comes of normal color. A couple of months after the operation the scar is hardly noticeable.

In Brault's plan the irritant used is a solution of chloride of zinc, 30 gm., to 40 gm. of water. The mark is tattooed with needles dipped in this solution, and in addition the surface is lightly moistened with the same solution after the tattooing. A mild inflammatory reaction is produced, followed by the formation of a crust which subsequently exfoliates, leaving a pinkish, slightly scarred surface similar to that after Variot's operation.

In the use of either of these methods several attempts may be necessary. The surface treated at one time should not exceed one or two square inches, and of course ordinary surgical precautions as regards the cleanliness of the surface, both before the operation and during the subsidence of the inflammatory process, should be observed. Both of these methods are founded upon correct pathology and are worthy of trial. Variot's method would seem the one of preference, as the action of silver nitrate can be more accurately controlled than that of zinc chloride.

Ohmann-Dumesnil has proposed a method of removing these marks by digesting with digestive ferment the connective tissue which encapsulates the pigment particles and thus liberating them, so that they can be carried away by the lymphatics. For this purpose he uses glycerole of papoid or of caroid. His method is as follows: The skin is made surgically clean and then anæsthetized with a spray of ethyl chloride. The surface is then covered with glycerole of papoid or of caroid and tattooed with a bunch of six to ten very fine needles which have been dipped in the solution. The tattooing should be firmly done, but the needles should be driven in just far enough to draw the least possible blood. Glycerole of papoid or of caroid is then poured over the area and it is covered with gauze. On the removal of this after two or three days the tattoo marks present a hazy appearance. Shortly after, a crust forms which later falls off, and with it the marks disappear. If any trace remains the process is to be repeated. This idea is ingenious, but the results have not been satisfactory in the hands of some workers. It is questionable whether the results obtained are not those due simply to a destructive inflammatory process, as in the other methods.

William Allen Pusey.

TEA.—(*Thé*, Codex Med.) The prepared and dried leaves of *Thea sinensis* L. (*Camellia Thea* Link, etc. Fam. *Theaceæ*). This definition includes, as varieties, *Thea* (*Camellia*) *viridis*, *T. Bohea*, and others, as well as the wild Assam tea tree, supposed to be the origin of them all. The tea plant as seen under cultivation is a shrub, a metre or so in height (from two to five feet), but in the wild state it becomes a small tree of from five to ten metres. The leaves are alternate, evergreen, rather thick and leathery, smooth when mature, short-petioled, lanceolate, of varying bluntness, serrate, feather-veined, the veins not reaching the margins, and from 5 to 10 cm., or in the much larger wild plant, from 15 to 20 cm. long (Fig. 4596).

Tea is a native of Asia, and grows in a semi-wild state in many of the districts where it is cultivated, but has only been found in an unquestionably indigenous condition in Assam, where it was discovered, some fifty years ago, by Mr. Robert Bruce, as a good-sized tree with very large leaves. It is now cultivated in many parts of the world; first in importance in China, where it is said to have been domesticated more than a thousand years ago, also in great quantity in Japan, Java, and India, to a slight extent in South America and elsewhere, and finally in the United States, experimentally. Although it grows pretty well in many places and is comparatively hardy, the higher price of labor is a bar to its profitable production in most civilized countries.

The earliest knowledge of the use of tea is from the Chinese, to whom it was familiar one thousand and perhaps two thousand years ago. It was introduced into Japan in the thirteenth century A.D., and into Java and India in recent times. It was first used in Europe near the middle of the seventeenth century.

Tea is planted in gardens and tended without gathering until two or three years old; then the leaves and buds are plucked for two or three successive crops each season. If green tea is to be made, they are immediately dried over a heated stove, and afterward colored more or less. For black tea the leaves are pressed in little heaps, and allowed to wilt and ferment a little before drying, which

FIG. 4596.—Tea Plant, Flowering Branch. (Baillon.)

is effected in the same way as above; by this process some of the tannin is decomposed, and the essential oil altered so as to modify the taste and smell a little; its color is also very much darkened, as well as that of the infusion made from it. The principal varieties of tea are: Black—flowery pekoe, orange pekoe, souchong, congou, bohea, etc. Green—gunpowder, imperial, hyson, young hyson, etc. The teas of our market are nearly always "blends," made by mixing several grades together.

The usual shape of tea is attained by compressing and rolling the leaves in the hand or upon a table until they are crumpled into the little rolls or wads of which commercial tea consists; in the nicer sorts each leaf is rolled by itself.

COMPOSITION.—In the proportions of the ingredients there is considerable variation, but the following are the principal ones: *Essential oil* from one-half to one per cent., which is the source of its flavor; *caffeine* (theine) from one-half to two or three per cent., which gives it bitterness. This alkaloid is found in half a dozen other plants, most of which are used somewhere as stimulating food adjuncts (see *Caffeine*, *Guarana*, *Cola Nuts*, etc.). It is also related to cocaine and theobroma. The amount of *tannin* in tea is large (from twelve to seventeen per cent.).

ACTION AND USE.—The large amount of tannin found in tea makes it an active astringent, especially to those unaccustomed to its use. It constipates the bowels, impairs the digestion, and reduces intestinal secretion when taken in large quantity; locally it makes tea a mild hæmostatic, and a useful wash for indolent ulcers, exuber-

ant granulations, etc. The essential oil gives to tea its agreeable flavor and a good part of its exhilarating character; it relieves fatigue, stimulates thought, postpones sleepiness, and cheers the mind. The *caffeine* is the chief mental and nervous stimulant and cardiac tonic element. By long-continued, habitual use neither of the above effects is much felt, unless carried to the extent of diminishing the appetite and developing dyspeptic troubles.

The least desirable of the constituents of tea is the *tannin;* it is also one of the slowest to dissolve out, and can, therefore, with a little care, be largely left with the dregs. The quicker an infusion of tea is made, the more fragrance and less bitterness and astringency it has; and the more slowly, the more tannin. Tea for drinking should be made by pouring *boiling* water into a suitable vessel containing the tea and allowing it to stand for from five to ten minutes, no longer. A better way is to rinse the cup in boiling or very hot water until it is heated through, then put in a teaspoonful of dry tea, fill the cup with boiling water, and allow to stand a few minutes. Tea should never be boiled or stand long unless the *tannin* is wanted. If made in an iron vessel or in a tin one which has begun to wear, it will become dark from the formation of a bitter tannate of iron. On account of its almost universal use over the entire world, tea is not often available as a medicine; its effects are identical with those of coffee, but perhaps more astringent and less stimulating than that article. As is the case with coffee, the commercial value of tea depends more upon its aroma than on the amount of caffeine it contains.

ALLIED PLANTS.—There are a dozen or more species of *Thea*, one of which is *Thea Japonica*, the beautiful camellia of the gardens. Besides this there is nothing of economic importance in the order. *W. P. Bolles.*

TEETH.—ANATOMY.—The teeth are commonly divided into two sets, according to the period of their eruption. The teeth which erupt first are variously designated as the deciduous, the temporary, the milk, or the primary teeth. The teeth erupting subsequently to the first set are called the permanent or secondary teeth. In addition to these there are supernumerary teeth, which usually occur in connection with the permanent, but may, in rare instances, be found with the temporary teeth; and there are so-called third dentitions, the genuineness of which, though fairly well established, is not without question.

The permanent teeth are thirty-two in number, sixteen being placed in the upper, and sixteen in the lower, jaw.

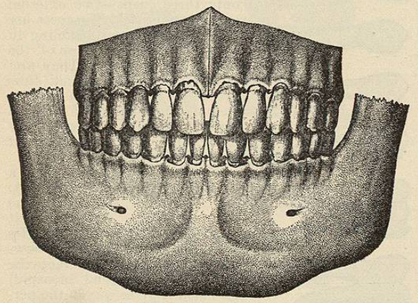

FIG. 4597.—The Permanent Teeth, natural size, showing their Method of Arrangement and Articulation. (Carabelli.)

In each jaw there are four incisors (two central and two lateral), two canines, four bicuspids, and six molars.

A formula to express the number of the various teeth in each jaw is written as follows: I $\frac{2}{2}$, C $\frac{1}{1}$, Bic. $\frac{2}{2}$, molars $\frac{3}{3} = 32$.

The teeth of the upper jaw are symmetrically arranged along the alveolar margin of the superior maxillary bones. When viewed from below, their crowns are found to describe a parabolic curve. This curve, however, varies according to nationality, heredity, and accidental circumstances. The teeth of the lower jaw are ar-

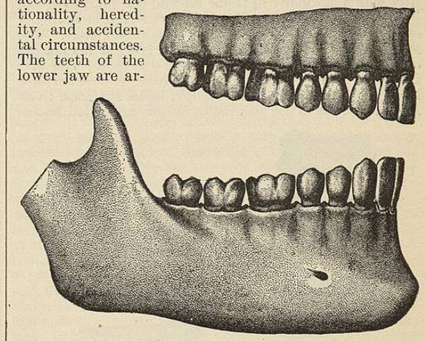

FIG. 4598.—The Permanent Teeth, natural size, showing the Curves in the Alignment of the Crowns. (Carabelli.)

ranged along the alveolar margin of the inferior maxillary bone, and their crowns describe a curve similar to that found in the upper jaw. This curve, however, is more pointed in front and more divergent behind. Speaking roughly, the masticating surfaces of the teeth of each jaw lie in a single plane, no crown projecting in a marked way beyond its neighbor. The teeth, also, when normally arranged, show no gap in the row, each tooth thus by its position giving and receiving support. In both these respects human teeth contrast strongly with those of the lower animals. In these it is common to find that certain teeth, as the canines in the carnivora, present a marked elongation, and also that between the teeth there occur intervals which allow of their interlocking.

The curve on which the upper teeth of the permanent set are arranged is normally somewhat larger than that of the lower teeth. In consequence, the anterior superior teeth overlap the anterior inferior teeth, as do also to a slight extent the superior bicuspids and first and second molars the corresponding lower teeth. The wisdom teeth, however, meet practically edge to edge. It is to be further noted that the superior teeth are not situated directly opposite corresponding inferior teeth. The superior centrals are opposite the inferior centrals and a portion of the inferior laterals; the superior laterals are opposite a part of the inferior laterals and a part of the inferior canines; the superior canine occludes between the inferior canine and the first inferior bicuspid; the first superior bicuspid occludes between the first and the second inferior bicuspids; the second superior bicuspid occludes between the second inferior bicuspid and the first molar; the first superior molar occludes with the first and the anterior portion of the second inferior molar; the second superior molar occludes with the second and the anterior part of the third inferior molar; the third superior molar occludes with the third inferior molar, and is the only tooth in the upper jaw having a single antagonist. While it has been stated that the masticating surfaces of the teeth of the upper and lower jaws are on a single plane, yet slight deviations from this rule are to be noticed. If we follow the lower edge of the upper teeth from a superior central around to the wisdom, we shall find that the line ascends gently from the central to the interval between the first and second bicuspids, then descends till past the first molar, when it ascends slightly to the end of the row. On the lower jaw the anterior teeth are slightly elevated above the posterior, and be-

tween the canine and the wisdom tooth a slight concavity is to be observed.

In its description a tooth is to be divided into a crown, a root or fang, and a neck. The crown of a tooth is that part which normally appears beyond the margin of the gum. The root or fang is that part which is normally embedded in the alveolus of the maxillary bone. The neck is a more or less constricted belt lying at the margin of the gum where the crown joins the root. The surfaces of the crowns are thus designated. Those surfaces lying adjacent to the lips are called labial surfaces, those lying adjacent to the buccinator muscle are called buccal surfaces. Those surfaces on the inner side of the teeth lying adjacent to the tongue are called lingual surfaces. In the case of the upper bicuspids and molars, however, such surfaces are more commonly called palatal surfaces, from their relation to the hard palate. The grinding surface of the bicuspids and molars is called the coronal surface. The surfaces between adjoining teeth are called approximal surfaces, and are divided into two classes—mesial and distal. The mesial approximal surface of a given tooth is that surface which, were the row of teeth in a straight line, would face toward a line drawn between the central incisors. The distal approximal surface is the corresponding surface at the opposite side of the tooth. These names are, as a rule, applied to the crowns of the teeth, though they are, with the exception of the term coronal, used also in connection with the roots.

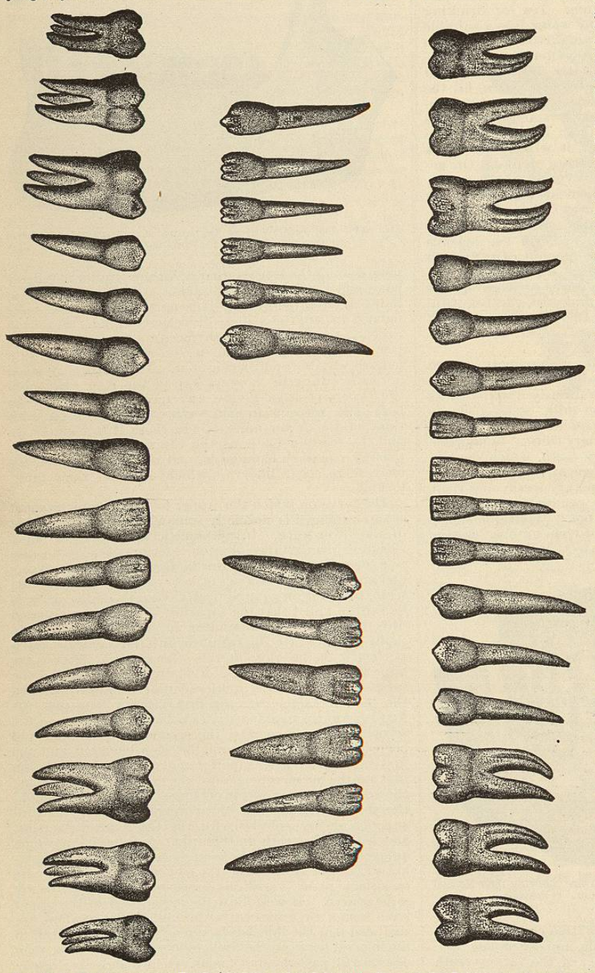

FIG. 4599.—The Permanent Teeth (slightly reduced in size), showing the Labial and Buccal Surfaces. The middle row of teeth represents freshly erupted incisors and canines, with the tubercles on their cutting edges intact. (Carabelli.)

The *temporary teeth* are twenty in number. In each jaw there are four incisors, two canines, and four molars. The dental formula is I $\frac{4}{4}$, C $\frac{2}{2}$, molars $\frac{4}{4} = 20$.

This formula differs from that of the permanent teeth by the entire absence of bicuspids, and by the loss of four molars. The temporary teeth can best be described by comparing them with the permanent teeth, which they closely resemble.

The incisors and canines of the upper and under jaws are very much smaller than the corresponding teeth in the permanent set, and the root of the upper central incisors is somewhat curved on the mesial side where the corresponding root in the permanent teeth is practically straight.

The first upper molar is situated behind the canine, and in appearance is a compromise between a bicuspid and a molar. Its crown resembles in general shape that of an upper molar, but is quite small, and bears only three cusps—two external and one internal. The roots are three in number, resembling in shape and position those of the permanent molars. They are, however, more divergent, thus providing room for the first bicuspid, whose crown is situated directly beneath the temporary tooth, and within the grasp of its roots.

The second upper molar is a much larger tooth than the first, and resembles so closely the first permanent molar that it might be mistaken for it. Its roots are more divergent, however, in order to embrace the crown of the second bicuspid, to which it gives way in the permanent dentition.

The first molar in the lower jaw is situated behind the canine, and resembles in shape a permanent molar of the lower jaw. Its crown is surmounted by four cusps—two external and two internal. It has two roots, one anterior and one posterior,

between which is developed the crown of the first inferior bicuspid.

The second lower molar is larger than the first, and a little smaller than a permanent lower molar, which it closely resembles. Its crown has five cusps—three external and two internal. There are two roots, one anterior and one posterior, which embrace the developing crown of the second lower bicuspid. It is characteristic of the temporary teeth that the foramen at the apex of the roots is larger, that the necks of the teeth are more constricted, and the color whiter and more delicate than in the permanent teeth; also, that the six anterior upper teeth do not overlap the corresponding lower teeth to such an extent as in the permanent set.

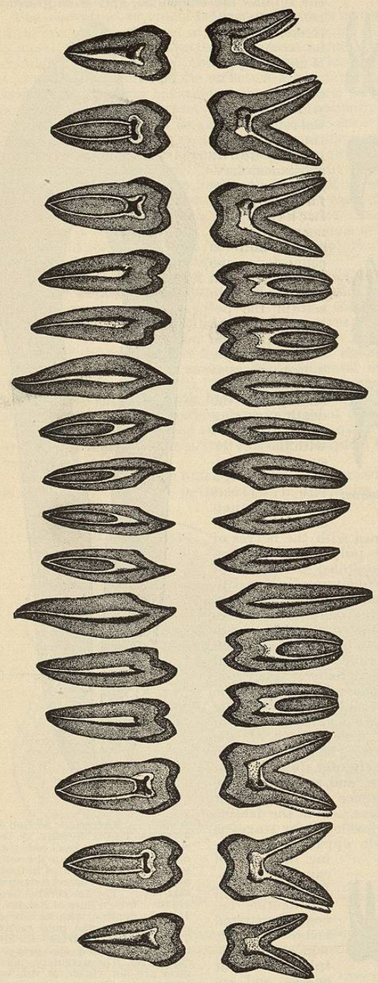

FIG. 4600.—The Permanent Teeth, natural size; a Section through the Pulp Cavity, showing its Size and Shape. (Carabelli.)

MICROSCOPIC ANATOMY OF THE TEETH.—A longitudinal section through a tooth will reveal four distinct structures—the enamel, the cement, the dentine, and the pulp. The pulp is a soft mass of connective tissue richly supplied with blood-vessels and nerves, and located in the centre of the tooth. It fills the pulp cavity. The pulp cavity starts at the apex of the root or roots, as the case may be, as a thread-like canal, and gradually enlarges till it reaches the crown, where it attains its greatest size; throughout its whole course it imitates in shape the external contour of the tooth. An artery and nerve, and sometimes more than one of each, enter the apical foramen of each root of a tooth, and, branching freely, distribute themselves to all parts of the pulp, being especially abundant about its periphery. A venous system returns the blood through the apical foramen into the general circulation. It is a matter of dispute whether a lymphatic system is present or not; most observers consider that it is not. Around the periphery of the pulp, and distinct from the connective-tissue cells forming its body, there exists a layer of cells called the odontoblastic layer, or the membrana eboris. In shape these cells are large in comparison with the connective-tissue cells; they are of columnar form and have several processes. By these processes they are in close relation with the terminal filaments of the nerve of the pulp, joined to one another, and connected with the dentinal fibrils.

Immediately surrounding the pulp comes the dentine, which is the most abundant tissue of the tooth. It is

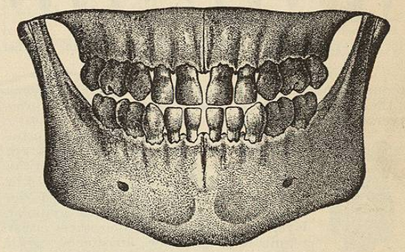

FIG. 4601.—The Temporary Teeth, natural size, showing their Arrangement in the Maxillary Bones, and Relations to one Another. (Carabelli.)

hard and dense in structure, of a yellowish-white color and silky lustre. On analysis it is found to contain animal matter, twenty-eight per cent.; earthy matter, seventy-two per cent. Its various components are thus given by von Bibra:

	Per Cent.
Organic matter	28.01
Phosphate and fluoride of calcium	66.72
Carbonate of calcium	3.36
Phosphate of magnesium	1.18
Other salts	.73
Total	100.00

Morphologically considered, it is composed of a structureless matrix permeated by countless tubules, each tubule possessing a lining membrane and a central fibril. The tubules start from the pulp cavity, where they have a diameter of about $\frac{1}{3000}$ of an inch, and radiate toward the periphery of the dentine, becoming smaller and more numerous as they advance. While the direction taken by the tubules in different parts of the tooth varies greatly, yet contiguous tubules are essentially parallel. Two or three undulatory curves are to be noticed in the length of a tubule, and the name primary curvature has

been attached to them. Numerous spiral turns occurring in the course of the undulatory curves have been named the secondary curvatures. The tubules give off

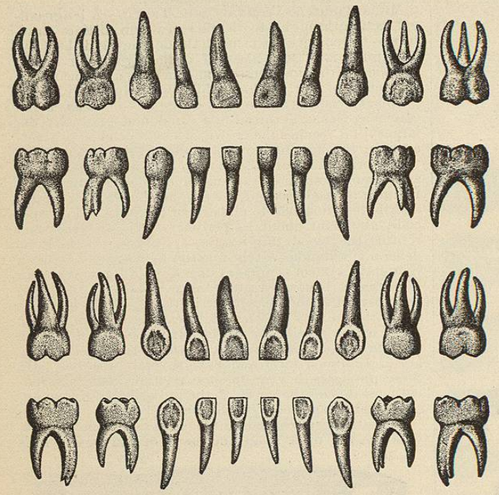

FIG. 4602.—The Temporary Teeth, natural size, showing the External and Internal Surfaces. (Carabelli.)

frequent branches throughout their entire length. Some of these branches are important, extending to the outer layers of the dentine parallel to the main channel. Other branches serve merely to connect one tubule with another, and still others are blind processes. At the outer layer of the dentine the tubules become diminished in size and very numerous. Some of the tubules can be seen entering the granular layer of the dentine, while others either terminate blindly or anastomose with neighboring tubules. The "granular layer of Purkinje" consists of numerous irregular cavities filled with cells having nuclei, and forming a layer about the peripheral portion of the dentine, being especially well developed where the dentine is covered by the cement of the root. The cavities of this layer communicate with each other, and in some cases with the canaliculi of the cement, besides being connected with the tubules of the dentine.

FIG. 4603.—An Upper Temporary Molar, with a Bicuspid within the grasp of its Roots. (Wedl.)

The tubules of the dentine have been shown to possess a lining membrane, and to this the name dentinal sheath has been applied. This structure resists the action of reagents which destroy the matrix in which the tubules are embedded, and is supposed to consist of elastic tissue, though its composition is not surely determined. The dentinal fibril which occupies the centre of the tubule is a soft homogeneous substance, having a nerve-like function, but lacking true nerve structure.

The fibril is connected at one end with an odontoblastic cell in the periphery of the pulp, and the other end enters, in many cases at least, the granular layer of the dentine, coming into contact with the soft tissue therein contained. Through the dentinal fibril communication is maintained with the nerves of the pulp, and sensation is supplied to all parts of the dentine. In longitudinal section of that part of the dentine which lies in the crown of the tooth are to be seen lines which are called the "incremental lines of Salter." They run, in general, parallel to the external contour of the crown, and mark stages in the development of the dentine, being not unlike the circular rings of wood fibre, and are due to the presence of interglobular spaces. That the dentine is developed by stages is made apparent by treating it with hot caustic potash. By this reagent the dentine becomes separated into layers, which cross the tubuli at right angles, and are concentric about the pulp. In the crown of the tooth, between one layer of dentine and another, there occur imperfectly calcified spots where

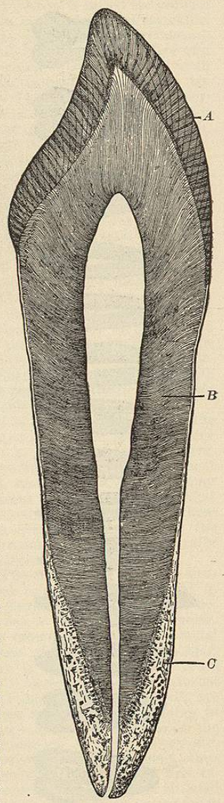

FIG. 4605.—A Microscopic Section of a Canine Tooth, showing, *A*, the enamel, with its enamel rods running from the dentine to the outer surface. The dark strips indicate places where the enamel rods cross each other. The fine parallel lines are the "brown lines of Retzius." *B* is the dentine, with its tubules radiating from the pulp cavity. The undulatory curves of the tubules are called the primary curvatures. The secondary curvatures are not visible at this enlargement. The granular layer is indicated by the dotted line about the periphery. It is especially marked between the cement and dentine, and practically absent between the enamel and dentine. The interglobular spaces are represented in the coronal portion of the dentine just removed from the junction of the dentine and enamel. *C* indicates the cement, with its lacunæ and canaliculi.

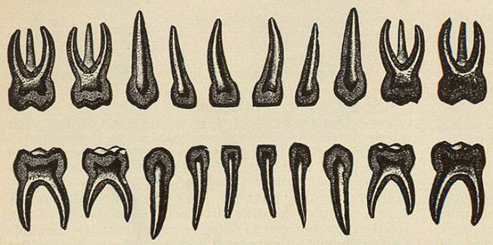

FIG. 4604.—The Temporary Teeth, natural size. A section through the pulp cavity shows its size and shape. (Carabelli.)

the dentine assumes a globular form, and where irregular interglobular spaces are found. Series of minute interglobular spaces give rise to the "incremental lines of Salter."

The dentine is surrounded in the crown by the enamel, and in the root by the cementum.

The cementum, or crusta petrosa, is the outer covering of the root. It is thinnest at the neck of the tooth, where it meets and slightly overlaps the enamel, and grows gradually thicker toward the apex, about which point it is most abundant and its structure is most perfectly developed. Cement has essentially bone structure; it possesses lacunæ and canaliculi, but has normally no Haversian canals. The lacunæ and canaliculi are wanting or rare in that part of the cement near the neck of the tooth, but about the apex of the root they are numerous and well developed. The lacunæ lie in parallel planes encircling the pulp cavity, their canaliculi anastomose freely with each other, and in some cases they connect with the granular layer of the dentine, thus establishing a communication between the lacunæ of the cement and the pulp of the tooth through the granular layer and tubuli of the dentine.

Immediately surrounding the cementum of the root exists the peridental membrane, which is identical with the periosteum which lines the bone forming the socket of the tooth. The peridental membrane serves a triple function. It nourishes the bone of the socket and the cement of the root, besides forming a bond of union between the root and its socket. The peridental membrane, like all periosteum, is composed of connective tissue richly supplied with blood-vessels. The arterial supply comes from capillaries of the gum about the neck of the tooth, from the deep substance of the bony socket, and from a branch of the artery entering the apical foramen of the tooth.

The enamel forms the outer covering of the crown; it is the hardest structure in the body. It resembles dentine in its chemical constituents, but has a much greater proportion of inorganic material. The following analysis is given by von Bibra:

	Per Cent.
Phosphate and fluoride of calcium	89.82
Carbonate of calcium	4.37
Phosphate of magnesium	1.94
Other salts	.88
Cartilage	3.39
Fat	.20
Total	100.00

The proportion of organic and inorganic matter is as follows.

	Per Cent.
Organic	3.5
Inorganic	96.5
Total	100.00

Morphologically considered, enamel is composed of rod-like, hexagonal prisms, arranged side by side, one end of the prism resting on the outer layer of the dentine and the other forming the free surface of the crown of the tooth. Each prism extends, as a rule, through the entire thickness of the enamel. There are some, however, which extend only from the centre of the enamel to its free surface, thus preventing gaps which would otherwise occur, the outer surface of the enamel being of greater extent than the inner. In diameter the enamel prisms measure $\frac{1}{7000}$ to $\frac{1}{4000}$ of an inch. Each prism, when isolated, has slight varicosities and presents a striped appearance similar to muscular fibre. The prisms run, in general, parallel to each other, and in a wavy course; their inner ends are implanted in slight hexagonal depressions in the surface of the dentine, and their outer ends are received into similar depressions in the under side of the cuticle of the enamel when the cuticle is present. A vertical section of the enamel shows that it is thickest in the crown, especially in the region of the cusps, and becomes thinnest at the neck of the tooth, where it is overlapped by the cement of the root. The enamel prisms are seen to leave the outer surface of the dentine at right angles, and radiate toward the external surface of the tooth. The general yellowish-white color of the enamel is varied by dark bands extending vertically from the dentine to the free surface of the enamel, caused by the crossing of bundles of enamel prisms. Certain delicate lines running longitudinally through the substance of the enamel are also to be noticed. These are called the "brown lines of Retzius," but it is not known to what they are due. Also between enamel rods, usually near the surface of the dentine, are

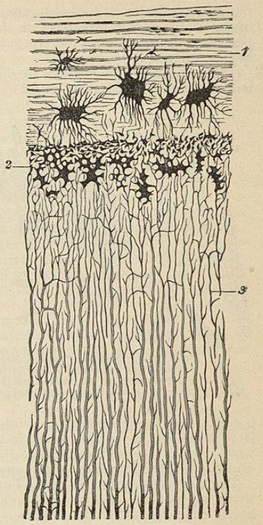

FIG. 4607.—A Section of Dentine and Cement. The figure *1* represents the cement with its lacunæ and canaliculi; the figure *2* represents the granular layer of the dentine. It is to be noticed that the lacunæ communicate with the cells of the granular layer. The figure *3* represents the tubuli of the dentine, showing their diminution in size as they go toward the cement, also their frequent anastomoses and their connection, in some cases, with the cells of the granular layer. (Quain.)

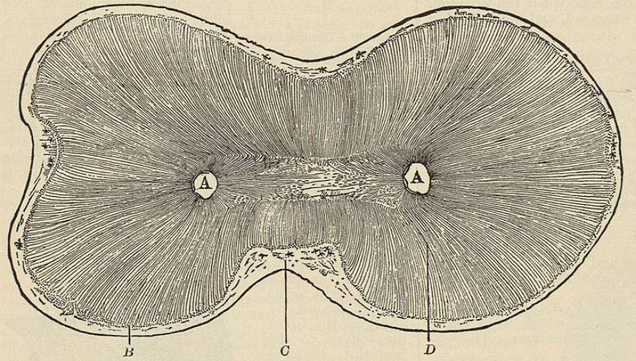

FIG. 4606.—Cross-section of an Upper Bicuspid Tooth. *A*, *A*, The root canals; *B*, the granular layer of the dentine; *C*, the cementum, showing occasional lacunæ; *D*, the dentine.