sponge where a suture was placed through the right superior corner. A small size suture (5-0) and a small sharp needle were used. The graft was sutured to the periosteum; it must not be sutured to movable tissue. One of the plastic sides of a trimmed sheet of Telfa was placed over the graft and surgical dressing was applied over the entire area. The dressing was removed in five to six days, the graft was gently cleaned, sutures were removed, and a new dressing was applied without Telfa. The second dressing was removed in five or six days. The epithelium may be necrotic, especially if the graft was thick, but new epithelium quickly recovered the graft. The patient was examined and local prophylactic care was given twice weekly until adequate brushing could be resumed (Fig. 4 a to e).

thritis of Techniques for Increasing the Zone of Attached Gingiva and Deepening the Vestibular Depth

Fig. 4. Free gingival graft technique to increase zone of attached gingiva.
In 1964, King and Pennel\textsuperscript{20} used the free soft tissue autograft. They reported a case in which they removed a split thickness graft from the palate and sutured it to the submucosa on the vestibular surface of a maxillary cuspid, like an apically positioned flap, where it attached as marginal tissue.

J. M. Nabers\textsuperscript{14} (1966) popularized the free graft procedure through a series of case reports which showed that it was clinically predictable and feasible. Sullivan and Atkins\textsuperscript{21} also published a detailed study of the principles of successful grafting.

**Variant Techniques**

The accordion technique, the strip technique, the connective tissue technique and a combination of strip and the connective tissue techniques have been used for increasing the width of the attached gingiva.

In 1974, Edel\textsuperscript{22} described the connective tissue technique which was based on the fact that the connective tissue carries the genetic message for the overlying epithelium to remodel itself into keratinized form. Therefore, only connective tissue from keratinized zone can be used as a graft. This technique had the advantage that the donor material could be obtained from under the palatal flap, which was then sutured back in place so that healing at the donor site occurred by first intention.

In 1985, Rateitschak\textsuperscript{23} and colleagues described the accordion technique. It attains expansion of graft by alternate incisions in opposite sides of the graft (Fig. 5).

In 1993, Han and associates\textsuperscript{24} developed the strip technique, which consisted of obtaining two or three strips of tissue about 1mm wide and long enough to cover the entire length of recipient site. These strips were placed in the base and the center of the recipient site, secured by sutures from the oral mucosa and wrapped around the tooth. The area was then covered with tinfoil and surgical pack. The donor site usually does not require any protection and heals uneventfully in a few days. Greater shrinkage of the graft resulted with this technique which can be prevented by a slightly large recipient site (Fig. 6).

In some cases, a combination technique was performed in which a strip of tissue about 3 to 4 mm was removed from the palate, placed between two wet tongue depressors, and sliced longitudinally with a sharp Bard-Parker knife. It was used as a graft both the superficial portion that contained the epithelium and connective tissue and the deeper portion that consisted only of connective tissue.

In 1985, Langer and Langer\textsuperscript{25} described the Subepithelial Connective Tissue Graft technique. They combined a partial-thickness flap coronally positioned with a subepithelial connective tissue graft. They employed a procedure with minimal palatal denudation with a smooth post-operative course. This technique had the advantage of a closer color blend of the graft with adjacent tissue avoiding the “keloid” healing present with free gingival grafts.
The procedure was as follows:

A partial thickness flap was created with two vertical incisions placed at least one-half to one tooth wider mesio-distally than the area of gingival recession. The coronal margin of the flap was started with a horizontal sulcular incision to preserve all existing radicular gingiva. The interproximal papillae were left intact. The flap dissection was partial thickness leaving connective tissue over the existing bone and/or root surfaces.

Donor Site: A second surgical site was created on the palate, the length of this was determined by the combined width of the teeth to be covered. A horizontal incision was made approximately 5 to 6 mm from the gingival margins of the maxillary teeth to the desired width. It was continued apically as an inverse bevel towards alveolar bone.

A second parallel horizontal incision was made 1.5 mm to 2 mm coronal to the first incision. It was continued apically until it met the base of the original incision. The palatal bone was scored to enable the operator to remove the connective tissue wedge. Vertical incisions were also made on either side of the horizontal incisions in order to facilitate the removal of the connective tissue graft and aid in wound closure.

The connective tissue and epithelium between the two horizontal incisions were excised and all adipose tissue was removed. In addition, the band of epithelium which was taken with the donor connective tissue was allowed to remain on that portion which would be covering the denuded root. This seemed to provide a smoother junction with the existing epithelium.

The palatal flap was sutured back into position immediately after taking the donor tissue in order to reduce the size of the blood clot which might cause tissue necrosis. The flap from the donor site was closed into a position approximating primary intention healing. If a void was present between the wound edges, Gelfoam or Avitene was packed into the void to lessen the probability of postoperative bleeding.

The combined epithelial and connective tissue graft was placed over the denuded roots and sutured in place. The donor connective tissue and epithelium were sutured to the underlying connective tissue interproximally. The partial-thickness recipient flap was positioned coronally in a manner so as to cover as much of the graft as possible, and then sutured in this position. No attempt was made to completely cover the graft, as this would create an excessive pull on the vestibular fold. The recipient site was dressed with periodontal dressing.

A modified technique of Langer and Langer was introduced by Bruno (1994) who had the following opinions:

1. The most important factor in flap preparation is maintaining its blood supply.
2. Blood supply to the gingiva comes from the apical area, the interalveolar septum and the external peristium (predominant source).
3. Supply to the flap after reflection depends primarily on the bilateral surrounding gingival tissue (lateraly) and oral mucosa (apically) in the surgical area, because the blood supply from the interalveolar septum and periodontal membrane is terminated.
4. The Langer and Langer technique requires a vertical incision to the flap, therefore reducing blood supply markedly.
5. The envelope flap (modified flap), which is reflected without the vertical incision, is superior to the full flap with a vertical incision in this respect.

Bruno modified the Langer and Langer technique to include a horizontal partial-thickness incision extending mesio-distally to the recipient site (Fig. 7). Blood supply to the graft would thus be increased because the grafted connective tissue is covered by this flap. Also, the lack of vertical incisions alleviates post-operative discomfort, facilitating healing, and no scar will develop in the vertical incision area (an aesthetic advantage). The horizontal incision (indicated by arrows) aids close adaptation of the interdental papilla area and graft with a butt-joint effect. The blood supply from the interdental papilla area is enhanced by this close adaptation.
In 1996, Reiser and colleagues\textsuperscript{27} presented a classic article on careful retrieval of the subepithelial connective tissue graft from the hard palate in order to avoid surgical complications. Their article summarizes the following points:

1. The thickest tissue can be found in the area from the mesial line angle of the palatal root of the first molar to the distal line angle of the canine.

2. The clinician can easily determine the thickness of the donor tissue by needle soundings following the administration of local anesthesia.

3. The greater and lesser palatine nerves and blood vessels gain entrance into the palate by passing through the greater and lesser palatine foramina. The foramina locations can be identified apical to the third molar at the junction of the vertical and horizontal parts of the palatine bone. These nerves and vessels course anteriorly within a bony groove. The neurovascular bundle may be located 7 to 17 mm from the cementoenamel junctions of the maxillary premolars and molars.

4. Prior to making the initial incision to procure the donor tissue from the palate, the surgeon should attempt to palpate the bony groove. The groove is easiest to palpate at its most posterior extent. This palpation allows the surgeon to determine the maximum apical (superior) placement of the incision that is possible before violating the neurovascular bundle. The surgeon can indicate this groove with a line made by an indelible marker on the soft tissue surface of the hard palate, which can be a useful reference when obtaining the donor tissue.

5. Caution must always be exercised not to violate the neuro-vascular bundle when obtaining the donor tissue, and extreme caution must be exercised when the palate is shallow.

6. The terminal branch of the greater palatine artery extends to the incisal foramen, where it passes superiorly up the incisal canal onto the nasal septum into Kiesselbach’s area. In this anterior palatal region, the artery drops inferiorly, decreasing the distance from the artery to the cementoenamel junctions of the anterior teeth. Therefore, the authors recommend limiting the anterior extent of the donor site surgery to the distal line angle of the canine tooth to avoid damage to the greater palatine nerve and artery, which could cause postsurgical bleeding and paresthesia or anesthesia.

7. If the surgeon encounters bleeding from the palatine vessels, the following actions can be taken in sequence: a) Immediate direct application of pressure and the injection of a local anesthetic containing a vasoconstrictor into the region; pressure should be constant for at least 5 minutes; b) placement of one or more sutures proximal to the bleeding site (i.e. between the bleeding site and the foramen); c) elevation of a full-thickness flap—the vessel is reflected with the flap, visualized and ligated.

**Discussion**

For many years the presence of an “adequate” zone of gingiva was considered critical for the maintenance of marginal tissue health and for the prevention of continuous loss of connective tissue attachment.\textsuperscript{16} Clinicians had the impression that sites with a narrow zone of gingiva were often inflamed, while the wide zone of gingiva found at neighbouring teeth remained healthy. The prevailing concept was thus that a narrow zone of gingiva was insufficient (1) to protect the periodontium from injury caused by frictional forces encountered during mastication and (2) to dissipate the pull on the gingival margin created by the mucles of the...
adjacent alveolar mucosa. Moreover, it was believed that an “inadequate” zone of gingiva would facilitate subgingival plaque formation because of improper pocket closure resulting from the movability of the marginal tissue, and favor attachment loss and soft tissue recession because of less tissue resistance to apical spread of plaque-associated gingival lesions. It was also believed that a narrow gingiva in combination with a shallow vestibular fornix might favor the accumulation of food particles during mastication and impede proper oral hygiene measures. The opinions expressed concerning what could be regarded as being an “adequate” or “sufficient” dimension of the gingiva varied. While some authors suggested that less than 1 mm of gingiva may be sufficient, others claimed that the apicocoronal height of keratinized tissue ought to exceed 3 mm. A third category of authors had a more biologic approach to the question and stated that an adequate amount of gingiva is any dimension of gingiva which is compatible with gingival health, or prevents retraction of the gingival margin during movements of the alveolar mucosa.

If there is retraction of gingival margin during movements of alveolar mucosa (tension test is positive), or if there is accumulation of food particles in the vestibule (during mastication) and the patient is unable to maintain his/her oral hygiene due to inadequate space for placement of toothbrush in the vestibular fornix, clinician should treat the oral condition by any one of the above surgical procedures keeping in mind the advantages, disadvantages, indications and contra-indications of each.

Acknowledgements:

Heartfelt thanks to Ms. Preranna Parwani (our daughter) for the schematic diagrams in this article.


Dental Postcards LI

“Talk about cheek!”

This unused black-and-white lithographic US postcard, circa 1910, portrays a young boy with a bandana wrapped around his face to support his swollen left cheek. (Perhaps his mother neatly tied the knot at the top of his head?) The woeful, distracted expression on the child’s face belies what is about to happen in this unfolding drama. Behind him, hundreds of bees are streaming out of an apiarist’s wooden hive. The hive itself is so full that honey is pouring out. The boy will have some explaining to do when the bees catch up with him—it is the broken-off branch on the ground next to him that must have disturbed their work! Maybe he mistakenly believed a little fresh honey would relieve his toothache, but instead it’s only made matters worse…

3 ½ x 5 ½ inches

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Dental Trade Cards XXXVII
Theodore P. Croll, DDS
& Ben Z. Swanson, Jr., DDS, MPhil

Images of toothbrushes or other implements involved in cleaning teeth were rare on Victorian-Era advertising trade cards. When pictured, toothbrushes are usually shown because the card is advertising a dentifrice, but the brush itself is unnamed and uncelebrated.

However, one tooth cleaning implement was advertised: the Horsey Manufacturing Co. of Utica, New York made the Ideal Felt Tooth Polisher and marketed the product with trade cards.

Besides testimonials for the Tooth Polisher by prominent dentists from all over the country, endorsements from celebrities of the era were solicited by the manufacturer. Among the endorsers were novelist George W. Cable, stage actress Helena Modjeska, humorist Marshall P. Wilder, and renowned psychiatrist Dr. G. Alder Blumer, who was Superintendent of the New York State Lunatic Asylum (now there's a recommendation!).

Claims for the product were varied and bold. “Ideal Felt Tooth Polisher prevents Sore, Bleeding and Receding Gums, Riggs’ (sic) Disease, Grooving of Enamel, Tartar Accumulations,” and “Insures absolute cleanliness and comfort.” Other more sublime claims were that, “If you are Well and would enjoy life’s fullest blessing, use it to increase your health and happiness.” “If you Live in Society, use it to improve your appearance.” “If you live in Solitude, use it to preserve your teeth.” “If you are Rich, it will make you richer.” “If you are Poor, it will save your money.” “Whatever your Age or Condition you cannot afford to be without it.”

Preposterously, the claim was made that “thousands of intelligent mothers who have discovered that their teething children, even the youngest, enjoy its regular use when refusing to be tortured by bristles.” One must wonder what type of brush bristles were used in those days that could be considered implements of torture.
The "Ideal Tooth Polisher"

The "Ideal Tooth Polisher"
(Trade Mark)
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The Adjustable TOOTH CLEANER AND POLISHER.

HORSEY MFG. CO., Utica, N.Y.
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IF YOU EVER BRUSH YOUR TEETH
Read these Important Facts.

The Felt Tooth Brush is made of Felt especially prepared and cut in such a manner as to present an infinite number of fine points on the surface of the brush, the general shape of which is such, as to conform to the contour presented by the teeth.

The Felt Brush is particularly adapted to remove tartar and prevent its deposit without destroying the gum line, as the bristle brush does, often causing a recession of the gums that results in the loss of the teeth. The absorbent quality of the felt is an advantage no other form of brush can claim. taking up matter on its surface, when in many cases the bristle brush crowds it between the teeth and excites decay. Another advantage is the polishing of the teeth so that decay is prevented and not invited, as is often the case when bristles are used.

The lacerating of gum tissue, the grooving of enamel and the discomfort and positive injury, as the result of the use of the bristle brush, has led to the invention of the felt brush, which a practical test has proved will cleanse the teeth more thoroughly, and yet is free from all the objections urged against the use of bristles.

In diseased conditions of the gums, and spongy gums, and those that bleed easily, and in the case of young children whose gums are always tender, owing to the changes incident to the loss of the temporary and the eruption of the permanent teeth, nothing can compare with the felt in comfort and freedom from irritation so desirable in those conditions. The bristle brush has been so positively prohibited in these cases, that the profession have advised the use of cloth, chamois, &c., but the felt meets the conditions perfectly and does the work more thoroughly and in much less time.

How Regarded at Home.

Dr. F. A. Cooke, D.D.S., Boston, writes: "After using the Ideal Felt Tooth Polisher, my teeth have a clean, smooth feeling, that cannot be obtained with the bristle tooth brush."

Dr. E. W. Kellogg, M.D., Hartford, Conn., writes: "As a beautifier of the teeth it is unrivalled."

Dr. G. Alden Blumke, Supt. N. Y. State Lunatic Asylum, writes: "Constant personal use of the article since its first introduction has demonstrated to my entire satisfaction the soundness of the principles of dental hygiene on which its construction is based."

Dr. Geo. F. Smith, D.D.S., Chicago, Ill., writes: "I find it very satisfactory, and shall recommend it to my patients, especially to juveniles."

Dr. J. P. Carmichael, D.D.S., Milwaukee, Wis., writes: "As a polish for the teeth and a means of hardening the sensitive gums, it has no equal."

Mr. Geo. W. Carle, the eminent novelist, writes: "I have your brush in use. It certainly gives the teeth an extremely pleasant feeling of Polish."

Mr. Moleska's Prediction: "I believe them [Ideal Felt Tooth Polishers] to be an invention that will in time almost entirely supersede the brush of bristles."

Marshall P. Wilder, New York's famous wit, writes: "I find the Felt Tooth Polisher to be all you advertise, a most excellent article."

BULLETIN OF THE HISTORY OF DENTISTRY

official monthly publication of
American Academy of the History of Dentistry

A PROSPECTIVE HISTORY OF DENTISTRY IN ARKANSAS

The History Committee of the Arkansas State Dental Association has requested that all persons having dental patents, photographs of Arkansas dentists or dental groups contact the chairman, Fred W. Dietrich, Camden, Arkansas. A History of Dentistry in Arkansas is scheduled for the spring of this year (Arkansas D. J., 26:47 June 1955).

Dr. Dietrich has contributed some information on early Arkansas dentistry in Arkansas Dental Journal 26:23-24, June 1955; 26-27 Sept. 1955.

HISTORY OF NAVY DENTAL CORPS

With the November 30, 1955 issue, the Naval Dental Corps News (mimeographed bulletin, issued by the Technical Information Bureau of Medicine and Surgery, Navy Department, Washington 25, D. C.) has begun publication of a "Historical Resume" (of dentistry in the Navy) in three parts.

CENTENARY CELEBRATION FOR ST. LOUIS SOCIETY

The St. Louis Dental Society is preparing to celebrate its one hundredth anniversary throughout the year 1956. (J.A.D.A. 52:95 Jan. 1956; St. Louis D. Soc. Bul. 26:103 Dec. 1955). The Society has issued a brochure giving the program for the events of this celebration. The fourth and last event has the theme: The Past is our Foundation, and will include an account of the history of the Society. E. S. Khalifah is chairman of the History Committee.

POLISH STOMATOLOGY OF THE SIXTEENTH CENTURY

The Herbarium of Simon Syrenius Sacranus (b. 1541, d. 1611) is discussed with relation to oral therapeutics in an article by Mieszyslaw Fucha (Czasopismo Stomatologiczne, 6:133-138 April 1955, Warsaw).

VINCENZO GUERINI

A good account of the life of the dental historian Vincenzo Guerini (b. 1859, d. 1955), with three illustrations, by Arturo Mingoli, is published in Clinica Odontoiatrica, Parte Varia, 10:167-170 July 31, 1955.

CORRECTION IN NAMES

Dr. J. Menzies Campbell calls attention to two errors in names in the article by Lilian Lindsay mentioned in the December 1955 Bulletin. John Rankin Brownlie should read James Rankin Brownlie, and W. R. Woodburn should be W. S. Woodburn.
THE PHYSIOGNOMIC RECONSTRUCTION OF A POET

"The Portrait of Hugo Foscolo and his Bright Teeth" (Il ritratto di Ugo Foscolo ed i suoi "tersi denti") by Angelina Ciaraspico (Clinica Odontoiatrica, Parte Varia 10:79-84 April 30, 1955) attempts to reconstruct the appearance of the Italian poet (b. 1778, d. 1827) from literary and graphic sources.

DENTISTRY IN INDIANA


Under the title "Heritage of the Hoosier Dentist," Dr. Stoller, in the March 1955 J. Indiana D. A. 34:14-15, urged the participation of all Indiana dentists in the collection of historical material for a history of dentistry in the state, to be published for the centenary celebration of the Association in 1958.

CHARLES H. LAND MUSEUM

Columbia University has named the dental school museum the Charles H. Land Museum in memory of Dr. Land, the originator of the porcelain jacket crown. General Lindbergh, his grandson, has financed the preparation of an annotated catalogue of the historical collection and this is underway under the direction of Curt Proskauer.

REVIVAL OF OLD PRINCIPLES

Under the title "Prothesenherstellung im Einpreszverfahren" (Making dentures by the single pressure technique) E. A. Boltes in Das Deutsche Zahnärzteblatt (9:20-22, June 8, 1955) compares the modern injection method of packing denture base resins with the method employed in early years with vulcanite and demonstrates the similarity of injector presses.

BIBLIOGRAPHICAL NOTES


THE MICHIGAN CENTENNIAL

The most notable of the various centenary celebrations of local and state dental societies is that of the Michigan State Dental Association, the earliest founded (Jan. 9, 1856) of the state organizations in continuous existence to the present. The January, 1956 issue of the Journal of the Michigan State Dental Association features several historical articles: an editorial announcing the events in the centenary celebration, an article on "History of Dental Hygienists in Michigan" by Dorothy Harv (38:5-15), "Historical Sketch - Detroit Dental Aid Commission" (38:16). The February number will be designated the Centennial Issue.

PRE-CEPHALOMETRIC STUDIES OF GROWTH AND DEVELOPMENT

Research on growth and development of the stomatognathic system (to about 1930) from the points of view of histology, anthropology, and animal experimentation is summarized historically by Allen C. Brader ("Historical Review of Research Findings of Growth and Development Prior to the Introduction of Roentgenographic Cephalometry") in Angle Orthodontist 26: 1-9 Jan. 1956.

EARLIEST DENTAL SCHOOLS IN LATIN AMERICA

César Mena Serra has contributed an article entitled "Las Primeras Escuelas Dentales de América-Latina" in Resumenes de la Facultad de Odontologia (University of Havana) Nov. 1955, No. 4, p. 25-30.

CORRECTIONS

A reference to the toothbrush in Cornelius van Solingen's Handgriffe der Wundartzney (1676) appeared in the Bulletin for November, 1955. Curt Proskaure calls attention to the fact that van Solingen's mention (edition 1693) concerns a brush with the bristles in line with the shaft of the instrument used by the dentist for the application of nitric acid or other strong chemicals for the purpose of cleaning the teeth. This instrument does not qualify as a tooth brush, since it is used only by the dentist and is not constructed with the bristles at a right angle to the handle.

J. Menzie Campbell calls attention to the reference under Ruspini in the name directory of B. W. Weinberger's Introduction, vol. 1. The mention, on p. 230, to "The renowned Chevalier," Campbell points out, refers to the Chevalier John Taylor, "a roving mountebank, who had been oculist to George II," and not to Ruspini.
BIBLIOGRAPHICAL NOTES


E/ Columbia University Press, New York, announces the publication of The Presbyterian Hospital and the Columbia Presbyterian Medical Center, 1868-1943: a History of a Great Medical Adventure by Albert R. Lamb. (xx+495 p., $8.95)


QUARTER OF A CENTURY FOR THE KELLOGG FOUNDATION

E/ The Kellogg Foundation has issued a two volume set of books consisting of a biography of W. K. Kellogg by Horace B. Powell and an account of the Foundation entitled The First Twenty-five Years (1955). References to dentistry and the work of the Foundation in that field occur throughout the latter volume. Brief special sections deal with "Preparation of Dental Teachers," "Canadian Dental Schools Survey and Consultation Program," "Regional Planning for Dental Education," "Graduate and Postgraduate Dental Education," and "Education of Dental Hygienists."

CORNELIO, ITALIAN DENTIST OF EARLY NINETEENTH CENTURY

E/ Vittorio Cornelio, styled Cavaliere Incognito (the disguised knight) was one of the most prominent dentists of the late eighteenth and early nineteenth centuries. He is the subject of an article by L. Casotti entitled "Vittorio Cornelio, Dentista Pioniere del Primo Ottocento (sig) Torinese" (Minerva Stomatologica 4:364-366 Nov.-Dec. 1955).

SEVENTY-FIVE YEARS OF KANSAS CITY SCHOOL

E/ The Diamond Jubilee of the University of Kansas City School of Dentistry (1881-1956) is featured in the February, 1956 number of the Journal of that institution with illustrations. The dean, Roy James Rinehart, named "Men of the Year" by the alumni association, is honored in a biographical sketch with pictures pertinent to his career.
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The Toothpick and its History

by Dr. Hans Sachs
Translated by Anna C. Souchuk, PhD
Published by Steven Potashnick, DDS
Soft cover, 51 pages, 86 illustrations

There have been a number of English language articles about the toothpick, J. Menzies Campbell’s 1952 paper (Campbell JM. Toothpicks and toothbrushes. Dent Items of Interest. 1952;74: 295-305.) is of particular note. However, Der Zahnstocher und Seine Geschichte eine kulturgeschichtlich-kunstgerbliche studie (The Toothpick and its History: A cultural-historical and arts and crafts study) remains the premier reference resource. We must congratulate Dr. Potashnick for the time, effort and cost in providing this English translation.

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A Guide to Bone Toothbrushes of the 19th and Early 20th Centuries

by Dr. Barbara E. Mattick

While this book’s primary audience is archeologists, the subject of toothbrushes is intimately connected to our profession. A valuable reference source has been provided to those with an interest in collecting bone toothbrushes, and for anyone with an interest in dental history. Dr. Mattick has assembled, in a useable and well-visualized monograph, essential information for identifying such material. The basis of this book is derived from research for her master’s thesis in anthropology, which proved that “bone toothbrushes are excellent dating tools for historical archaeologists.”

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A Sourcebook of Dental Medicine
Being a Documentary History of Dentistry and Stomatology from the Earliest Times to the Middle of the Twentieth Century.

by Gerald Shklar, DDS, MS
& David A. Chernin, DMD, MLS
864 pages, hardcover

The aim of this book is to make available to the profession of Dental Medicine and other interested parties the extensive literature of the past dealing with the diagnosis, description, causes, treatment and prevention of oral diseases. Drs. Shklar and Chernin are presenting the original texts concerning the diagnosis and management of oral diseases ranging from ancient Egypt through the world of the 20th Century.

Many of the basic texts of the past have already been translated into English, French and German from the original Sanskrit, Greek, Latin and Arabic. However, a number of important texts have never before been translated into English. The authors are presenting all these materials to the English-reading professionals in medicine and dental medicine in this 864-page reference book.

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Intriguing and Eccentric Characters & Stories from the World of Dentistry

by Arden G. Christen, DDS, MSD, MA
& Joan A. Christen, BGS, MS

In this 230-page book, the authors have glimpsed into the lives of 32 dental characters: professionals who range from the noble to the bizarre. Introducing this work is a chapter on one of the most memorable and controversial characters of all time, Dr. Painless Parker (1872-1952). All of these fascinating individuals have left indelible marks on their chosen profession. The stories from this collection may be inspiring or infuriating, ingenious or absurd, credible or questionable—but seldom are they dull.

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by Joan A. Christen, BGS, MA
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The authors have compiled 188 previously-published limericks related to dental, oral and facial themes; plus they offer an additional 384 personally-composed limericks. The humorous verses in this collection are at once bawdy, whimsical, ludicrous and cynical, and though simple in format, they communicate in few words their strong, sometimes paradoxical message. 159 pages with complete index.

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