

thus have debased his child in himself. The results of an excessive venery may have been transmitted. A mother, from lack of nourishing material, may have degenerated her offspring. These causes of transmitted ills, the appreciable ones, are many: all must recognize them.

Improper diet to the developing child, as has been suggested, is plainly enough a cause of bad teeth. The state of health of such a developing child has its influence; indeed, so marked is this, that by an observation of teeth belonging to the various periods of life, one can easily trace constitutional variations; for just as at different periods the functions of organic life were healthily or unhealthily performed, so we find the disturbances written in the character of teeth belonging to the period. More expressive even than this is the fact that the deciduous teeth mark, in the progress of their development, the health of the mother.

That the teeth, in their formative state, partake of the healthy or unhealthy condition of the system at large, all observers admit. But here, unfortunately, the matter has been left, most practitioners acting on the premise that such impressions are never to be altered. At such a conclusion it is impossible not to express surprise. Who, in his own person or in the persons of friends, has not remarked the varying conditions of the health of the teeth? Up to the age of sixteen the writer was a martyr to toothache; yet about that period a change occurred, since which time he has had no trouble. Is it suggested that the teeth may have been filled? True, they have been; but certain of the fillings came out years ago, and have never been replaced, yet the teeth are quite as good as those in which the operations remain.

Similar instances exist in profusion, and yet the lesson seems unheeded. There is a constitutional treatment for the carious tooth, as there is for the carious maxilla, and from a common stand-point are the diseases of both to be viewed. It is not, of course, every case of a carious bone that demands systemic treatment, neither is it so with the teeth; the source of offence in the one, as in the other, may be strictly local in character; but ill success must ever attend that practitioner who has not the inclination to look for meaning of a lesion outside of things strictly local in signification.

Résumé.—Integrity of the teeth depends on two general conditions: inherent vital resistive power, and the absence of irritating influences. A tooth may, in its vital relations, be just strong enough to resist external forces brought to bear against it, if in its construction there be no mechanical imperfection. It may, even with imperfections, be able to resist temporary injurious impressions. The vitality of a tooth can be elevated as the vitality of a lung is increased. The study of the vitality of a tooth, and the study of its adverse influences, is the study of vitality and the expression of irritation anywhere. The treatment of dental caries is both medicinal and operative.

CHAPTER IX.

SURGICAL CONSIDERATION OF DENTAL CARIES.

CARIES of a tooth differs surgically from caries of bone proper in the fact of a too common inability to repair by any effort of nature the injury done through the destructive influences of the disease. Not but what such repair is attempted, and indeed oftentimes successfully accomplished, as witnessed in tubular consolidation, where power sufficient exists to perfect the attempt,—seen in the process generally spoken of as vitrification or eburnification, a mode of natural cure and resistance which no mechanical operation, however successfully performed, can equal. This process of secondary calcification, or eburnification, exhibits fully the circulatory relations associated with dental caries, for not otherwise than as such expression is it possible to explain the phenomena: it is, in every particular, a modified repetition of the ordinary lymph exudation and circumvallation seen in abscess, either of bone or soft parts.

A tooth attacked in any part by caries expresses the stages and steps of the inflammatory process, inasmuch as at the first attack of the disturbing agent immediate alteration occurs in the circulation or nutrition of the part, the tubules being filled up and solidified, or such attempt inaugurated, by deposit of adventitious matter. Disease being thus resisted and retarded, it conquers only when stronger than the vital force which combats it.

Such phenomena express to an observing mind the principles of the treatment of dental caries, *i.e.* to relieve the part from the agent of offence, and to strengthen the resistive ability.

Passing from the first of these principles, which has been considered on preceding pages with perhaps quite sufficient fulness, we proceed to the discussion of the second.

A tooth attacked at a given point by irritating agencies will, step by step, break and give way before the irritant; or, otherwise, will resist and antagonize. Resistance implies assistance, which assistance may be either of nature, of art, or of both. Whatever shall tend so to consolidate or protect the parietes of a cavity as to render the parts impervious and insusceptible to external agents, will save the tooth. Such result is aimed to be secured through the removal of dead and dying dentine from a cavity, and provocation to tubular consolidation through the introduction of an agent exciting to the vascular system of the tooth; the chloride of zinc being among the best of such agents, and most conveniently employed in the preparation known as oxychloride. (See

Dental Therapeutics.) Zinc so introduced into a tooth will not infrequently be found followed by such inflammatory consolidation that parietes from being soft and of loose structure are seen to become solid and dense to an extent that makes them entirely self-protecting; they have become glass-like in hardness: this occurs, however, only where the vital force is able to respond to the excitation. The practitioner, aware of this fact, directs a medication to the assistance of an asthenic system laboring under advancing dental caries, precisely as, under similar circumstances, he endeavors to assist nature in the arrest of caries of bone. In the one case as in the other, thus only may he expect to get a cure. Such principle of treatment is so in accordance with the exhibitions of nature's expression, that no medically educated experience may doubt the indications.

The cure of caries by filing finds its explanation precisely as expressed in the employment of the zinc. The file cutting away the weak point, and exciting, through the exposure of the dentine, vascular response, structural consolidation results, and thus external or offending agents are shut out, precisely on the same principle as a ball may become encysted in a bone and remain for years innocuous.

Gold or other ordinary agents employed in filling act to an extent in the same way: these, however, being commonly non-irritating, or non-exciting, are not apt to be found associated with the same extent of change; in all reasonably vital teeth, however, are to be seen such attempts at resistance. A filling of metal represents, and, to a degree, stands in place of, tubular or structural consolidation.

FIG. 72.



Fig. 72 represents a section of carious tooth from life, exhibiting structural consolidation as shown in the black boundaries of the cavity. In this particular case, although the hole—being in a lower molar—was large enough to contain a pea, caries was held completely in abeyance, and had been so for years. The parietes of the part were as hard as flint.

In the local treatment of dental caries, three indications exist:

1. Neutralization of adverse oral fluids and the induction of a state of general health in the mouth.
2. Medical treatment of the tooth.
3. Mechanical treatment of the cavity.

1. The normal condition of the oral fluids is neutral. A healthy saliva, in which practically is included the secretion of the mucous glands, as well as that brought into the mouth by the ducti salivarii, is an inodorous, tasteless, slightly viscid fluid, bland, uniritating, subject to changes as influenced by physiological impressions, affording at times an alkaline reaction, again being temporarily acid, sometimes sweet, and often, under the impressions of dry bodies, mucilaginous to a marked extent, owing this last characteristic to

excess of mucus, a substance almost analogous to vegetable mucilage, having as a chief constituent an albuminoid compound, with the office of preserving the membranes moist and in a condition fitted to the performance of their functions.*

* Messrs. Griffith and Henfrey, the able editors of the "Micrographic Dictionary," state, when speaking of the oral cavity: "The mucous liquid of the mouth contains, in addition to detached epithelial cells, very transparent corpuscles about 1-2000 to 1-1500" in diameter, consisting of a delicate cell-wall, a nucleus, with a number of minute moving molecules. We have figured these among the TEST OBJECTS. (Plate I, Fig. 5.) They are called mucous or salivary corpuscles. Kölliker regards them as a form of exudation corpuscles; and this view is probably correct, for they may occur in the secretion of any mucous surface and have no special connection with the salivary glands; we have found them in myriads in the urine."

Dr. Joseph G. Richardson, of this city, Professor of Pathological Anatomy in the University of Pennsylvania, claims, however, to be the first to demonstrate their true nature and origin, viz., that they are simply "migrating" white blood-corpuscles, which have become distended by the endosmosis of a fluid less dense than the liquor sanguinis. He remarks, "From my experiments as detailed in the same article, page 253, and briefly described on page 157 of this chapter, I conclude that 'tracing now the white blood-corpuscle from its condition of irregular outline and amoebiform movement, as observed in serum and in heavy urine, when the circumambient fluid approaches the density of 1028, through its rounded form, with slightly more distinct nuclei, in the liquor puris and in urine of lower specific gravity, we find that immersed in a rarer liquid approximating to the mean density of the saliva (1005), it has an accurately spherical outline, is more than twice the magnitude, and contains a number of minute actively-moving molecules, thus exactly resembling in all sensible characters the true salivary corpuscles; and it therefore seems reasonably certain that the blood, under the appointed nervous influence, congesting the buccal mucous membrane and associated glands, moves slowly enough through their capillaries to allow some of its white globules to penetrate the walls of the vessels, as they do those of the frog's mesentery in Cohnheim's experiment (*Virchow's Archiv*, Band xl. S. 38 *et seq.*), which, under the influence of the rarer saliva expanding them and setting free to move their contained molecules, constitute the bodies so long known to histologists as the corpuscles of the salivary fluid.'" (*Vide Handbook of Medical Microscopy*, p. 165.) The demonstration by Dr. Richardson is as follows: "Placing a drop of blood from the tip of my finger," says Dr. R., "upon a growing slide" (see *Pennsylvania Hospital Reports*, 1869), "I covered it with a thin glass and placed it upon the stage of the microscope. After finding a white blood-corpuscle showing well-marked granules, I raised the objective and arranged a fine filament of thread from the reservoir filled with fresh water to the upper edge of the cover, and a fragment of wet paper to the lower, according to the usual method for securing a constant current beneath the thin glass. On depressing the body of the instrument and bringing the corpuscle again into view, I found it still adhering to the surface of the cover, notwithstanding the torrent of red globules hurrying over the field; and as these became paler and less distinct by reason of the diminished density of the serum, the white cell first gradually expanded and displayed its delicate wall with two rounded nuclei, then, after acquiring the magnitude of about $\frac{1}{1700}$ th of an inch, it exhibited the rapid and incessant movement of its contained molecules, and, finally, when its diameter reached about the $\frac{1}{1400}$ th of an inch, it burst suddenly, discharging a portion of its contents, whose outbreak resembled that of a swarm of bees from a hive, and some particles of which, actively revolving as they went, swam off to the confines of the field. On repeating the observation and allowing some aniline solution to flow in with the water after the first few moments, the nuclei were strongly stained and beautifully distinct, although the movements of the molecules promptly ceased,—in this respect, as in all the others, showing a precise identity with the reactions afforded by the pus and the salivary corpuscles, as above

Analysis of the fluids bathing the teeth is to precede operations upon these organs. As acidity or alkalinity is concerned, such analysis is most easily made—demanding but a few days—by furnishing the patient with two strips of test-paper,—litmus, as it is called; paper colored with the dye of the plant *Lichen roccella*,—one piece being blue, as found in the shops; the other made red by subjecting it to the action of a weak acid, or for this latter purpose turmeric paper may be used. Having these pieces of test-paper, the patient is to wet them with salivary fluid, slip after slip, at varying periods of the twenty-four hours, particularly in the morning immediately on rising and before taking anything into the mouth. If persistently the result be acid or alkaline, as evidenced by the blue slips being turned red if the first condition exists, or the red slips of litmus being changed to blue, or the yellow of the turmeric to brown, if the action be alkaline, then is primarily indicated the necessity for antagonizing agents as suggested in the prescriptions presented a few pages back.

When sordes are found enveloping the teeth, or where the mucus is glairy, the condition manifested by such secretions is to find correction before any reasonable hope is to be indulged of saving the denture or of making mechanical operations which may have in them any special import of good. (See *Mucoid Saliva*.)

The restoration to a state of health of gums, turgid and congested from any cause, is to precede dental operations. Of such causes of ulitic troubles there are many. These will be found discussed in the chapter on Diseases of the Gums. In a word, attention to local or systemic indications is to precede, or have association with, as judgment may determine, the operative requirements of existing cavities of decay.

The physical history of a tooth to be treated demands consideration. Teeth so vary in character as to suggest their division into four classes.

I. *Teeth of the Sanguine and Allied Temperaments with Similar Hereditary Association.*—These teeth are white, shading into a cream tinge which deepens as it approaches the gum and as age advances: the organs are uniform in dimensions and arrangement, are dense, and have a periodontium of the most resisting character,—the associated alveolar process being condensed to a corticle-like extent; their relation with the jaw is so unyielding as not infrequently to suggest union of the parts. Such teeth, as justly remarked by Harris, indicate, “if not perfect health, at least a state which bordered very closely on it at the time of their dentinification, and the possession by

described. It should be noted that a certain variable proportion of the white cells of the blood thus treated exhibited no moving molecules, and apparently consisted solely of nucleus and cell-wall.”

Since the above was in type, this doctrine seems to have been corroborated by further experiments of Dr. Richardson, in which salivary globules were again reduced to the size of the white cells of the blood, and their amoeboid movements restored, under the influence of a three-quarter per cent. solution of common salt. (*Vide* paper on the Structure of the White Blood-Corpuscles, Transactions of American Medical Association.)

their proprietors of stomachs always willing to digest whatever the teeth are ready to masticate.”

II. *Teeth having a Blue Shade.*—These, without doubt, are much more common to females than to males. Constitutionally they indicate the lymphatic temperament. They are commonly super-sensitive, having a softness yet tenacity of structure that expresses disproportionate excess in animal matter; observation seems to indorse the conviction that such teeth are associated more or less in a hereditary history with struma. Certain it is, that to preserve them constant watchfulness is necessary, both as a systemic and a local aspect are concerned.

III. *Chalky Teeth.*—Teeth of this class are not infrequently to be met with having so little mechanical resistance as to suggest their relation with plaster of Paris. As such teeth have in themselves no resistive force, an only hope of prolonging their existence lies in the antagonizing of agents injurious to them. Thus arises a necessity for that care on the part of a person so afflicted, which is to keep him informed continuously of the state of the oral fluids, or if such care be not consistent with the character of the individual, then are antacid agents to be kept in constant use.

IV. *Pearly Teeth—Teeth frequently found allied with the Tuberculous Predisposition.*—Teeth of this class are commonly of great symmetry, being in harmony with the delicate conformation of the individual, and akin with the organization which has produced them. The inherent force of such organs is much in proportion with that of the common body. A treatment which tends to preserve them is that which increases the physical integrity of the individual at large. The author is not aware of a tendency to any peculiar local disease in them. The fluids of such mouths are commonly neutral.

Teeth of the first and fourth classes seldom have indications of any required direct preparatory treatment. Teeth of the third class may only have immediate adverse associations antagonized. Teeth of the second class, however,—and these constitute four-fifths of all diseased teeth,—are benefited by direct local medication to a degree that is oftentimes found to be their salvation. (See chapter on *Dental Therapeutics*.)

A soft moist dentine indicates non-resistance on the part of the immediate vital force (residing in the organ) to the advancing disease. There is here little or no antagonizing structural consolidation. Can this be remedied? Without doubt, in perhaps the majority of cases; such remedy residing in stimulation of the dental pulp, and in affording to it a power of response. To secure such response implies combination with the local of general stimulation. As the first is concerned, it has been implied that no agent surpasses the aqueous solution of chloride of zinc as used combined with osteo-dentine.

A soft, non-resisting tooth, in which such a temporary plug has been used, will not infrequently in the course of a few months be found so hard that an ordinary excavator shall scarcely be able to make an impression on the dentine; indeed, in many cases, so thorough has been the calcification that no

other treatment is found necessary; the caries has been cured, the dentine vitrified.*

In the employment, however, of such stimulation, it is to be inferred that the nicest exercise of judgment is demanded. Quite as many teeth are destroyed by chloride of zinc fillings as are saved; perhaps the preponderance is to the first side; but this is the fault of a practice which overstimulates, provoking inflammation and suppuration where gentle excitation to a hyper-nutrition is alone demanded. A good rule to adopt is to feel one's way, recognizing always that the extent of local stimulation is to be commensurate with the ability of the pulp to respond; the object aimed at being to re-excite the formative capacity of the pulp, and thus oppose advancing disease by securing a calciferous barrier.

Secondary indications to be met preparatory to filling a carious tooth exist in a necessity for the destruction of any fungi that may be found in the cavity, the immediate antagonism of the carbonic or other acids, or any alkali temporarily present, and the saturation of the part with an antiseptic,—warm alcohol being about the best preparation that may be used for the last purpose. By saturation is meant that the dentine be bathed in this fluid after the preparation of the part and immediately before the introduction of the filling. A person undergoing the process of having teeth filled should freely use as a rinse alcohol and water, combined in the proportion of one part of the first to four of the second. Or, where the refrigerating influences of the spirit are found irritating to the cavity, it may be replaced by the permanganate of potassa, one grain to the ounce of water. Creasote is also justly lauded as an application to be made to the walls of a cavity just before the introduction of the filling. If the odor of this medicament be objectionable, it may be replaced with a weak solution of chloride of zinc.

Separation as a prophylactic and curative agent.

Having in a chapter on operative dentistry referred to the use of the file from the mechanical stand-point, we have here to consider the instrument as a prophylactic and curative means.

In the process of preparing approximal cavities for filling, it is seen that in very many cases—indeed, in a majority—the dentine of teeth has been exposed, and that afterward no steps have been taken for its protection. This absence of care arises out of the experience that such dentine left to itself does not tend to decay, but that when the operation of filling has been accomplished with judgment and the proper delicacy, the tooth seems in quite as resistive a condition as before being denuded.

Acting on the premises of such experience, it is to be commended not only

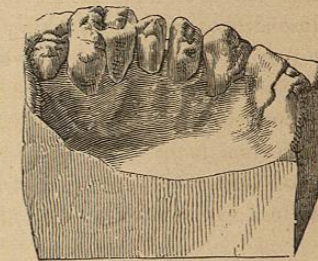
* Vitrification, vitrified. The use of a term signifying glass—glass-like—would in such a case seem quite as permissible as its application to one of the humors of the eye, the condition being one of glass-like hardness and smoothness. Eburnification, or conversion into a substance resembling ivory, is another term used to express the same condition.

that conditions of incipient caries be filed away, but also that in irregular dentures the irregularities which invite disease be treated—in prophylaxis—in like manner. Of all the various operations performed upon the teeth, none, certainly, demands more experience than the one now being considered; or if experience is to be replaced, it may only be by a judgment which possesses the fullest recognition of the requirements.

It is to be borne in mind as a cardinal principle that, in prophylaxis, dentine is never to be uncovered except the surface exposed can be made self-cleansing; hence it is at once seen that certain positions of decay preclude this treatment; cavities, for example, occupying sulci upon the grinding faces of teeth.

A second principle, which is to possess its weight with the operator, lies in the premise that separation is not to be practised upon teeth the conformation and relation of which deny continuance of the position in which the operation leaves them. This second might be considered but an iteration of the first premise if it were not so well known that filed teeth, unless wedged, tend to change position. Hence the judicious use of a file or disk considers not only a present, but a future. In Fig. 73 an illustration is given of what is meant. Observing the bicuspid and approximating teeth in this diagram, it is seen that

FIG. 73.



between the first and the second bicuspids the file has been passed directly through to the gum, the space being the same behind as in front, and at the necks as at the cutting edges; this is, as seen, a free and open space. Referring now to the molar-bicuspid relation, it is shown that these teeth, which have been filed in a precisely similar manner, have fallen together, and so fallen as

clearly to exhibit the impossibility of keeping them cleansed unless by a care that very few persons are found to give to the organs. Teeth so filed are cut only to their injury, unless, indeed, it may be that, by the act of cutting, such response is excited from the pulp as to eventuate in a resistive consolidation of the structure,—a result that it would scarcely be wise to anticipate, being certainly possible, but scarcely probable.

Eburnification, or vitrification, the process by which exposed and irritated dentine becomes self-protective, has been described on a preceding page. An operator, before resting anticipations of the cure of superficial caries on the file, is to appreciate well the responsive efforts with which the manipulations are likely to meet.

Teeth of soft character are perhaps never found so tolerant of the file as are those of more solid structure, and when cut not infrequently give way as by a process of invisible ulceration, just, indeed, as caries in bone, while so commonly cured through the relief afforded from operative means, will be