

A HISTORY OF DENTIFRICES.\*<sup>1</sup>

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The history of dentifrices is a striking example of the persistent marketing and use of preparations containing substances known by the medical profession to be harmful. The literature abounds in advertisements lauding dentifrices, and in medical criticisms of their ingredients. It is true that the most dangerous, for example, sulphuric acid for whitening the teeth and powdered glass as a powder, have fallen into disuse. Dentifrices constitute such a substantial proportion of the toilet preparations sold by pharmacists, and the latter, as well as the general public, are to-day presented with such a multiplicity of conflicting statements regarding the various market products that survey of the ingredients used in previous centuries may be of interest.

The Council on Dental Therapeutics defines dentifrices as preparations (pastes, powders and liquids) which aid in the removal of débris from tooth surfaces. From almost the earliest recorded writings on the subject, dentifrices have taken these three physical forms. Such preparations were first used chiefly to whiten the teeth, that is to beautify, but even as early as the middle of the first century Damocrates, a Greek physician, considered cleanliness the indispensable condition for avoiding disease of the teeth and gums. In any case the covering or removal of unwholesome breath was undoubtedly an important object as practically all formulas included one or more perfumes or deodorant materials.

Powders were composed of a great variety of substances, usually insoluble and often abrasive or astringent in character. In the 19th century insoluble powders were considered objectionable because they tended "to accumulate in the space formed by the fold of the gum and the neck of the tooth, and thus present a colored circle." To hide this, many tooth powders were colored red with bole Armenian.

Pastes as made then were of the same fundamental composition as powders but altered by the addition of a gum or a "pasty" substance, or often by addition of a liquid such as honey, and were unstable. It was not until early in the 20th century that the modern stable tooth paste or dental cream, of very much more complex constitution, was produced.

Mouth washes were sometimes of very simple nature, such as wine, asses' milk, etc., but more frequently were composed of very many substances and thus recall the "shotgun" remedies of the early ages. The active ingredients appear to be without exception acidic or astringent. These preparations were often claimed to be effective in "strengthening" the teeth and were, therefore, probably also used in the treatment of diseases of the gums.

Throughout the Middle Ages these various forms of dentifrices changed but little, and their ingredients were usually of indefinite composition and often of doubtful efficacy, or injurious. A partial list of ingredients is as follows:

Magistry of Pearls, Dragon's Blood, mastik, myrrh, pineapple, flowers of pomegranates, spring-water, gum of guaiac, Peruvian balsam, aqua vulneraria, cinnamon water, spirit of cochlearia, powdered crab's eyes, orris root, cuttlefish bone, burnt roots of birthwort, white salts, honey,

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<sup>1</sup> Library, E. R. Squibb & Sons, Brooklyn, N. Y.

burnt land snails, unwashed wool burnt with salt, sal ammoniac, costus, pellitory, pepper, emery, talcum, pumice, alabaster stone, coral powder, burnt purple shell or ashes of the murex, burnt trumpet wheels, pennyroyal, sage seed, Saint John's bread, gall-nuts, ashes and powder of stag's horn, ashes of the heel of an ox, and of the feet of a goat, goat's milk, burnt eggshells, salt, powdered skin of the radish, asses' milk, alum, cedria, burnt figs, burnt gypsum, verdigris, vinegar wine, meerscham, nitre, burnt orris root, aristolochia and reeds, moschata, cubeb, juniper seeds, root of cyperus, rosemary leaves, cream of tartar, armenian bole.

During the 18th and 19th centuries a greater variety of definite chemical compounds were incorporated in these forms of dentifrices. Also, in 1868, there appeared a "new and improved form of tooth powder," the tooth tablet. This was supplied in the form of a cake from which one tablet at a time, sufficient for one brushing, could be broken. Tooth soaps, made by adding about one-third by volume of powdered soap to an ordinary tooth powder, had their vogue toward the end of the 19th century. At this time, as a result of the search for a means of preventing dental decay and bad breath, the trend toward dentifrices and mouth washes having antiseptic properties developed.

It is our purpose in the following, so far as is possible, to classify early dentifrice ingredients according to their mode of action, and to show how the members of those classes varied from antiquity up to the end of the 19th century.

The use of abrasives is as old as dentifrices themselves. Chemically, abrasives have consisted usually of phosphates, carbonates, silicates and carbon but the form and sources of these compounds have varied greatly.

Ashes obtained by calcining bones or portions of animals were much used for several centuries. One of the favorites was the ash obtained by burning the head of a hare, mentioned alike by Hippocrates, Pliny and others. At times this was combined with the ashes of mice and substituted by the ashes of the heel bone of an ox, the teeth of a dog, stag's horn, etc. Ashes from such sources doubtless consisted chiefly of tricalcium phosphate, to-day considered too highly abrasive for use.

Probably the most effective abrasive substance, which appears to have been used but little, was the "very white glass, similar to crystal, powdered and mixed with spikenard," which Scribonius Largus, physician to Emperor Claudius, recommended. Pumice was likewise a constituent of the 14th-century powders of Gaddesden and of de Chauillac mentioned above. It was condemned as harmful by Berdmore in 1769 and by James in 1814, but it appeared as a constituent of a dentifrice marketed in this country as late as 1879, which was moreover claimed harmless by its maker. Ashes of vegetable products, mentioned below, would be like glass and pumice, of silicious character.

Vegetable substances that were "burnt" were used as abrasives in ancient times. Galen (131 A. D.) advised that teeth be rubbed with dried figs burnt and pounded with spikenard and honey. Charcoal or ashes of other vegetable products such as wood, tobacco, cigars, bread, etc., were frequently used during the 19th century and carbon or soot in admixture with salt and snuff was much used. Charcoal from such sources was usually thought harmful, but a dentifrice consisting of it and quinine (2:1) appeared in the French Pharmacopœia of 1866. Because of its chemical identity it is pertinent to note in this connection that Aristotle considered the diamond dangerous to keep in the mouth as it would inevitably crack the teeth. It is doubtful if he referred to this as a mode of cleaning the teeth.

Calcium carbonate in its several forms has been continuously used as a dentifrice from very early times, on account of its mild abrasive action and its value as an antacid. Hippocrates (430-377 B. C.) discusses the use of powdered marble or white stone; Pliny, burnt eggshells; de Chauillac (1368 A. D.), powdered sea shells.

Powdered cuttlefish bone, which consists chiefly of calcium carbonate, was an ingredient of a powder recommended by Gaddesden of Oxford, in the 14th century, by Guy de Chauillac (1300-1368), by Anton Nuck (1650-1692) and later by Ruspini in 1750. The French Pharmacopœia

in 1850 contained a dentifrice recommended by Canton containing cuttlefish bone and Sir Edwin Saunders, Court dentist to Queen Victoria in 1851, also recommended one containing it. Powders for general use, used in London in 1872, contained cuttlefish bone and small amounts of it may still be constituents of them to-day.

Seventeenth-century dentifrices often contained powdered red coral, as did the dentifrice included in the French Pharmacopœia of 1850.

Thereafter chalk was usually substituted and was frequently used alone. It was recommended by John Greenwood, dentist to George Washington, who wrote him as follows: "If your teeth grow black, take some chalk or a pine or cedar stick; it will rub off." In Philadelphia in 1784, when tooth brushes were not known, people rubbed their teeth with a chalk rag. In 1842 the English used a dentifrice consisting mostly of white chalk and the largest constituent of Dr. Bridge's tooth powder used in 1854 in Brooklyn was prepared chalk. Equal proportions of prepared chalk and orris root made a good dentifrice (1854). Chalk was the main constituent of Dr. Chapin Harris' dentifrice (1850), Sir Edwin Saunders', Dr. Brown's (1867) and several powders used in London in 1872. Further references to this ingredient are unnecessary—it is the most extensively used abrasive in present-day dentifrices.

Salt was used by the Chinese, the Greeks and the Romans in dentifrices, and was mentioned by Paul of Ægina. Later Avicenna (980–1037 A. D.), Guy de Chauliac and Giovanni of Arcole included salt in their dentifrices. Table salt along with other saline substances was considered undesirable in dentifrices in 1814 and again in 1847. In 1902, however, Greve gave two formulas for dentifrices, each of which contained 70 parts of a saturated solution of sodium chloride and today sodium chloride is still recommended by some for regular use.

Toward the end of the 18th century, orris root was used extensively. Ruspini mentions it in 1750. It continued to be a constituent of dentifrices through the 19th century and was present in Dr. Bridge's tooth powder (1854), Dr. Chapin Harris' dentifrice used in Baltimore in 1850, Sir Edwin Saunders' powder and Dr. Brown's powder (1867). As late as 1898, Dr. Willoughby D. Miller, an American dentist who practiced in Germany, recommended a tooth powder containing pulverized root of orris. It does not now appear to be extensively used, but appears in some formulas.

Reviewing briefly the tendencies of change in this field, it will be seen that in ancient times very abrasive substances were used—such as silicates, tricalcium phosphates, etc., and that their dangers were likewise very early recognized.

During the 11th century, Avicenna (980–1037 A. D.) in his book "The Canon" said that hard tooth powders injured the dental substance and must be avoided. In 1769, Berdmore warned that dentifrices that whitened the teeth by mechanical grinding were always composed of pumice, emery or some other cutting powder and were extremely pernicious, as they destroyed the enamel. However, when theories about the teeth changed, advice about the use of abrasives changed. In 1782 when many believed that the enamel of the teeth could be regenerated and it was of no consequence that it be worn away by the use of abrasives, a renowned surgeon, Theden, recommended the use of them.

After the excessive use of abrasives in dentifrices during the first part of the 19th century, they were condemned strongly toward the end as being the cause of decay and irritation. This was probably due to some extent to the work of James, who in 1814 experimented with abrasives by placing teeth in a vice and rubbing them with powders containing coral, pumice, emery, etc. He found that one hour's application of them with a brush removed the enamel from the tooth. He stated his results thus:

"From this fact we may ascertain pretty nearly the time required for the destruction of enamel under the daily use of powder. Suppose such dentifrice be used for 10 seconds each day; by this calculation, we see it requires but one year's perseverance in its use to ruin the teeth."

Bell considered that frequently the cause of dental decay was the abrasion of the enamel produced by coarse, gritty materials in tooth powders. Burchardt (1898) also discussed the irritant effects of abrasives such as charcoal and pumice and recommended the use of precipitated chalk or of magnesium carbonate or hydrate.

Because the original purpose of dentifrices was to beautify, there were, among the earliest used preparations, many for the whitening of teeth by chemical means. Some of these were of unknown and indefinite composition, as for example, the excrement of the bat used by the Chinese

in a powder. The Emperor Huang-Ti, called the founder of Chinese medicine, who lived from 2698–2598 B. C., described two powders for whitening teeth, both of which contained musk.

The majority of whitening agents used have been acid in character. One of the most harmless used in early times was vinegar—mentioned by Hippocrates (460–377 B. C.) and subsequently by others. From Strabo we learn that the Cantabri and other peoples of Spain used to clean their teeth with old urine which was kept for the purpose in suitable cisterns.

To Lazare Riviere (1589–1655), professor at the University of Montpellier, goes the doubtful credit of first suggesting sulphuric acid for this purpose. "If the teeth be very dirty, sulphuric acid might be used pure, otherwise one mixed it with mel rosatum or with water." The present-day whitening agents which consist of mineral acids such as hydrochloric, cannot, therefore, be considered original or unique.

After such treatment it is not strange that toward the end of the 18th century acids fell into disrepute as ingredients of dentifrices. Among the critics were Thomas Berdmore (1769), dentist to George III, and James of Boston (1814), both of whom stated in no uncertain terms that whitening dentifrices, without exception, owed their action to the presence of acid by virtue of which they destroyed as well as cleaned the enamel.

Tartaric acid, first mentioned as an ingredient of dentifrices by Nuck (1650–1692) was later replaced by Ruspini (1750) by the less acidic potassium bitartrate, cream of tartar. This was an ingredient of a dentifrice included in the French Pharmacopœia of 1850, and was present with an equal weight of powdered lactose in the acid dentifrice given in the same pharmacopœia of 1866. With respect to the earlier formula, the statement appears that this salt may ultimately injure the enamel.

Although it was well recognized that its continued use would injure the teeth, chloride of lime appeared in dentifrices of this period and was recommended, in a mixture with 2 parts of powdered red coral, for brushing yellow teeth. It was considered to have disinfectant and deodorizing properties.

Toward the end of the 19th century, phenol was recommended by Frey as an ingredient of a dentifrice. Benzoic acid was recommended by Miller in a dentifrice in 1898, tannic and benzoic acids and boro-benzoic acid by Greve in 1902.

Ancient dentifrices, particularly washes, contained astringent substances and these were also sometimes included in powders. Alum was one of the earliest used of such substances and was mentioned by Paul of Ægina (625–290 A. D.), by Scribonium Largus who recommended it rubbed on the teeth three times a month and by Rhazes (850–923) as a constituent of a cement to stop tooth decay. It continued to be an ingredient of many dentifrices until late in the 19th century. Myrrh was used for the same purpose during ancient times and in the middle ages. Other astringents such as camphor, tincture of rhatany and quinine sulphate came into use in the 19th century. The last two still appear in formulas.

Calcium carbonate as chalk was first used for its abrasive action but by the middle of the 19th century its value as a neutralizer of mouth acids was recognized. For this purpose it was sometimes allowed to remain on the teeth over night.

Blondeau, a pharmacist, is given the credit for introducing alkaline salts in dentifrices before 1836. A dentifrice of magnesium subcarbonate in combination with cocoa butter appeared in France in 1847, and preparations containing magnesia and magnesium carbonate, shortly after. A suspension of magnesium hydroxide was recommended as an antacid in 1898.

Another alkaline salt recommended at this time was sodium bicarbonate which is also to some extent still in use in antacid dentifrices.

Soap came into use in the 19th century and has since been an important ingredient of creams and the subject of much controversy regarding its effects on the gums.

It must be recognized that the application of dentifrices at the present time is far different than in previous centuries. Although the relationship of cleanliness to tooth preservation was early recognized and Giovanni in 1484 recommended cleaning of the teeth after every meal, this practice was certainly not general. Dental education among laymen and the general advance of hygienic knowledge has resulted in a great increase in care of teeth which are now brushed daily or

oftener by a large proportion of the population. The heroic treatment given by many of the older dentifrices was possible only because they were applied at infrequent intervals. Along with the change in frequency and mode of application have developed the modern dental creams and powders, better adapted by physical form and the character of their substituents to produce and maintain dental hygiene without injurious effects on the teeth or gums. These, it is true, contain in some instances the very abrasive and acid substances mentioned above but usually only when the product is to be used in certain special conditions and with the advice of a dentist.

During the first third of the 20th century the relative importance of the various types of dentifrices has undergone considerable change. Liquids or solutions have been sharply differentiated into those intended to whiten the teeth and into the antiseptic mouth washes. The first class, as always, was uniformly acid. Investigations have shown that many of these contain the mineral acids, hydrochloric and sulphuric, and are distinctly harmful to the teeth. Somewhat less objectionable are those which contain the organic or so-called fruit acids.

Mouth washes containing various antiseptic ingredients have been extensively advertised and sold but it is now recognized that only extremely active disinfectants can be expected to have any action on the mouth bacteria under the conditions of use. These preparations, however, continue popular for the purpose of improving the breath and removing that bad taste.

The modern toothpaste or cream, welcomed on account of its convenience, palatability and stability, rapidly became a best seller. The first preparations of this type contained the more severe abrasives recommended at the time, such as tricalcium phosphate. Other abrasives which have been considered are magnesium phosphates, calcium fluoride, barium sulphate, silica, calcium and magnesium sulphates, etc. These and many others have been investigated and the majority abandoned for various reasons. Experience has shown the consumer that extremely abrasive creams are not suitable for continued use. Generally chalk or precipitated calcium carbonate has satisfactory cleansing action without injurious effects on the enamel, and it is therefore to-day the polishing agent most frequently present in pastes intended for general use, as opposed to the abrasive creams intended for prescription use.

A good polishing agent, but chiefly valuable as an antacid, magnesium hydroxide or milk of magnesia first appeared as an ingredient of pastes in products sold locally in Detroit and San Francisco and soon thereafter in a nationally advertised cream. The insolubility of this base gives to creams containing it the ability to neutralize mouth acidity without conferring on them the high alkalinity of the earlier alkaline creams. Magnesia dental creams now comprise a most popular type of dentifrice.

The scope of this paper does not permit the discussion of numerous ingredients in addition to those necessary for stability, used in creams. Attempts have been made to render these antiseptic by the addition of strong oxidizing agents, such as peroxides or other compounds inherently bactericidal. Recalling the use of chlorinated lime in the past, potassium chlorate was at one time an ingredient of a popular toothpaste. In 1931 Chilson still considered it a common ingredient of pastes. Disinfectants are now, however, infrequently added to pastes, except for the pur-

pose of stabilizing the paste, it having been recognized that they, like washes, can hardly be effective in the manner applied.

The tooth soaps common during the latter part of the 19th century declined in importance with the rise of the toothpastes and are now little in evidence. In spite of the extended controversy over its dangers and advantages, soap, however, has continued an important ingredient of dentifrices. Powders, so important during past centuries, became much less so after the development of pastes. It has been said that recently, especially during the last year, the sales of pastes have declined in favor of powders. According to a survey made by *American Perfumer*, however, sales of pastes still greatly predominate; the sales of powders in 1934 representing only about 8% of the total.

Modern dentifrices, in whatever physical form, are quite complex as compared to those of the 18th and 19th centuries, and indeed at times approach the complexity of those of the ancients. In contrast to them, the individual constituents of present dentifrices, particularly of creams, are as a rule necessary to the stability of the preparations.

The authors are indebted for the above facts to the books listed in the bibliography and to many others which contained no additional information.

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### CALIFORNIA FAIR TRADE ACT.\*

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The anti-trust law of California, passed in 1907, is popularly known as the Cartwright Act. In the act a trust is defined to include a combination to increase the price or prevent competition in the sale of merchandise or to fix any standard or figure, whereby its price to the public or consumer shall be controlled. (Stats. 1907, page 984, ch. 530.) Such a trust is forbidden and very severe penalties are prescribed.

Statistics are not readily available to show what attempts were made to enforce the California anti-trust law in the two years following its enactment, but it is doubtful whether it was ever sternly enforced in all its rigor.

In its original form the California anti-trust law absolutely forbade any kind of a price setting agreement. It was clearly based upon the economic theory that the general welfare would be promoted by free and unlimited competition. It was enacted at a time when it was believed that an industrial system saturated with competition would automatically result in well-equipped factories, an efficient system of distributing the manufactured products and room for an unlimited number of small retail outlets with an ever-increasing rate of turnover. The law of supply and demand was considered adequate to adjust prices. *Laissez-faire* was the slogan.

In some magical way the energetic California competition was to make it possible for all the retail outlets, the numerous small drug stores as well as the large ones, to have customers who had the purchasing power to maintain indefinitely a high rate of turnover with a healthy mark-up. Now these California customers were mainly people with pay envelopes, salary checks or those receiving incomes

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