

## ANALYSIS OF DENTINE.—

Phosphate of lime.....	62.
Fluorate of lime.....	2.
Carbonate of lime.....	5.5
Phosphate of magnesia.....	1.
Soda and muriate of soda.....	1.5
Gelatin and water.....	28.

Attention is to be directed to the variable density of the teeth; consequently any individual analysis can only be an approximate.

## ANALYSIS OF ENAMEL.—

Phosphate of lime.....	85.3
Fluorate of lime.....	4.
Carbonate of lime.....	7.
Phosphate of magnesia.....	1.5
Soda and muriate of soda.....	1.
Animal matter and water.....	2.

ANALYSIS OF CEMENTUM.—The near approach of cementum to bone affords large proportions of organic matter,—twenty to thirty parts to the one hundred. A quantitative analysis of a given specimen yielded as follows:

Phosphate of lime and fluoride of calcium.....	58.73
Carbonate of lime.....	7.22
Phosphate of magnesia.....	0.99
Salts.....	0.82
Cartilage.....	31.31
Fat.....	0.93

## CHAPTER V.

## DENTITION.

By dentition is meant the development of teeth. Teeth, together with the alveolar process, develop upon the bone proper of the jaws.

In the earliest days of foetal existence the jaws are planes of cartilage. These planes are overlaid by mucous membrane. Between the cartilage and the membrane the papillæ known as dental germs are first met with.

The period at which dental germs are earliest seen is about the sixth week of intra-uterine life. At this period, a little sooner or later, such germs are to be exposed by lifting the mucous covering from the basement cartilage. At all subsequent periods previous to eruption section through the overlying parts exhibits their presence.

The alveolar process, with its many pits, is simply an osseo-spongy tissue, serving as a common envelope to the growing tooth-germs. In its origin it constitutes the primitive dental groove. This groove is never, however, a ditch, or depression, except as such an idea is conveyed by the pits and depth of an adult jaw. Neither are alveolar process and body of bone one except as regard is had to relationship. Alveolar process is a provision associated with teeth; as dental germs develop so does it; when the teeth are lost so also does it disappear. Alveolar tissue grows around papillæ; the dental pits signify obstruction. The papillæ are not first met with in a groove.

A dental germ is made up of a congeries of granular nuclei dispersed irregularly through a firm homogeneous blastema. It is not enclosed in a cell-wall, or membrane of its own; it is a hyaloid structure.

A developing germ carries with it the overlying mucous membrane; the membrane hugging it closely. This covering, or envelope, constitutes a tunic; it is to be denominated coat first, or tunica propria. The relationship of this covering to a papilla is precisely that of parietal peritoneum to a knuckle of intestine in incarcerated or strangulated hernia. The shape of this coat is that of the papilla it encasules.

While, after the manner described, a tunic has been secured by the tooth-germ, it is recognized that the common mucous membrane has in no wise altered its relation to surrounding parts; it abuts closely all the circumference of a papilla; it is contracted, like an elastic substance, about its base; it associates from this base with adjoining parts.

Corresponding with the growth of a papilla is that of its alveolar envelope.

As such envelope is of submucous nature, being an organization arising out of cells existing between the mucous membrane and plate of jaw, among which cells the germ lies, it is to be recognized that as this increases about the germ it necessarily carries around it a second coat, or tunica; tunica reflexa it is not unwarrantable to call it. This now is the dental relation: a germ, originally microscopic, has enlarged until it stands in shape and size the representative of a tooth; this germ is enveloped in a double sac; it is overgrown on all its circumference by tissue which later is to express itself as alveolar process and gum.

At this period the dental pulp, as the papilla is now to be called, having attained the size of the tooth-crown it represents, commences the formation of dentine. Before the attainment to full size by the papilla, there existed between it and its sac proper a halitus. This halitus, now that the congeries of cytoblasts or nucleated granules have obtained their full growth and secretory power, is replaced by a more highly endowed production; the work of matured cells. This secretion constitutes the future dentine. Calcification is progressive with secretion.

As this deposit deepens within the mucous envelope, so the pulp contracts until, finally, it stops at that certain point which maintains within the tooth a canal, or cavity, and a vascular and nervous pulp to occupy it,—this pulp being the contracted original papilla. The vessels of this papilla are analogous to those of the ordinary papillæ of touch.

Why this secretion, in its organization, should assume the position of the elongated tubular cells which pertain to the structure of dentine, is not here to be discussed, and it is quite enough for our purpose to say that it is a law of form perhaps not to be fully comprehended, apprehension of which would, at any rate, have but little clinical signification.

The formation of dentine completed, the covering of it with enamel begins; or rather this deposit is, to a degree, coincident with the dentinal formation. Secreted by the same pulp which forms the dentine, the same secretion, some portion finds its way into and through the primary sac. As it passes through this sac, to be moulded against the second, it is modified by the epithelial surface, which constitutes the outer face of the tunica propria; this sac, as it is understood, being a mucous membrane. Between the enamel, thus formed, and the dentine, exists the primary sac; simply the modified mucous membrane, which we first saw as overlying the papilla. The sac of mucous membrane—tunica propria as it has been termed—continues to exist between these two hard bodies, and receives and modifies, for the support of the enamel, the liquor sanguinis found in the dentinal tubules and intertubular structure. This tunica propria is the enamel membrane. It is from this that we receive impressions of pain when it becomes exposed by a break in the continuity of enamel.

In the process of tooth development, particularly at that stage when the hard structures are being formed, a grade of vascularity is present in the ex-

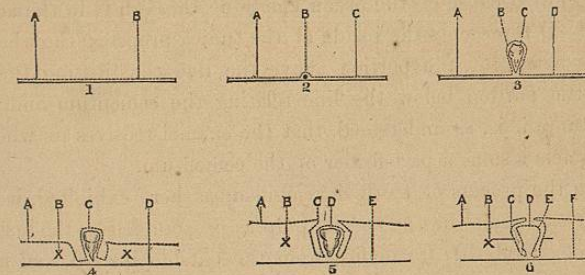
ternal sac which seems quite to have deceived microscopic observers, as these persist in viewing such congested and thickened membrane as the agent which deposits enamel, whereas, in reality, it serves here simply as a mould, and has its permanent office and meaning in the periodontium, which membrane a moment of reflection will show to be the persistent remainder of the tunica after the crown portion has been lost in eruption of the tooth. Enamel is analogous with epithelium. The only place where dentinal secretion comes into relation with, and under the influence of, epithelial correlation, is where it passes through the tunica propria into the moulding interspace existing between this and the tunica reflexa. A tooth at large is not a dermoid structure; the enamel of a tooth is dermoid to the extent and expression that its characteristic is received from, and is impressed by, a mucous membrane as just described.

The growth of a root of a tooth, as its dentine is concerned, has precisely the history of the body. Such growth is associated with pyramidal elongation of the pulp, which, pushing upward the crown, extends upon itself the enamel membrane and tunica reflexa. This elongation, with a greater vascularity and vitality assumed by it as approach is made to the basement vessels, modifies again the result obtained by the exudate passing through it from the dentinal pulp, the result being an approach to true bone in the production of cementum. Analogy is found in nails and epiderm structures of similar signification and origin.

Periodontium, as suggested, is the modified external sac, lost, of course, above the neck, as the tooth has emerged through it.

This is a very simple and easily understood explanation of tooth growth. The observations leading to the conclusions have been somewhat extensive, and the phenomena are certainly endorsed by general anatomical analogy. Let them be objected to, however, as, perhaps, they will be by the physiologist, they are irrefutable as all surgical relations with the teeth are concerned.

FIG. 54.



ILLUSTRATIONS.—The tooth selected is an inferior central incisor. Subfig. 1 shows two lines; A represents mucous membrane overlying B, a plane of cartilage.

Subfig. 2 shows, A, mucous membrane; C, basement cartilage; B illustrates the mucous membrane as it begins to be raised as an envelope—tunica propria—for the tooth-germ seen below it.

Subfig. 3 is diagrammatic of the mucous envelope—tunica propria—as it invests the developed germ, no reference being made in the drawing to the developing alveolar walls.

Subfig. 4 is diagrammatic of the idea of the manner of envelopment of germ by the second tunic,—tunica reflexa. It is understood that  $\times \times$  (B) is the growing alveolar walls, and that as this develops between the base bone and the covering of mucous membrane, it necessarily lifts the latter, but that in lifting it the tunica propria is not disturbed; hence a second tunic, having as its eventual office the meaning of a periodontium,—i.e., a bond of relationship between tooth and alveolus. The cut is to be understood as being purely diagrammatic. A, mucous membrane; B, alveolar process; C, tunica propria; D, base of jaw.

Subfig. 5, also diagrammatic, is designed to afford idea of a tunica reflexa about completed. The relations of the parts in this cut need alone, in order to be exactly as in nature, that the two tunicae be in relation with each other, separated only by an intervening halitus, and that similar relations exist between tunica propria and pulp. A, mucous membrane overlying gum-tissue, which tissue in its turn overlies  $\times$  (B) alveolar process; C, developing tunica reflexa, being part of the original plane of mucous membrane seen in Subfig. 1, and which here has been made to envelop the tooth-germ and its original tunic by reason of the developing alveolus of the germ represented and of the other germs; D, tunica propria, got by the germ, as shown in Figs. 2, 3, and 4; E, base of jaw.

Subfig. 6 shows similar relations as in 5, except that here the tooth-germ is withdrawn from its envelope, and the parts stand exposed, as would be shown by a transverse section. A, original mucous plane; B  $\times$ , alveolar process; C, tunica reflexa, which tunic is eventually to constitute the periodontium; the portion above, or that portion which relates with the tooth-crown being lost because of the organ emerging through it in the act known as cutting;\* D represents the inside of the tunica propria; the whole tunic, as shown, is persistent, the portion above the line constituting the enamel membrane, the portion below the line relating the cementum and dentum. From this tunic it is, as understood, that the enamel receives its whole nourishment; it acts also as a part-feeder of the cementum.

Accepting the process of tooth development as here exhibited, it becomes understood that enamel has no special pulp as propounded by the histologists. It is also understood that it calcifies from the outside inward, and not from

\* The so-called ligamentum dentes is simply the thickened ring of the tunica reflexa, resultant of the remnant of the crown portion of this coat; part is absorbed, part contracts towards the root portion.

the inside outward. It is as well seen that it is a vital tissue nourished exactly as are other parts.

The description illustrates as well the manner and matter of periodontal formation. It exhibits that a correct naming of that tissue would designate it alveolo-dental or alveolo-odontal membrane.

Also it is made plain that the enamel membrane is not strictly dependent on the common pulp for its nutrition. It has another source of supply, namely, that received through the cemental portion of the tunica propria coming in its turn from the osseous-like circulation of the cementum derived from the periodontium,—i.e., the persistent root portion of the tunica reflexa,—from the alveolo-dental membrane, and that gotten from vessels which come to it from apical vessels.

We pass here to a more directly clinical consideration of the subject; to the relation of the first and second dentitions.

The first of the papillae of the deciduous teeth to make their appearance pertain to the anterior molars; after these are the germs of the canines and incisors; last, the posterior molars. About the fourth month these papillae are all in their saccular envelopes, while forming behind the lids of the sacs are little crescentic depressions, called cavities of reserve, lined with mucous membrane, and containing the germs, or papillae, of the second set of teeth,—one to each deciduous germ. The first molar of the permanent set is markedly related to the deciduous, by having a common origin from and on the primitive dental plane. From sacs, secondary to the capsule of this tooth, spring the reserve cavities of the second and third molars of the second set.

The eruption of the temporary set, although more or less irregular, ensues, as a rule, in the following order and time,—the lower teeth erupting first: Central incisors about the seventh month, lateral incisors about the eighth month, anterior molars about the thirteenth month, canines about the sixteenth month, and the posterior molars about the twenty-fourth month. The age intervening between the first and the last eruption is considered the critical period in infantile existence. (See chapter on *Associative Lesions of First Dentition*.)

The calcification of permanent teeth commences, just before birth, with the anterior molars, proceeding forward, but terminating with the premolars at about the third year. This description does not, however, include the posterior molars, which are really the last to dentinify.

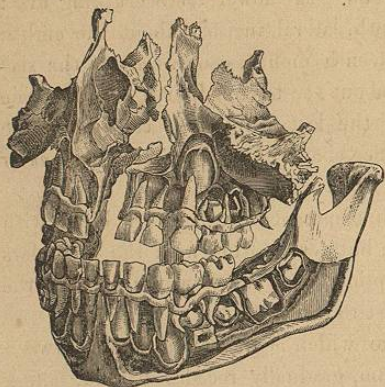
The position of the permanent papillae, which at first are situated between the sacs of the deciduous and the gum, gradually recedes behind, falling deeper and deeper, at least relatively so, as the milk set elongate; until, on the completion of growth in the deciduous, the germs of the permanent set are found in the common alveoli at the apices of these cavities, occupying, indeed, almost the position and physiological relations of the original papillae.

At this period, whenever it may be, and it varies of course with different individuals, a process of antagonism commences. It is intended that the new may advance and increase, that the old shall decline and diminish. The relative position of the two bodies is as follows: extending to the apices of the alveoli, and receiving at these apices the principal vessels of nutrition, are the perfected roots of the first teeth. Crowding down into these alveoli, with nutritious vessels of their own, possessed with the high vitality of growing bodies, are the pulps of the second teeth. As these pulps enlarge, so is there a corresponding absorption in the alveoli containing them, until, finally, through such process of absorption they have fallen directly beneath the roots of the first set. Of course a pressure has been equally exerted upon these roots, and as a result, the nutrient vessels passing into the pulp-cavities, through the foramina at the apices, have been gradually obliterated.

But do the pulps of the milk-teeth die? Not at all; or at least not necessarily. The neighboring vascularity is very great, the requirements of the organs very small; a sufficient supply is received from the circulation in the dentine, as well as from the periodontium, which, to the last, continues to close in the enlarging foramina. This, however, does occur: the absorbent, or destructive, system has been given the mastery, little by little, day by day, month by month, the roots of the first teeth disappear, while the crowns of the second advance, and occupy the space gained, until at length, as is witnessed every day, the milk-teeth drop out of their cavities, minus roots, while the crowns of the permanent ones are seen in their places.

If here we take up a thrown-off tooth, we find that the pulp-chamber, or what remains of it, instead of having an almost complete bony envelope, as is the case in the perfect organ, has communicated more and more largely, for

FIG. 55.



First and second dentition, upper and lower maxillæ.

they appear commonly at about the sixth year, seldom earlier, not infrequently from one to several months later; the sixth year, however, is the rule. The

a varying period, with the soft parts, guarding us, in such knowledge, against a treatment in aching milk-teeth, at certain periods, which would be most applicable at others.

To judge of the condition of the foramina of the first teeth, the practitioner is to compare them with periods of eruption of the second, recognizing that the enlargement, or absorption, corresponds with such advance in the permanent.

The first teeth of the second set erupt entirely back of the temporary, and in no way interfere with them. These are the anterior, or first molars,

second teeth to appear are the central incisors, the lower a little in advance of the upper—about the seventh year; the third, the lateral incisors, at the eighth year; the fourth, the anterior premolars, at the ninth year; the fifth, the posterior premolars, at the tenth year; the sixth, the canines, or cuspidati, at the eleventh year; the seventh, the second molars, at the twelfth year; and the last, the third molars, or wisdom-teeth, at a period varying from the seventeenth to the twenty-fifth year—most commonly, however, about the eighteenth year.

The teeth, in their eruption, arrange themselves after a physiological regularity in arches which have enlarged for their accommodation through a process of elongatory and interstitial growth; if development and functional harmony have not been interfered with, the fully-grown organs are found occupying in regular relations the two jaws, yielding perfect occlusion and articulation. (See *Associative Lesions*.)

**Articulation.**—In examining the articulated skull, it is seen that the six upper front teeth close over and in front of those of the inferior jaw, while the external tubercles of the bicuspidati and molars of the lower jaw lodge in the sulci between the external and internal tubercles of those of the upper jaw; thus, in the articulation, placing the tubercles of the upper teeth external to the outer tubercles of the lower. The central incisor of the upper jaw, because of its greater width, closes not only over the inferior central, but overrides the lateral. The superior lateral overrides the cuspis; the cuspis its fellow and the first premolar. The premolars override their fellows and the anterior third of the first molar. The first molar opposes the anterior third of the second molar and the posterior two-thirds of the first. The second molar antagonizes the posterior two-thirds of the second molar, and the anterior third of the wisdom-tooth. The wisdom-tooth of the upper jaw, being smaller than that of the lower, finds a required antagonism in the portion of its fellow left unoccupied by the second molar. Thus it is seen that no two teeth exclusively oppose each other,—an admirable provision, which not only guards as much as seems possible against loss of the organs from lack of articular relation, but secures the fullest results in the trituration of food. (For a splendid diagram showing articular relations of the teeth, see chapter on *Prosthetic Dentistry*. See also Fig. 1.)

## CHAPTER VI.

### ASSOCIATIVE LESIONS OF FIRST DENTITION.

THE calculations of Dr. Arbuthnot that, at the period of dentition, one child in every ten has its life destroyed through the associative and influenced lesions of the age, may, perhaps, not be strictly in accordance with statistics at large; but the mortality is so alarmingly great that, to the general practitioner, no subject offers in its study more important and vital interests. Professor Camper is authority for the statement that out of 5989 infants admitted into foundling-hospitals, only 884 were found alive at the end of the fifth year.

In the first place, it is to be remarked that the process of dentition, while a physiological one, is yet, like that of utero-gestation, one of continuous irritation. Of the meaning of this word irritation, every surgeon and every physician has in his mind quite enough reminiscences. Irritation, then, is the matter of consideration in all of these associative lesions; if happily, in such cases, we could exactly appreciate and exactly control such irritations, we should of course abort, or resolve, the results.

It is not, however, by any means to be esteemed that all infantile diseases are influenced by, or indeed even remotely associated with, dentition: mistakes of such nature are quite too frequently made, and infants are tortured, and in many cases have the existing disease aggravated, by the lancing and cutting which follow. It is very true that irritation from this cause has not always an associated external local manifestation; but such manifestation is much more frequently found present than absent,—at any rate, it is always to have its full share in the making up of a diagnosis. It will of course be taken for granted that dental irritation is influenced to a most marked extent, all other things being equal, by the slowness or rapidity of the evolution of the teeth. Thus, such equality existing, we would not anticipate from the eruption of a single tooth the trouble of five or six, and such a difference in evolution is so common that it may be said of some children that they cut their teeth in mass, while with others it is a process of the greatest regularity and harmony. Again, the physical condition and age of the child are matters not without significance. A delicate infant suffers more, as a general thing, than a robust one; while premature dentitions are attended with more danger than late ones. In taking into consideration the influences of this process, we are not to forget either the varying degrees of susceptibility manifested in different individuals, as thus we are led to appreciate the fact that judgment is

not to be founded alone on the extent or degree of local manifestation. Some children are preternaturally susceptible to stimuli, and these are not at all necessarily of the weak and feeble class; others, on the contrary, are so obtuse, even from earliest age, as to be very little influenced by any ordinary or common cause of irritation.

To the experienced physician, the appreciation of associated or abstract dental irritation should not be a matter of difficulty. He sees, and he does, what is to be done,—what only can be done; if the treatment fail, the fault resides not in the practice. In the first place, to understand dental irritation, one must be familiar with dental evolution; this, of course, is the understanding of the physiology of the subject. We know the varying periods of eruption, and we are thus at once led very directly in our researches. If we find a source of offence, as manifested by a tumid, congested gum, we have only to pass a lancet down to the confined tooth, and, having done this, we are to expect and hope for relief from any trouble which has been engendered by the just liberated organ. If we look into the mouth, and see no manifestations of offence, it is generally the case that dentition has nothing to do with a trouble which may have influenced the search,—not always, however, for it has been inferred that dentition may be a source of reflected trouble, while itself presenting no local signs. Still, such cases are very rare, and when existing, depend on great rapidity in evolution; either as a single tooth is concerned, or the simultaneous development of many. Several teeth, rapidly advancing at the same time, could very well be appreciated as a source of constitutional offence, not only as diverting in such direction an excess of the vital force, but also in local irritations induced in neighboring structures, and which might not at all be evident by any external signs. In these latter cases the physician can do nothing but increase, by indicated means, the ability of the system to endure the irritation; such means being more frequently found in tonics than in sedatives. In the weak, strict attention is to be given to diet, to exercise, and to cleanliness. The character of the clothing is also of much consequence. If the milk of the mother be not properly nutritious, other means are to be taken to nourish the child.

In cases where there seems simply an excess of irritability, such susceptibility is to be lowered by the withdrawal of everything capable of fostering it; this will pertain to the lodgment of the child, to its food, drink, clothing, exercise, etc., matters which should at once strike an observant practitioner.

Disturbance provoked in the alimentary canal, and fever induced through the process of teething, when existing conjointly with acute disease, of whatever character, necessarily aggravate such disease, and increase by just that much the attending discomfort or danger; hence the recognized increased mortality in the exanthemata occurring at this period.

The diseases, if they may be so called, directly associated with and dependent on abnormal dentition, and having, therefore, necessarily their cure more or less intimately associated with the correction of the primary lesions, are,—