strictest research, he was led to believe it unexampled in the human species. Accepting this, we have here, side by side, extremes. Understanding each,

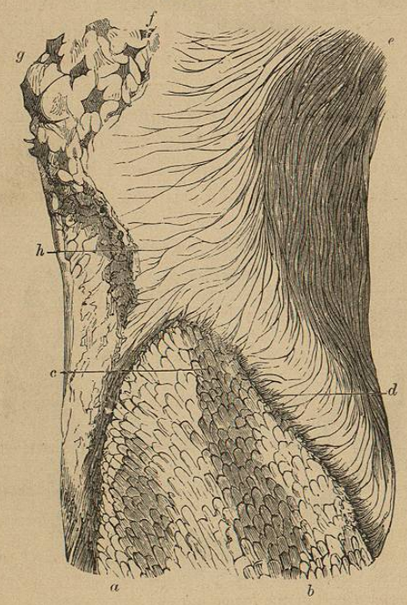
tion of its elements is described as existing, discernible by the naked eye. (See Figs. 576 and 577.)

Between the tumor and the wall of the cyst was a thick, fibro-cellular tissue, free on the side of the former, where it covered the whole intramaxillary portion, and was joined to the latter by filamental prolongations of a cellulo-vascular appearance,—these being attached to the numerous openings that covered the face of the cyst. The external surface of this membrane was bathed with a muco-purulent liquid, smelling like dental caries.

At the base and anterior extremity of the tumor, an indentation is described fitting the crown of a large molar that stood between it and the maxillary bone. (See Fig. 577, *b*.) A portion of the same tooth caused a slight elevation on the external face of the jaw. (Fig. 576, *c*.) M. Forget also describes the tooth encountered in the operation. (Fig. 576, *d*.) Its location, as will be seen, is directly beneath the alveolus of the first molar, which is standing in its true position. (Fig. 576, *e*.)

All the teeth, with the exception of the last two molars, it will thus be seen, were found, and the space appropriated for them was filled by the tumor. What, then, queried M. Forget, could have become of these two great molars? It could not be, he argued, that the bulbs, compressed from their very origin, had disappeared without leaving a single vestige of their existence. The numerous instances, he held, that had occurred of the simultaneous development of teeth and anomalous productions in the very centre of the maxilla

FIG. 578.



would not allow him to think of accepting such an explanation. In all the analogous cases that had fallen under his observation, the teeth were of the ordinary dimensions, and complete in number, although removed from their normal position, and sometimes buried even in the morbid substance itself.

there is not likely to come anything between that we may not be able readily to explain.

A dental germ assuming or compelled to an abnormal position may have various sequelæ. It may make a mal-eruption; it may remain encysted; it may die after partial development, or it may present heterogeneously.

We have, then, but to consider heterogeneous development, and we have mastered the pathology of the lesion and all its various phases.

First, let us dissect a tooth,—for the parts of a tooth are the parts of such tumor. A tooth is made up of enamel, dentine, cementum, pulp-substance, periodonteum, and tunica propria.

Enamel of the Teeth.—Cortex strata, adamantina dentium; crusta dentium adamantina; substantia vitrea.

The enamel of a tooth is that portion which caps the crown. In structure it is fibrous; its fibres radiating from the centre to the surface.

In microscopic structures, the enamel (Owen) consists of long and slender, solid, prismatic, for the most part hexagonal, fibres of phosphate, carbonate, and fluorate of lime; which are essentially the contents of extremely delicate membranous tubes.

Dentine.—Os dentis, substantia ossea ebur dentis. This is the portion of the tooth between the pulp and the cementum and between the pulp and the enamel, the tunica propria intervening. It makes up the great body of the organ. Dentine is composed of numberless tubules, these being not smaller than the one-four-thousandth of an inch in diameter; their course is waving, each tubule having several curves resembling, according to Retzius, the Greek letter ϑ. "Professor Retzius confirms the observation of Müller, that the tubes contain an organic earthy matter in granular masses, which disappears under the action of dilute muriatic acid. The cells, and the small

Let us now, that we may fully comprehend such a class of cases, pursue the study of this particular one.

Fig. 575 represents the left half of the body of the inferior maxillary bone, hollowed into a large cavity, containing an ivory-like bony tumor.

d. Side view of the alveolar edge.

a. Orifice of the dental canal upon the surface of the resection of the bone in the continuity of the ramus.

b. Plane of the cut in front, showing the second small molar which was found in it.

c. Crown of the first molar, in regular position.

Figs. 576 and 577. The two halves of the anatomic section, divided according to its axis (osseous cyst, and included tumor).

Fig. 576.—*c*. Crown of great molar, seen through a notch in the outer wall of the cyst.

d. Second small molar.

e. First small molar.

a and *b*. Points of the same wall, perforated by the prolongation of the tumor.

f. Summit of the most elevated of these.

Fig. 577.—*a*. Interior aspect of the tumor.

b. Great molar inverted.

c and *d*. Cellulo-fibrous membrane, interposed between the osseous cyst and tumor.

Fig. 578. Microscopical appearance.

tubes which radiate from them, also contain earthy matter, as in bone. They are naturally white and opaque, but, after maceration in dilute muriatic acid, become coloress and transparent."

Chemically, dentine differs from enamel principally in the absence of the fluorate of lime.

Cementum—Crusta Petrosa.—The cementum of a tooth is that portion which invests the fangs. In character, it corresponds quite closely to the osseous structures. The microscope demonstrates clearly the existence of Haversian canals, and the so-called corpuscles of Purkinje, or, as Robin prefers to term them, osteoplasts.

In growing teeth, with fangs not fully formed, the cement is so thin that the Purkinjean cells are not visible; it looks like a fine membrane, and has been described as the periosteum of the fangs, but it increases in thickness with the age of the tooth, and is the seat and origin of what are called exostoses of the fangs, which are wholly composed of it. It is the presence of this osseous substance, says Professor Owen, which renders possible many well-known experiments of which the human teeth have been the subject; such as their transplantation and adhesion into the combs of cocks, and the establishment of a vascular connection between the tooth and the comb, etc. Under every modification, the cement is the most highly organized and most vascular of the dental tissues, and its chief use is to form the bond of vital union between the denser constituents of the tooth and the bone in which the tooth is implanted.

Dental Pulp.—The pulp is that vascular, reddish-gray, highly-sensitive substance occupying the cavity of the tooth. It is made up of delicate connective tissue, in which ramify the dental nerve, artery, and vein.*

When, says Mr. Nasmyth, the internal structures of a dental pulp are examined, the number of minute cells which present themselves in a vascular form is remarkable; they seem, indeed, to constitute the principal portion of its bulk. Mr. N. describes them as "varying in size, from the smallest microscopic appearance to one-eighth of an inch in diameter; and as being disposed in different layers throughout the body of the pulp." This tissue is highly endowed, and, perhaps, more liable than any other portion of the body to take on morbid action; fungoid degeneration is, perhaps, its second most common disease.

Periodonteal Membrane.—This is the periosteum of the tooth. Anatomically and physiologically it differs little from this general class of membranes. Pathologically, it may be remarked as being more susceptible to disease, and more disposed to assume quickly acute perversions. For example, inflammation of the periodonteal membrane is easily provoked, and, once inflamed, the part is ever after surprisingly prone to reassume morbid action.

* Exception is taken by so eminent an observer as Dr. Atkinson, to the existence of vessels proper within the pulp. This gentleman, whose learning and keen sense of observation commend his inferences to the professional reader, prefers to consider the nutrition as of capillary signification.

Familiar with tooth composition, we turn to Fig. 578, and trace a perversion of development in the structures,—see them forming a tumor, strictly dental, yet to the last degree anomalous and abnormal.

We refer here to the microscopic examination of M. Forget's odontoma, made and noted by Professor Ch. Robin, Fig. 578 (400 diameters). This figure represents a portion of a slight cut made into the tumor represented in Fig. 577, *a*. The preparation is taken from near the free edge, or the irregularly mammillated surface of the tumor. The latter is formed principally of the ivory or dentine, easily recognized upon the thin section by its very fine tubes, disposed in parallels, or nearly so, through part of their extent (Fig. 578, *e*).

These tubes, radiating more or less regularly from the little depressions or cavities observable in the mass of the tumor (Fig. 577, *a*), very near to each other through part of their extent, become more rare, fine, and ramified as they approach the surfaces of the dental tumor (Fig. 578, *d*, *f*), and end in a very sharp point toward the lines of junction between the ivory and the enamel (*a*, *b*, *c*), and the cement (*f*, *g*, *h*). The presence of the ivory, which forms the greater part of the tumor, demonstrates its dental nature very clearly.

Enamel.—Another important particular is the presence of the enamel on the surface of the tumor, where it in some measure covers the irregularities with a varnish which moulds itself upon them in order to penetrate more or less deeply into the fissures or depressions that divide the growth superficially into lobes.

This bed of enamel varies in thickness from microscopic dimensions to a millimetre (.03937 inch), or near it, and is as irregular in places on the lower or adhering face as it is on the free surface, which the microscope alone allows to be seen. The portion of the section of the tumor that is here delineated (Fig. 578) is taken at the level of one of the points where the enamel (*a*, *b*) in a manner penetrates (*c*) into the body of the ivory mass of which the tumor is principally formed.

The enamel is easily recognized by its narrow prisms, from six- to eight-thousandths of a millimetre in width, which are in immediate juxtaposition (Fig. 578, *a*, *b*). The figure shows them inclined, as by the accidents of the cuts in making the section. When the cut is perpendicular, or nearly so, to their greatest axis, their prismatic form, with five or six faces, is easily seen; this is shown in the neighborhood of *b*, Fig. 578.

Cement.—In the depth of the fissures, and here and there in the mass of the tumor, near its surface, and especially that part of the surface hidden in the adventitious cavity of the maxillary bone, the microscope discovers some trails or beds of variable thinness, formed entirely of the substance of the cement (Fig. 578, *g*).

The cement is inclosed between masses of ivory, and is consolidated by the immediate contact (Fig. 578) with the masses between which it lies. It extends itself in places with the surface of the tumor to the neighborhood of, and even to contact with, the enamel. The section represented in the plate is taken at a point that shows this arrangement (Fig. 578, *f*, *g*, *h*). There are, besides, thin pieces of cement extending far forward into the body of the tumor.

The cement is known to be no other than the osseous substance. The figure before us exhibits the characteristic elements belonging to it. These are the microscopic cavities, called osteoplasts, or, incorrectly, osseous corpuscles, for they are excavations. The air that fills the dry bone makes these cavities appear black under the microscope (Fig. 578, *g*); but in the fresh state they are full of liquid, and are pale and more difficult to observe than in the dry pieces.

These cavities, which are in breadth and length from one- to three-hundredths of a millimetre, are always of very irregular shape, on account of the presence of the fine tubes that start from all their peripheries and traverse even the substance interposed between the osteoplasts.

The best-joined pieces show that these little canals are subdivided two or three times, and are then inosculated with those of neighboring osteoplasts. The portion of cement shown in the plate does not exhibit this arrangement, which was visible, nevertheless, in the parts close to it.

The cuts in the tumor exhibit, moreover, little openings, that are either full of a grayish or brown pus, or empty. These small orifices are from two- to six-tenths millimetre and upwards in width, and from about one to two millimetres apart. The microscope shows that these orifices accompany the narrow, irregular cavities, sometimes in the form of elongated conduits, hollowed out of the ivory through which they pass. The instrument shows also that the tubes of the latter start from these cavities to radiate toward the surface of the tumor, in the same manner as those of the ivory in the normal tooth start from the natural cavity of the dental pulp. These narrow, irregular cavities, more or less elongated, traverse the mass of the growth, and some of them even reach within a few millimetres of the surface.

These cavities are, in reality, nothing more than the pulp-canals of this morbid product, either rugous from desiccation, or still containing some remnant of the dried organ in the form of a brownish or grayish powder.

Recapitulation.—The result of the observations of the case is thus epitomized by M. Forget:

1st. An original union of the follicles of the last two molars, followed by an intimate union of them, caused by phlegmasial or other action.

2d. Under the same morbid influence, the excess of vitality in the organic elements of the follicles has produced hypersecretion of an ivory-like osseous substance.

3d. That the irregular aggregation and diffusion of these constitutes the pathological growth.

4th and lastly. Its growth has formed in the cyst, and it has maintained therein a permanent inflammation which has disorganized the osseous tissue and altered the structure of the adjacent soft parts to such an extent that a radical operation is necessary.

Many curious illustrative instances might be mentioned of anomalous incongruities in dental evolution; but, as we are prepared to understand, all would be found in character the same,—enamel, dentine, cementum, pulp structure; arrangement only would differ. A practitioner using his eyes, or assisted by the microscope, is to be able to pronounce concerning any of them.

Ability to distinguish a dental from a malignant osteoid tumor must certainly prove a source of much satisfaction: for, as M. Forget has remarked, if intervention cannot be too radical in an instance of cancer, it is certain, on the contrary, that more caution and moderation are desirable when it is a question of a lesion which is essentially local and of a benignant nature, and allows the surgical operation to be restricted to the precise limits of the lesion, without its being necessary to provide against an improbable repetition by encroaching upon the osseous tissues that border it, thus subjecting the patient to a mutilation which could not be justified.

Data.—1. There are twenty teeth in the deciduous denture, which twenty are to be replaced by thirty-two, each of which is to be at least twice the size of its predecessor.

2. A contracted maxilla, having no accommodation for certain teeth, the germs of which are in the jaw, gives us, among other lesions, irregularity in dental evolution.

3. Irregularity in evolution yields morbid conditions, as described, which conditions are influenced, not unlikely, by peculiarities of the general organization and by manner of interference with development.

4. An overcrowded arch will surely yield periodonteal and other minor troubles, and may produce lesions of grave character. The extraction of the bicuspid teeth of the permanent set is therefore to be practised, whenever time makes evident the existence of contraction on the part of an arch.

5. Dental tumors vary from simple cystic growths to such perverse and anomalous evolutions that the microscope alone is capable of explaining them.

6. A dental tumor is an abnormal growth, having its point of departure and development in irregularity of tooth evolution.

7. Dental tumors are benign; operations for their cure promise all success, and are to be practised in exclusive consideration of the disease as it locally exists.

8. The existence of a dental tumor is to be inferred, *cæteris paribus*, in case of deficiency and derangement in the dental arch.

The extent of very large cysts, as occasionally found in the lower jaw, involves in a treatment the preservation of the contour of the parts,—complete

section of the bone being never, as a primary operation, permissible. Such required precaution is best secured through the preparation of a plate fitting the teeth precisely as directed for fractures when the inter-dental splint is used. (See *Fractures.*) This plate, before the cyst is at all interfered with, is to be placed in position, and the jaw fixed in its place. This accomplished,—although it adds to the inconvenience of the treatment,—a cyst may be crucially incised and stuffed with very little danger of fracturing the continuity of the parts. Cysts of such delicate attenuation are, however, not at all common, a consolidating and supporting periosteal exudate counterbalancing to a marked extent the attenuation. The author, at the present time, has under treatment a cyst of the lower jaw quite the size of an ordinary orange, yet the bone seems as solid as iron. The patient in this instance, however, is a remarkably vigorous laboring man.

Cysts may have a self-explaining origin, yet, from the presence of a systemic vice, depart from their homologousness. As heteroclitic contents are met with, so will be found want of success in attempts at cure by the granulative process. The septi alluded to as seen so frequently in the simple cyst will be found at times replaced by what is known as the soft multilocular cyst. Again, the cavity will be found filled with a pulpy, liver-colored, turgid mass. It has been the experience of the author that exactly in the degree in which these cysts depart from simplicity, do they afford evidence of the change by the sympathy expressed in the overlying mucous membrane. (See *Cysto-Sarcoma.*)

In accounting for the formation of the ordinary dentigerous cyst, the hypothesis has been advanced that the condition is due to a morbid secretion into and enlargement of the capsule of the enamel organ: this, however, is certainly not the explanation, as the true enamel membrane—the tunica propria—is always found in a normal relation and position. That an effusion might have occurred between the enamel and its matricial membrane—the tunica reflexa—is barely probable, though possible; the enamel of the crowns of the encysted teeth being commonly too perfect to warrant inference of interference of any kind in the process of development.*

* The exciting causes are often unknown, and probably are various. The attempts of the impacted teeth to reach the surface have an exciting action in certain cases; but, on the other hand, such teeth may lie quiet in the jaw during the entire life, and cause no trouble, or may be found inclosed in a cyst after all attempt at growth had been given up for years. That the disease should follow the extraction or aching of carious teeth is not remarkable, considering how common these are at all ages; yet such irritation in some cases may have been the exciting cause as well as the obstinate resistance of a milk-tooth to the advance of its follower. In the first and second cases given in the tables the disease was evidently excited by the blows which preceded. The additional presence of undeveloped teeth in the jaw is, of course, essential in all these cases, for without these the affection *cannot exist.*

Whatever may have been the exciting cause, the pathology is essentially the same. The disease is due to a morbid secretion into and enlargement of the capsule of the enamel organ of the unfortunate tooth. This is shown by the position of the latter, whose crown lies exposed in and to a certain degree faces the cavity. This position serves to distinguish

The teeth most frequently found encysted are the cuspidati; this would be inferred from the relation of these organs. After the eye-teeth, the next in frequency are the dentes sapientiæ. According to the observations of Dr. Bolles, the sexes seem nearly equally liable. Most of the instances collated by this author are noticed as having occurred between the ages of ten and forty: one to ten, one case; ten to twenty, nine; twenty to thirty, nine; thirty to forty, three; forty to fifty, none; fifty to seventy, three;—the duration being between four months and thirty years; the lists of ages being at time of operations.

Dentigerous cysts, as would be inferred, are related with the permanent (or, as they would in this connection be better named, the successional) teeth. One or two exceptions, however, are related: one from the practice of Mr. Alexander Edwards, of Edinburgh, being in the person of a young man in whose upper jaw, just below the orbit, a tumor had developed. This tumor consisted of exostosis from the maxilla, combined with a bony cyst, containing a tooth which was pronounced by Professor Goodsir to be a temporary molar.

Of the various preparations in existence of cyst of the jaws, the largest with which the author is familiar is one in the Museum of St. George's Hospital. This immense tumor rested upon the clavicle when the head of the patient was thrown as far back as possible. It may be found figured in Holmes's System of Surgery, vol. iv. p. 459. An example in the author's practice showed a cyst eight inches in diameter.

Cystiform Antra.—Fig. 579 represents a cystic tumor, or, rather, expansion of the walls of the antrum, as occasionally met with. The cyst represented in the view occurred in the person of a young gentleman some twenty years of age, from whose jaw it was removed two years back. This cyst, the size of an ordinary orange, was successfully treated without external incision, the soft parts being dissected off by pulling outward and upward the angle of the mouth; the wall of the cyst, about the thickness of ordinary parchment, was cut away with a chisel. This particular cavity was without contents of any kind. After the removal of the vault, the soft parts were permitted to

this cyst from those instances where innocent teeth, before eruption, have become displaced by the growth of solid or even fluid tumors in which their own enamel organs bore no part, or other cavities which stimulate it, but are as distinct from it as hydrocele from scrotal abscess. *If the fang instead of the crown project, it is not a true dentigerous cyst.*

Probably the reticular parenchyma of the enamel organ is destroyed by its expansion, but in the multilocular forms this may possibly aid in forming the partitions. The whole inclosure is lined with a serous membrane, which is sometimes considerably thickened and vascular, and continuous over the crown of the tooth, as would be expected from its origin. A microscopical examination of such specimens would be very interesting; it should show an absence of the "cuticula dentis" from the tooth and the continuousness of its covering, the enamel membrane, with the rest of the wall. The fluid is usually serous, but may be purulent,—contain cholesterine, flakes of lymph, or shiny matter, or vary in other respects. A bony exostosis in one case accompanied the cyst, and may have been the exciting cause of it. Other complications have occurred.—*Extract from a Prize Essay on the Dentigerous Cysts*, by W. S. Bolles, M.D.