WEEKS.

MANUAL

OF

OPERATIVE TECHNICS

A Practical Treatise on the Elements
of Operative Dentistry.

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PREFACE.

It is not my object to present in these pages an exhaustive work on operative procedure, or to conflict in any way with existing text-books on the subject, which, so far as the author is aware, cover the whole ground over which the student will travel in his three years' course of study.

The suggestions as to what may be done and how the subject may best be presented, are the result of the experience of the author and his confreres. Experience has shown that to attempt to indicate to students what and how much they shall learn of operative procedure from existing text-books, to enable them to intelligently perform practical operations, involves an immense amount of labor and an expenditure of time which can be better employed in some other direction.

I have attempted to present in a compact form such fundamental knowledge of operative dentistry as every student should possess before attempting to practice upon patients, and to direct him how to perform the various operations in the technic laboratory.

If we may judge by the large number of colleges which announce technic courses in their catalogues, educators all over the country are alive to the importance of a systematic course of manual training which shall give a more thorough knowledge of the teeth and the principles which underlie all operations upon them.

These are the conditions prompting the attempt to outline a course and to present a succinct statement of principles, which shall be a primer on operative dentistry for the student, his handbook and constant reference while performing the operations required. The desire to be helpful to both teacher and student has been the constant motive, and I hope that the object may be realized, and that the principles are so represented that all teachers may use them as a basis for their own particular methods.

T. E. W.

INTRODUCTORY.

"New times need a new system."

"To prevent going backward we must work on the line which goes forward."

In the early history of dentistry the young men who received their training from the best practitioners were, by much practice in the laboratory, of the purely mechanical or technical, taught to be "handy," but with the increasing demand for a more general scientific knowledge, there grew a tendency to platform instruction—an extension of didactic work at the expense of the practical. In many instances this resulted in a cramming of the head which left too little time for training the hand.

There is no escaping the truth of the relations existing between the mind and the hand. Some one has called the hand the moral rudder, the balance wheel of the mind. Certain it is that what the hand is to execute is originated in the mind; then through the eye, the mind directs the hand. Simultaneous training of the mind, the eye, and the hand is the underlying principle of the various systems of manual training, to which the teaching of technics in dental colleges is analagous.

Operative technics is generally understood to apply to that part of the instruction which is obtained by operations upon teeth out of the mouth. As this practice exercises the mind and the eyes, and increases the dexterity of the hand, it must be allowed that its governing principles are the same as those of manual training.

That the dental student should become "handy" by doing some suitable hand work, is not only desirable but necessary. The best teachers recognize that the child gains a much better understanding by seeing and handling and doing, than by merely hearing and remembering. They recognize also that systematic training of the hands is not antagonistic to mental growth, but assists it.

There are two kinds of knowledge—what we know through our own experience, and what we know through the experience of others. What is *told* us is another's; it rests on a different basis from that which we have gained by our own experience. Does the knowledge of the existence of the ant, or the bee, or the various winged creatures of the woods make an entomologist or a naturalist? Is a man a machinist because he has *learned* the parts of the steam engine, and can define axle, lever, plane, and screw? Should a man be called a *dentist* because he can name the teeth, bones, muscles and nerves, describe the making of amalgams, or detail the best method of filling a tooth? *No*, not even if he can rehearse *all* his teacher has repeated to him. A purely mental acquirement is a theorem, and a theorem is a demonstrable proposition. Whether it may be proved is always a question until the act of *doing* solves the doubt.

In the progress of knowledge, practice ever precedes theory. That it is necessary for the dental student to possess more knowledge than can be gained from lectures and text-books, of the form, structure, and diseases of the teeth, of the properties of materials, and of the forms and uses of instruments, as well as dexterity in handling them, before he be allowed to operate for patients, is now generally acknowledged.

Prof. G. V. Black, recognizing that the practical uses of any science or branch of knowledge are of higher importance than the purely intellectual, sounded a distinct note for advance, in a paper presented before the Chicago Odontological Society in June, 1888.

He proposed a course in operative technics, which, without limiting any part of the instruction in operative dentistry as usually given, would broaden and improve that teaching, which would, in fact, form the *basis* for didactic and clinical instruction. He says: "Students shall be taught the nature and physical qualities of the teeth upon which they are to operate, of the materials they are to use, and of the instruments by means of which they are to use them. This I would do in a series of object lessons, by having students handle teeth and study their forms and examine enamel and dentine by cutting them with instruments; manipulate the material used for fillings, study and practice the use of instruments, and learn the tests for perfect manipulation." This is the foundation of the courses in operative technics in the several colleges where that plan of teaching is in operation.

A course modeled on these outlines was instituted in the Chicago College of Dental Surgery for the session of 1888-9. The Dental College, Department of Medicine, of the University of

Minnesota adopted a similar course the following year. Others followed, until at the present time about one-fourth of the colleges of the United States have systematic courses in operative technics. Besides the outlines already referred to, and the paper by Dr. D. M. Cattell before the World's Columbian Dental Congress, comparatively little has been written; nothing so far as the writer is aware which would serve as a text or reference book for teachers and students has been published. To meet this demand is the present object.

The difficulty of presenting any form which in its entirety could be adopted by all teachers, is appreciated, but an endeavor will be made to present a course which shall embrace the *principles* which underlie operative procedure. It is generally conceded that a familiarity with the organs to be operated upon should take precedence of all else; consequently dental anatomy will be given first place.

The existence of so good a text-book of dental anatomy as that of Prof. Black's removes the necessity of giving more than a few suggestions as to how it should be studied and the manner of presenting the subject to classes. Experience has shown that while text-books, models, charts, etc., are indispensable, these are not all that is necessary. The teacher must study each class, modify the course to suit their needs, and present it in short, terse explanations. The introduction of these explanations at intervals gives relief from the tedium of handling and cutting teeth and all other purely manual exercises, as well as carrying out the object of simultaneous development of the mind, the eyes and the hands.

The equipment of the technic laboratory with double curtains, a screen and stereopticon, ready at a moment's notice to present images of the teeth and their structure, has proved both useful and instructive. These pictures, produced by photography, are more accurate, and the method of presentation seems to interest the student and hold his attention better than charts or drawings do.

The syllabus presented does not include pathology or therapeutics to any greater extent than is necessary to elucidate the points where they modify or govern operative procedure.

The object is to fill the time allotted to this work with the *what* and the *how*, leaving much of the *why* for subsequent instruction.

CHAPTER I.

OUTLINE OF COURSE.

OUTLINE OF THE COURSE BY DIVISIONS.

- I. Dental Anatomy.
  - Descriptive.
    - Terminology and nomenclature.
    - Notation.
    - Form.
    - Arrangement.
  - Structural.
    - Macroscopic.
    - Microscopic.
- II. Instruments.
  - Steel, its composition and properties.
  - Shaping, tempering and finishing.
  - Classification according to form and uses.
  - Action or use for each form.
- III. Canals.
  - Gaining entrance to canals.
  - Removal of pulps.
  - Cleansing and preparing canals.
  - Filling canals.
- IV. Cavities.
  - Classification from location and causes.
  - Preparation on principles governing.
- V. Pulp Treatment.
  - Conservative
    - Treatment and Protection.
    - Capping.
  - Radical.
    - Surgical devitalization.
    - Devitalization by drugs.
- VI. Filling materials.
  - Characteristics and composition.
  - Preparation.
  - Introduction into cavities.
  - Finishing fillings.

DESCRIPTIVE ANATOMY.—TERMINOLOGY AND NOMENCLATURE.

Recitations of first two chapters in Black's Dental Anatomy. Each student is furnished two brass rings about two inches in diameter; one bearing the teeth of one side, superior; the other the teeth on one side, inferior. Upon these teeth he will *locate* the different markings, as angle, apex, crown, root, pit, sulcus, groove etc.

Notation.—The following notation is one which furnishes the simplest form of expression for any given tooth. It was first introduced by Dr. Corydon Palmer. The use of the Roman numerals to designate the deciduous teeth was suggested by Dr. W. P. Dickinson.

DECIDUOUS TEETH.		PERMANENT TEETH.	
V IV III II I	I II III IV V	8 7 6 5 4 3 2 1	1 2 3 4 5 6 7 8
V IV III II I	I II III IV V	8 7 6 5 4 3 2 1	1 2 3 4 5 6 7 8

EXAMPLES.—Right superior central incisor, permanent, 1 |

Left " first bicuspid, " | 4

Right inferior second molar, deciduous, V |

The use of this system saves much time in labeling blocks or drawings and in making records. It will be used when convenient in this article.

Form.—Recitation upon each class of teeth.

Selection of one or more of each class.

Indicating upon these their chief markings.

Drawing or modeling each tooth.

First, recitation is heard upon the superior incisors. Following the recitation, the class make practical application of the information gained from the book, by selecting from a miscellaneous lot of teeth, one or more specimens of 1 | 1, and 2 | 2, pointing out and naming their crowns, roots, gingival line, surfaces, angles, grooves, ridges, and any departure from the normal.

As it seems to impress upon the student's mind the outline of the tooth, the sections for printing are cut while on the study of the form of that tooth

Finally, drawings should be made of the labial, lingual, and mesial surfaces of 1 and 2; or what is better, model each tooth in clay. These last exercises must be from memory.

This plan of study is carried out upon all the teeth, deciduous and permanent.

Arrangement.—All the permanent teeth are now selected and arranged after nature, in a dummy articulator. (See Fig. 1.) This exercise demonstrates the students knowledge of arrangement.

STRUCTURAL ANATOMY.

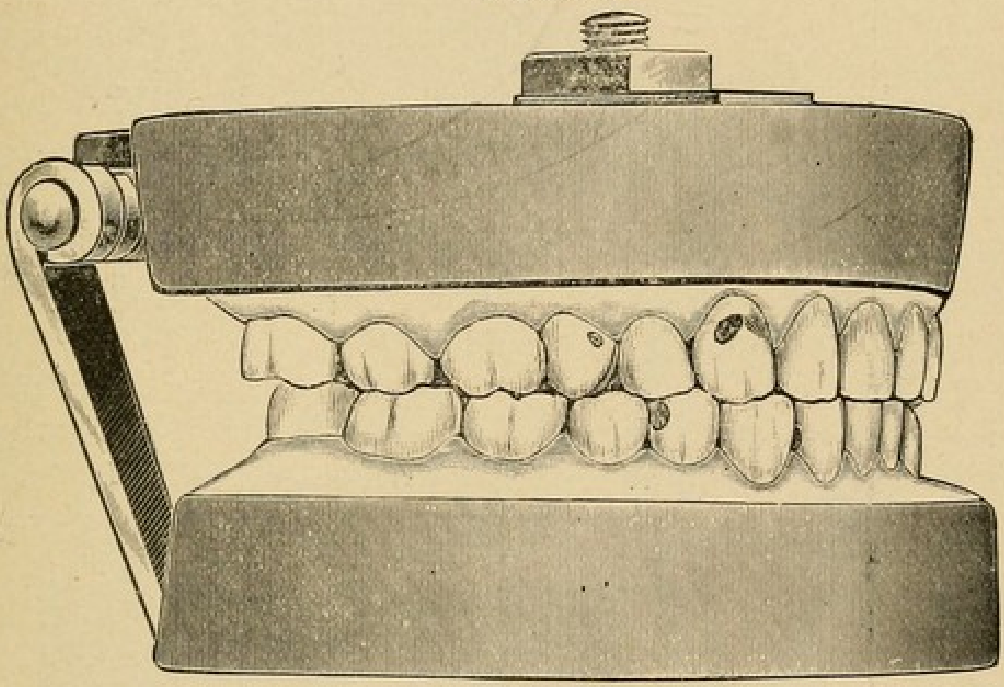
Macroscopic.—Cutting sections, longitudinal and transverse.

Printing silhouettes with these sections.

Studying form, location and size of pulp chamber and canals; form and thickness of enamel, and relative proportion of crown and root.

The importance and advantage of this work cannot easily be overestimated. It is the first direct contact that the student has with teeth. By cutting them he is taught the difference in the character of enamel and dentine. It gives training in the use of

FIG. 1.

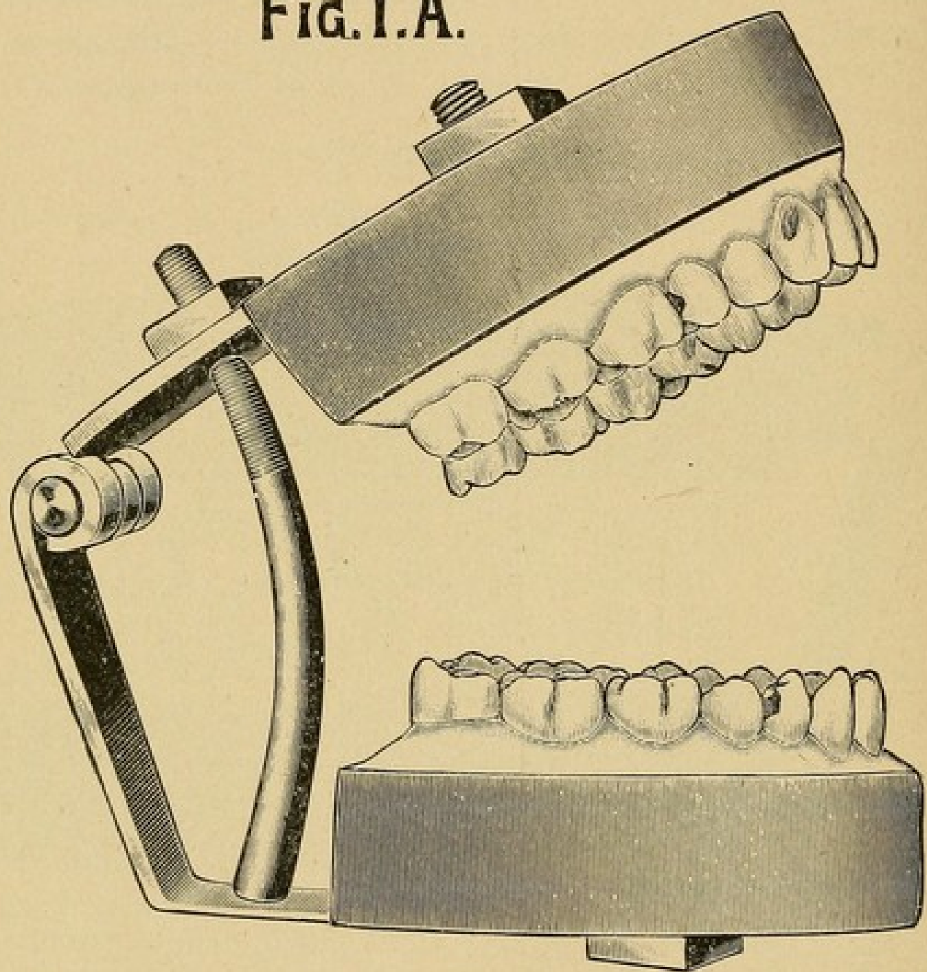


NOTE.—This dummy is made by bolting two brass forms to a strap hinge, which is bent so the joint comes above the line of occlusion. There is a bolt passing through it by means of which it may be prevented from opening wider than two or two and one-half inches, as in Fig. 1 A. The forms have a groove for the reception of the teeth. In arranging the teeth a thin layer of wax is placed in the bottom of the groove, which serves to hold the teeth in position until the proper arrangment is attained when they are finally invested in plaster. The teeth arranged for this exercise are the ones upon which the students perform the various operations comprised in the last four divisions of the course.

broaches. It fixes in his mind the forms of the teeth and the relative form, area, and location of their component parts. It teaches him the system of notation, and, best of all, it cultivates habits of neatness and order. At the same time it should not be extended until it becomes irksome, and it should not trench upon time required for equally important work. As the result of the author's experience, he has introduced several modifications in the work which he believes gives the student the greatest benefit in the shortest possible time.

The *teacher* should collect, examine and classify the teeth for this work; he should furnish the students with teeth and the blocks for mounting, and he should *retain the sections*. From this collection, students of each year will have opportunity to make a much better line of prints than if they were restricted to the cuttings of

FIG. I. A.



one winter. These sections are filed in trays, holding six blocks, which are incased in filing boxes holding twelve trays.

Each student should cut a section of at least one aspect of every tooth, and make prints of every aspect of six teeth of each denomination, in the book provided, besides a duplicate sheet of each leaf for the teacher.

The *teacher* should cut on every section the relief line showing the enamel. This relief line gives several advantages: first, it shows the relative proportion of crown and root; second, it shows the form and thickness of enamel upon different parts of the crown and, third, it shows the relative thickness of enamel upon the different teeth. It is cut with a minim wheel bur, which removes the stratum granulosum. The student needs for this work:

1 stick Am. Ex. sealing wax,
1 half round file, 8 inch, bastard cut, medium coarse,
1 bench vise,
1 alcohol lamp,
1 jeweler's hack saw, with 12 saw blades,
1 wax spatula.
1 excelsior ink pad.
1 rubber pad 3 in. x 6 in. x ¼ in.
1 book for printing, open at end. Leaves ruled as in Figs. 6 and 7.

Some fine canal explorers, some fine sandpaper, an old tooth-brush and some cotton cloth. To insure uniformity, these materials should be selected by the teacher and supplied from the clerk's desk at the college.

The teacher should provide the teeth for cutting, and the blocks for mounting; also tablets of paper same texture, size and ruling as books; and some tablets of similar paper for experimental printing.

In marking the blocks bearing teeth which are to be cut longitudinally, the abbreviations, la-labial, b-buccal, li-lingual, m-mesial and d-distal, may be used. The $\frac{1\text{-}2\text{-}3}{1\text{-}2\text{-}3}$ being conical, are usually cut to the central axis. A tooth cut mesio-distally would show a la. or li. aspect, and one cut labio- lingually would show a m. or d. aspect; but to avoid confusion we will label all sections cut in the manner first mentioned la. and those mentioned second, m. If transverse sections are printed upon pages ruled as in Fig. 7, no marking is necessary further than the notation.

The blocks bearing *superior* teeth should have figure denoting *tooth* in *upper* left corner, and letter or abbreviation denoting aspect, in upper *right* corner. See Fig. 2.

Those for *inferior* teeth should have figure denoting tooth in *lower* left corner, and letter or abbreviation in lower *right* corner. See Fig. 3.

As mentioned before it is an advantage to cut the sections of each tooth immediately after reciting upon the *form* of that tooth. Directions for cutting of *one* will stand for all of the teeth.

Let each student select from a miscellaneous lot of teeth a superior central, every second student cuts la. aspect, the alternates cutting m. aspect. Fasten upon block with sealing wax, see Fig. 4 and Fig. 5. Fix block in vise; holding the file horizontally at an angle of 45° with long axis of tooth, cut rootward until pulp chamber is penetrated. Pass a fine explorer through this opening into the canal and through the apical foramen; the explorer may be left in canal and cutting resumed until the canal is exposed in its entire length, when it is removed and the surface of section made as nearly plane as the direction of the canal will permit.

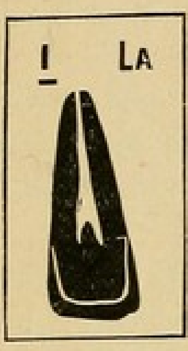


FIG. 2.

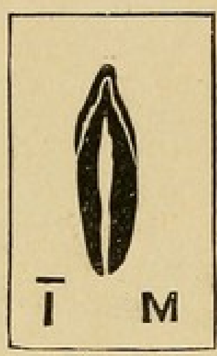
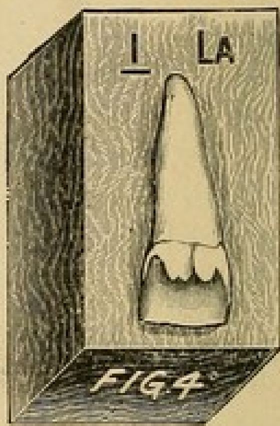
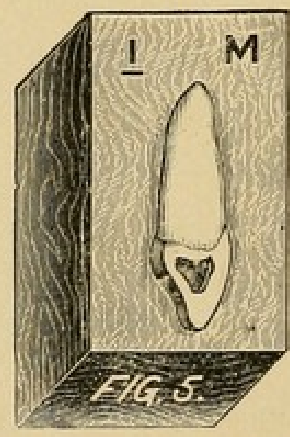


FIG. 3.





NOTE.—Blocks are 1¼x¾x¾ inches.

The section will then appear as in Fig. 2. When the teacher has accepted it and made the relief line it is ready for filing in the collection.

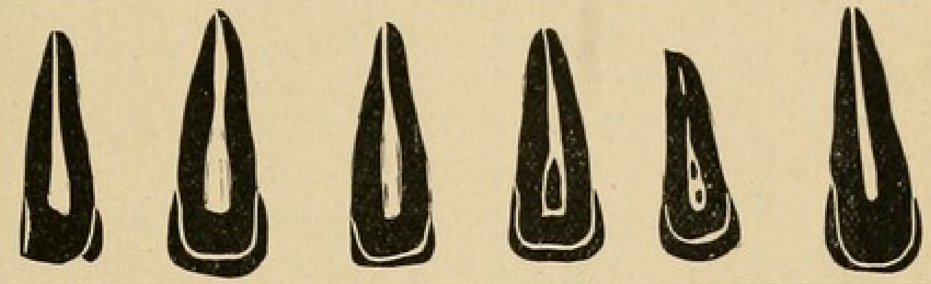
All the teeth must be mounted and cut as directed for *one*. Better prints result if the printing is done after the sections of *all* the teeth are cut. The printing is easy if care is taken to keep the surface of sections *clean*, if too much ink is not used, and if every part of the surface is held firmly in contact with the paper long enough for it to take the ink.

1893-4.
Bench No. 4.

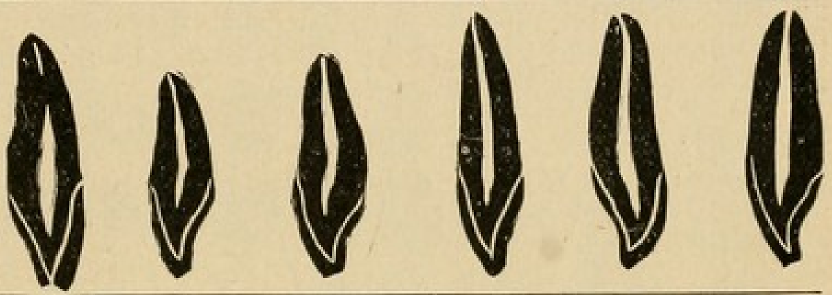
FIG. 6.

GEORGE HANSOM.

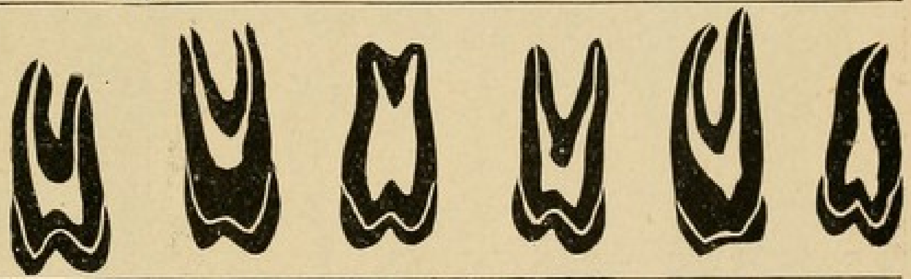
I, La.



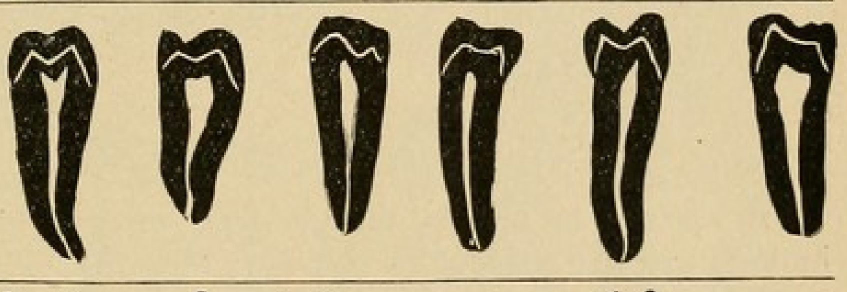
I. M.



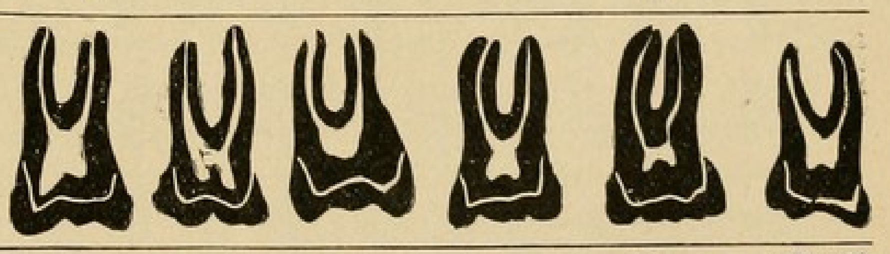
4. M.



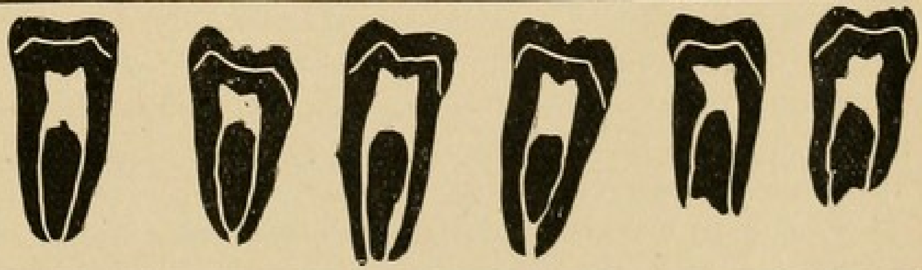
5. M.



6. B.



6. M.



Note.—This page is ruled as the pages in the books are for longitudinal prints. The prints were taken from sheets furnished the teacher by five students in the Freshmen class for 1893-4, College of Dentistry, Department of Medicine, University of Minnesota.

In longitudinal sections of $\frac{1\text{-}2\text{-}3}{1\text{-}2\text{-}3}$ only la. and m. aspects need be shown, but in $\frac{4\text{-}5\text{-}6\text{-}7\text{-}8}{4\text{-}5\text{-}6\text{-}7\text{-}8}$ b. li. m. and d. aspects should be shown. See Fig. 6.

For transverse sections many teeth may be utilized which are useless for other work, as the principal point to be observed is at or near the gingival line. These sections cannot always be preserved, but each one of a group of six students may print from the other's cuttings.

The value of transverse sections is in showing the form of root canals, whether round or flattened. The pulp chambers, located in the crowns, are easily explored when once penetrated ; so it is less important that their outlines as seen in transverse sections be shown. Consequently we need not make sections, throughout its

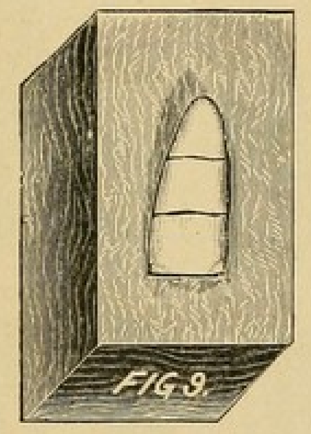
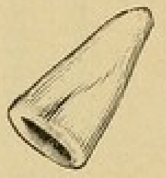


FIG. 9.

FIG. 8


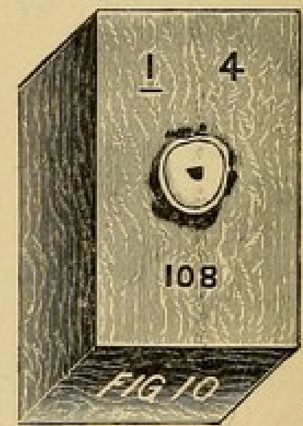


FIG. 10. *

entire length, of more than one tooth of each denomination. These should be printed on one page ruled as in Fig. 7. Printed in this manner they show not only the outline of pulp chambers and canals with the outline of the tooth, but they show the increase in width of interdental spaces, from contact point to gingival line. In cutting transverse sections the cuts between gingival line and apex may be made with the saw. These sections may be preserved. For the supplementary prints let the students select teeth whose crowns have been lost by decay ; six of each denomination. Have them cut to print view of gingival line, Fig. 8. They may then be fixed on blocks and sawed, Fig. 9. The sections may then be mounted on blocks and annotated, Fig. 10.

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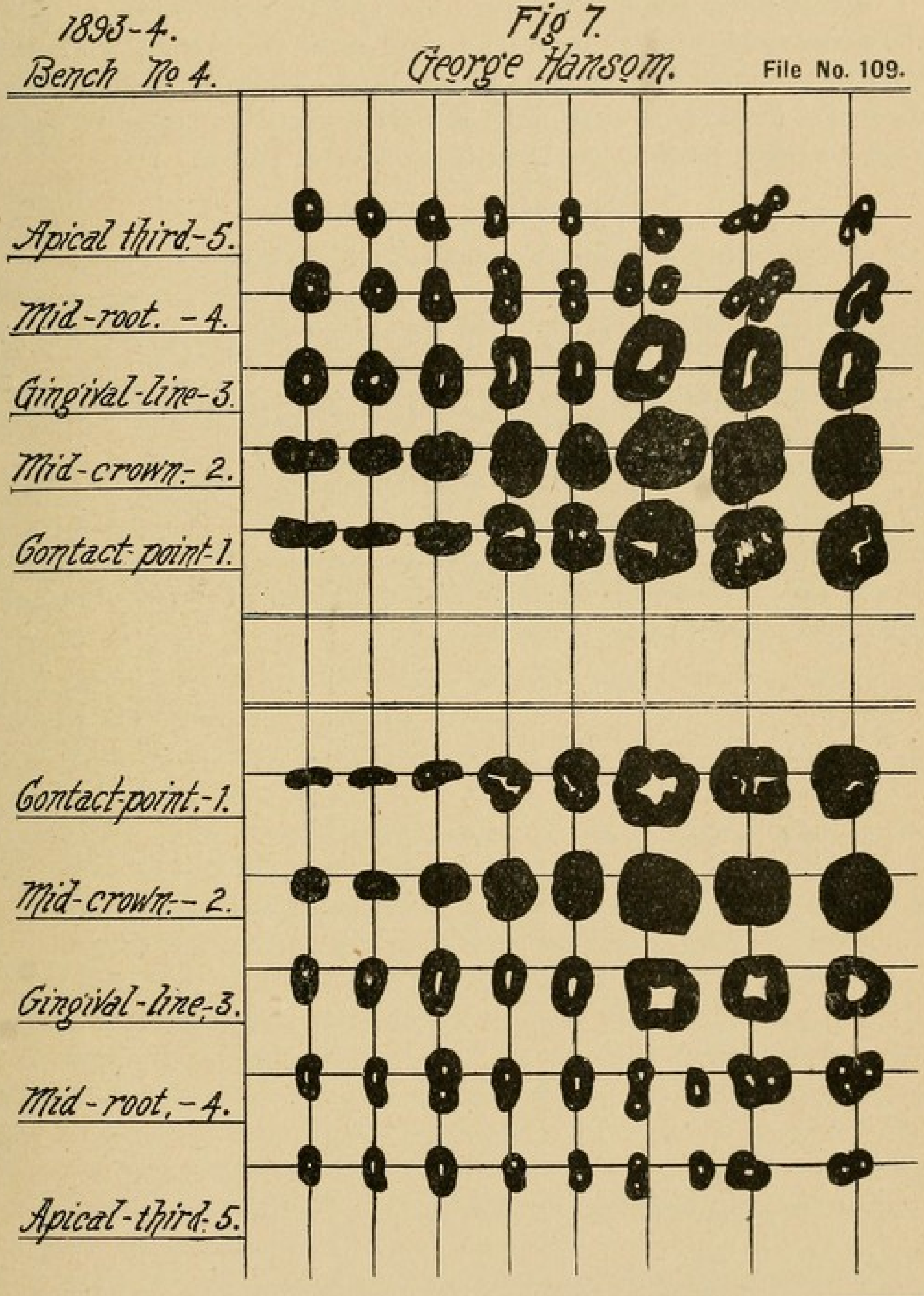
*1 indicates that the tooth shown is an upper central incisor, **4** indicates that the view is midroot, and **108** is the file member ; all of the teeth on one page have the same file number.



NOTE.—The prints on the page were made from transverse sections of all of the teeth of the left side. While not taken from the same mouth they were of uniform proportion and type. Prints made in this way are of much greater value if the teeth are so selected. Notice that prints Nos. 3, 4 and 5 are of more importance than Nos. 1 and 2.

STUDYING FORM, ETC.

Recitations should be heard upon location and form of pulp chambers and canals, form and thickness of enamel and the relative proportion of crown and root as shown in the prints. The students' knowledge should be tested by requiring them to draw, from memory, outlines showing these several points.

STRUCTURAL ANATOMY.

Microscopic.—Cutting sections (dry). Making drawings.

Each student should cut one longitudinal and one transverse section ; the assignment of teeth should be such that sections of the several classes of the teeth would be made by the class as a whole. By studying the other's sections, each student will receive the same instruction upon all the teeth.

Each student should make a drawing of that which the microscope reveals of dentine, enamel and cementum. If teeth are cut and studied in the regular course on histology this part of the course may be confined to study and drawings of good photomicrographs thrown upon the screen.

CHAPTER II.

STEEL AND INSTRUMENTS.

STEEL, ITS COMPOSITION AND PROPERTIES.

1. If the working of steel and the manufacture of instruments is comprised in the course in metallurgy, instruction in the operative technic laboratory may be confined to pointing, tempering and finishing of instruments, and the making of canal explorers and pulp extractors. This practical work should be supplemented by a study of the division on steel of either Essig's Metallurgy or Kirk's Metallurgy in the American System of Dentistry, with a didactic review and recitation, after the following syllabus:

STEEL.

Definition, "an alloy of iron with a small per cent of carbon." (Malleable iron also contains carbon.)

Specific gravity 7.893 to 7.736.

Melting point 3272, F.

Steel is capable of being hardened and tempered; iron is not.

Mild steel—that contains 0.15 or less per cent of carbon.

Hard steel—that containing 0.5 to 4 per cent of carbon.

Mild steel is capable of but little temper.

Hard steel is capable of much temper.

Instrument steel contains about 2 per cent of carbon.

Steel is hardened to its limit by heating to redness and immediately plunging in cold water. The more carbon it contains the harder and more brittle it becomes.

Hardened steel may be "let down," or tempered, by heating to a lower temperature and plunging. Plunging in oil gives a tougher temper than plunging in water.

Steel may be softened or annealed by heating to redness and cooling slowly; extreme softness is attained by excluding the air during the cooling process.

If overheated, steel becomes blistered, burnt and brittle—incapable of receiving a fine temper.

Instruments for different uses require different degrees of hardness.

Color indicates the degree of hardness.

Illustrate by holding a small rod of *polished hardened* steel in the flame until the various shades, from deep blue to faint yellow, appear; then plunge. The result will appear as in Fig. 11.

For the various dental instruments the temper as indicated by color should be as is shown in table opposite Fig. 11.

PRACTICAL EXERCISES.

Filing. Make of piano wire several very small and medium canal explorers, with long taper; on a part of these turn hooks for pulp extractors. To do this, hold them in a horizontal position on the anvil, covering one-eighth of an inch of the point with the large blade of a penknife, having the edge of blade toward large part, or handle, of the explorer. If the blade is held firmly against the anvil, and the handle of the explorer elevated to a perpendicular position, the point will be turned at right angles with the rest of the instrument. It may then be ground to the proper length. If desirous that the point or hook be at an acute angle with the long axis of the instrument, the instrument should be carried further in the turning process. The result will be as in Fig. 159.

Annealing.—Draw the temper in two excavator blanks by heating to redness and cooling slowly. Draw the temper in six Swiss broaches by laying on a plate of iron and heating to redness, allowing them to cool slowly. Draw the temper in six more by laying them on the iron and covering with plaster Paris or pulverized pumice, heating them to redness and allowing to cool before the covering is removed. Those annealed by the second process will be softer and tougher than those treated in the manner first described.

Shaping.—From one of the excavator blanks provided, shape, by cold hammering and filing, a small scaler same shape as Figure 78, length of blade $\frac{1}{8}$ inch, width of each side of blade at base of blade $\frac{1}{32}$ inch.

From another blank, by the same process, shape a chisel excavator like Figure 12, each side or edge of blade to be $\frac{3}{32}$ inch long.

Polishing. Remove all file marks and polish with emery paper of increasing fineness.

Hardening. Coat with soap; carefully heat to redness and plunge in cold water slightly acidulated.—Again polish.

Tempering. To prevent too sudden a loss of hardness, place point of blade in contact with the face of a small hammer. Hold shank in the flame until the proper colors appear, then plunge quickly in oil.—Polish.

Sharpening. A keen edge should be given on a fine Arkansas stone; be careful to preserve the proper bevel.

The above comprises the practical work, and while not interfering with any fuller course which may be given, it enables the student to repoint any cutting instrument and to keep himself supplied with canal instruments. It also relieves the tedium of the large amount of didactic work necessary in this division.

CUTTING INSTRUMENTS.

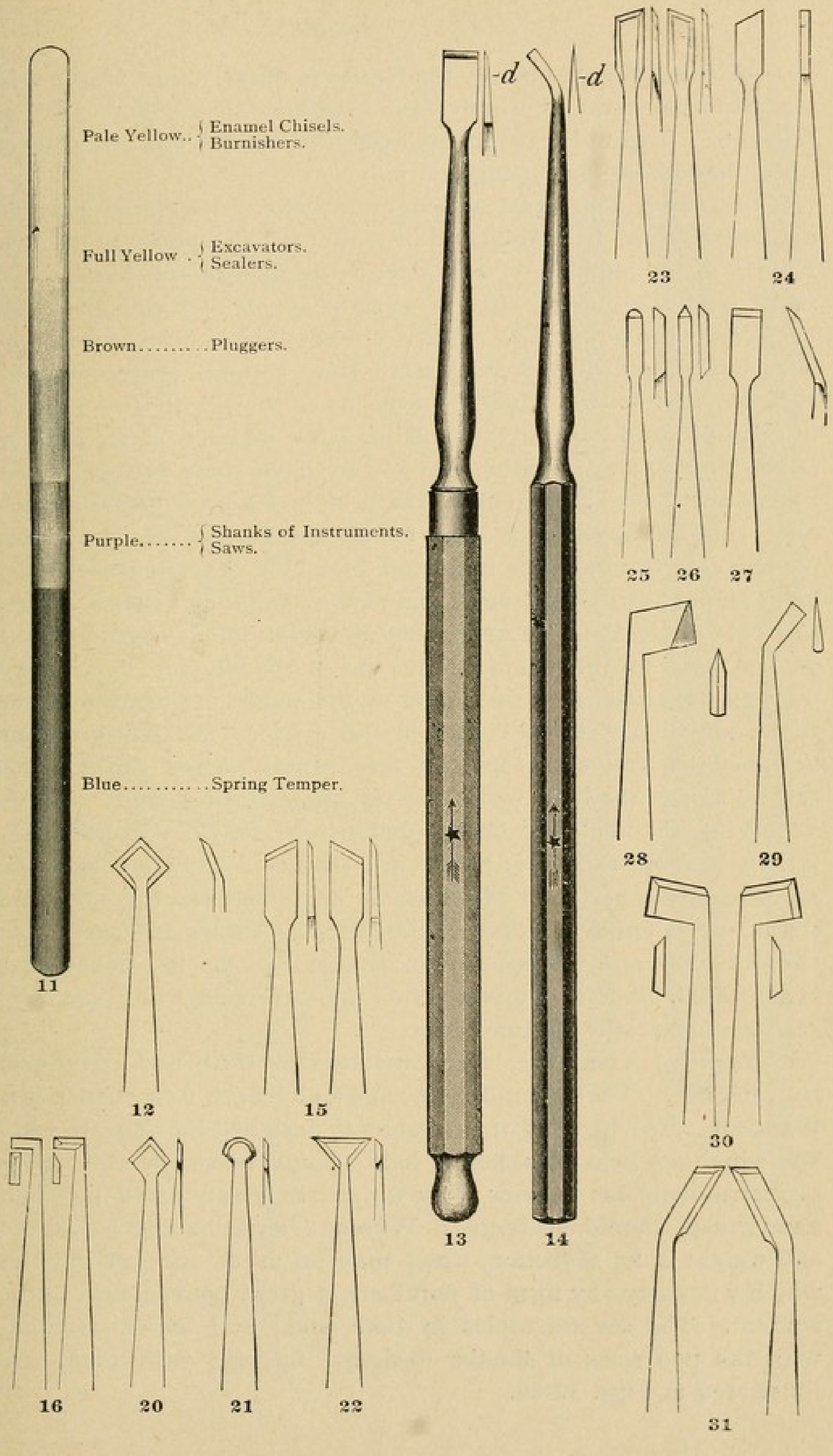
Dental instruments for cutting are analogous to such mechanical tools as the axe, chisel, knife, saw, file, and grinding wheels. As chisels, excavators, lancets, and scalers are similar in their form and action, they may be considered together. Each of these instruments has three distinct parts—the blade, the handle, and the shank. The blade is the acting part, that portion which cuts or scrapes. The handle is that portion held in the hand, by means of which the blade is manipulated. The shank is that portion which connects the blade and the handle.

Blades. These are of two forms; one having the bevel all on one side, Fig. 13, *d*; the other having an equal bevel on both sides, Fig. 14, *d*. The advantage of the double bevel is that both sides cut equally well; this is not important in instruments whose blades are on a line with the handle and shank, Fig. 13; but in those in which the blade is beveled as in Fig. 15, or in those in which the blade is at an angle with the axis of handle and shank, as in Figs. 14 and 16, it may be employed to obviate the necessity for two instruments. The length of bevel or angle of the cutting edge may be ascertained by placing the edge of the blade at the center of a circle which is divided as in Fig. 17. With one side of the blade upon the line drawn perpendicularly through the circle, the figure on the periphery of the circle on the line which follows the other side of the blade, will indicate in degrees the angle of the cutting edge. Fig. 17 *a*. Given the desired bevel or angle of cutting edge for any blade, it may be ascertained when it is correct in the manner just described. The length of bevel, or thin-

CLASSIFICATION OF INSTRUMENTS.

(Blackboard Diagram.)

- Instruments.
  - Cutting Instruments.
    - Instruments for the preparation of cavities and removal of deposits.
      - Chisels.
      - Excavators.
      - Lancets.
      - Scalers.
      - Drills.
    - Instruments for finishing.
      - Files.
      - Saws.
      - Trimmers.
      - Grinding instruments.
      - Smoothing instruments.
      - Smoothing materials.
  - Condensing Instruments.
    - Instruments for introducing and condensing filling materials.
      - Pluggers.
      - Burnishers.
      - Spatulas.
  - Miscellaneous Instruments.
    - Explorers.
      - Cavity.
      - Canal.
    - Broaches.
      - Smooth.
      - Barbed.
      - Hooked.
    - Clamps.
      - Rubber dam.
      - Matrix.
    - Separators.
      - Wedge.
      - Traction.
    - Mallets.
      - Hand.
      - Mechanical.
    - Adjuncts.
      - Matrices.
      - Wedging materials.
      - Ligatures.
      - Rubber dam and materials for excluding moisture.
      - Absorbents.
      - Mirrors.
      - Pliers.
      - Scissors.
      - Syringes.
      - Cheek and Tongue holders.



Pale Yellow.. Enamel Chisels. Burnishers.
Full Yellow . Excavators. Sealers.
Brown.........Pluggers.
Purple,...... Shanks of Instruments. Saws.
Blue...........Spring Temper.
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-d
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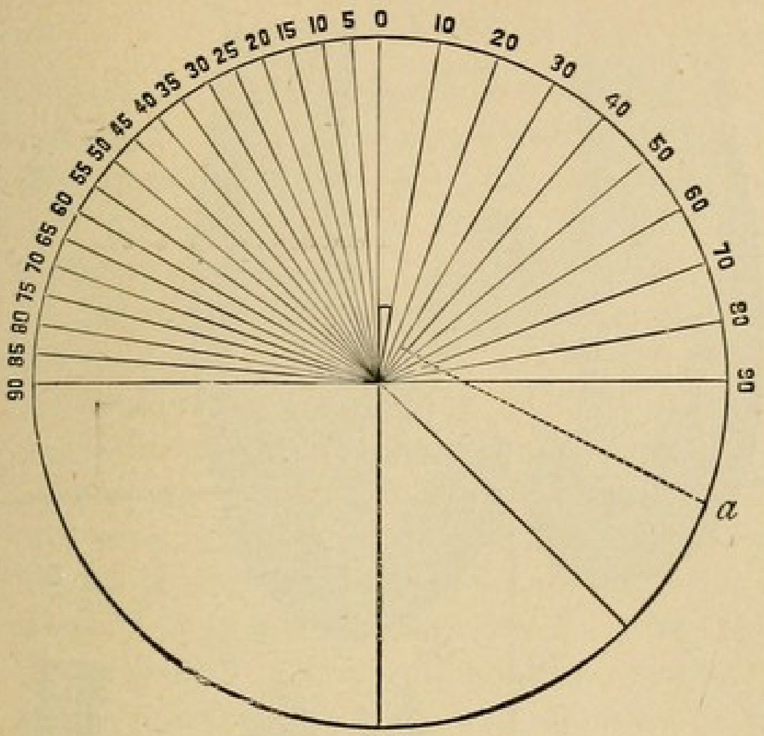
ness of edge, is governed by the hardness or resistance of the substance to be cut, and whether the substance is to be "split" or "shaved." Enamel instruments need a stronger blade and shorter bevel than those for cutting dentine.

In chisels for direct cutting, *i. e.*, where the force may be delivered direct from the hand or mallet to the point to be cut, Fig. 19 *b*, the blade is on a line with the axis of the handle and shank, and the cutting edge is at right angles with this axis; Fig. 13. When the point to be cut is not accessible to direct force, *i. e.*, where the force must be delivered from a point represented by Fig. 19 *c*, while the blade is still on a line with the axis of the handle and shank, the cutting edge may be at an oblique angle, Fig. 20 ; or rounded, Fig. 21 ; or have three cutting edges, Figs. 22 and 23. If the cutting is to be in a groove or fissure, the blade may be shaped as in Figs. 24, 25, and 26. If the force must be delivered from a point indicated by *d*, Fig. 19, the blades must be at an angle with the line of axis of the handle and shank. Figs. 27 to 31. The *degree* of angle may be determined by placing the central axis of the shank upon the perpendicular line drawn through the circle, with the center of the angle, or junction of the shank and blade at the center of the circle. The figure at the periphery of the circle on the line which passes through the central axis of the blade will show the degree of the angle. Fig 18.

While the blades of chisels and excavators do not differ materially in form, excavator blades are smaller. They are used *inside* of cavities, and there is always an angle between the blade and shank, or an angle or curve in the shank. Angles and curves between blades and shanks, and in shanks, are for the purpose of bringing the blade into direct action upon surfaces which are inaccessible to straight instruments.

Handles. These are largely a matter of taste and individual convenience. They should have sufficient length to accommodate the hand. The handles of instruments designed for delicate work and which are held as a pen is held, should be small, while those of instruments for heavier work which are manipulated by a full hand grasp, should be larger. Where a large handle is desired and weight is an objection, wood may be used. Socket handles which will carry any form of point are a great convenience to the student. The several styles in both steel and wood, together with the two sizes of shanks designed for use with them, are illustrated in Figs. 32-39.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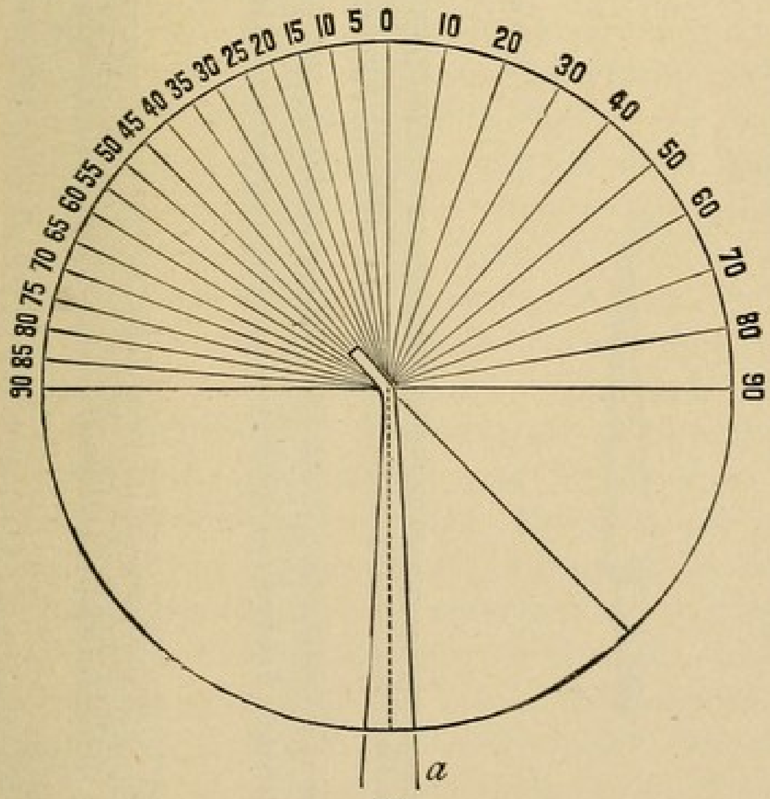
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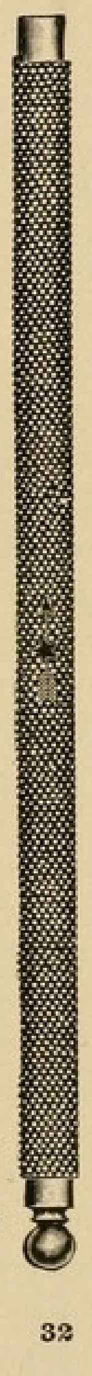

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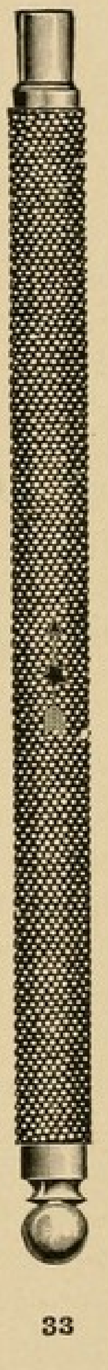

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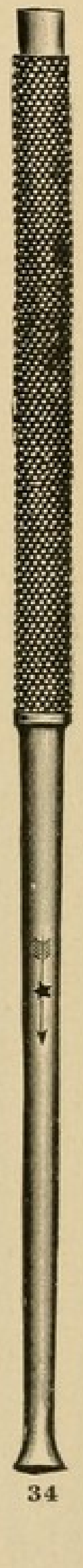

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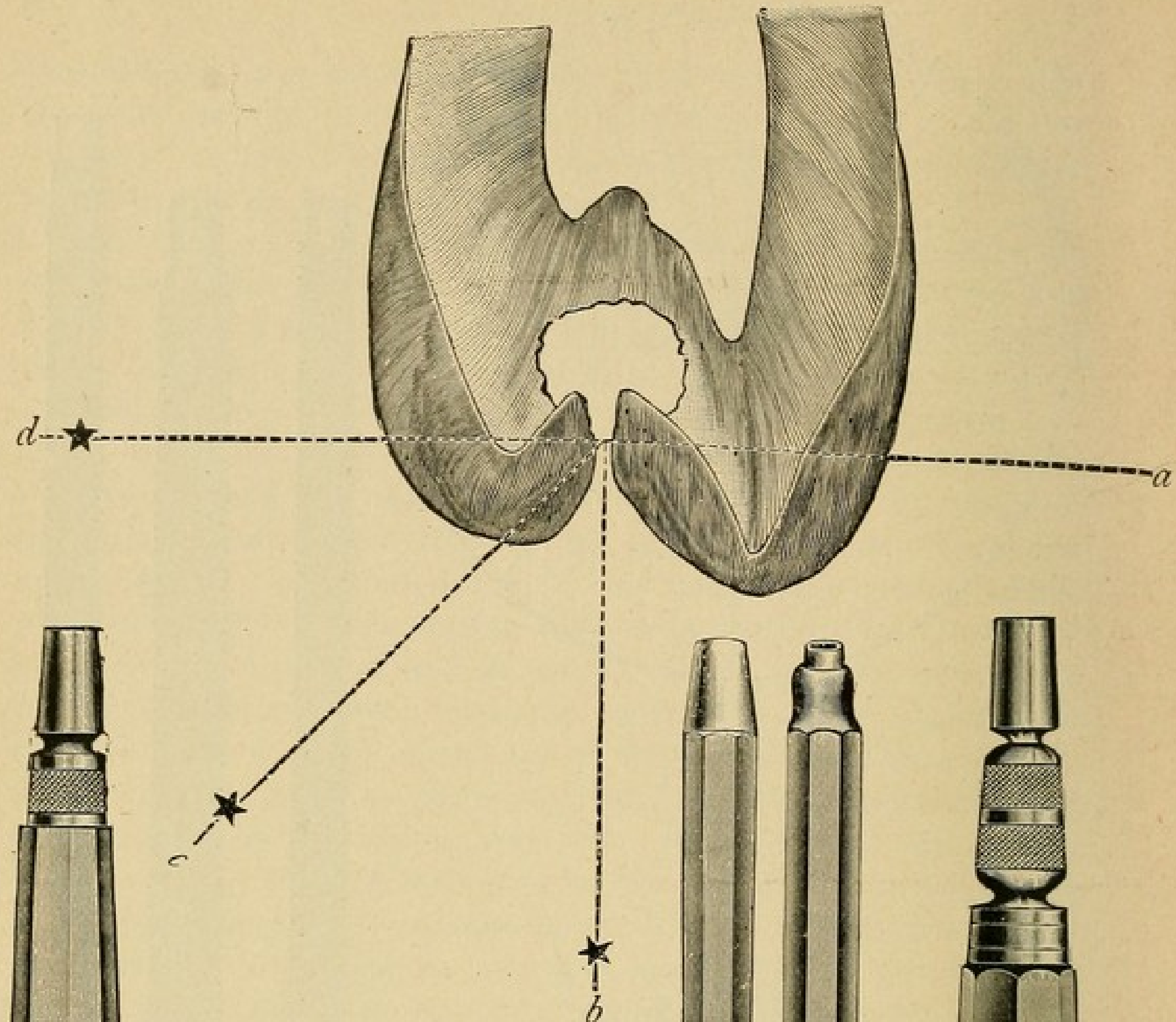

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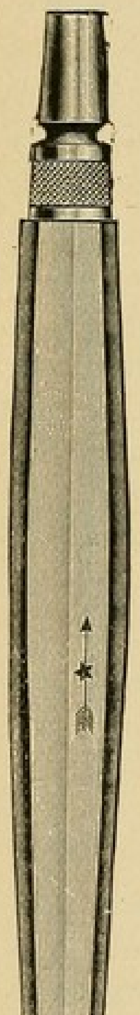

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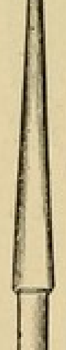

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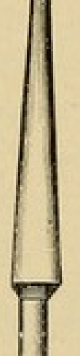

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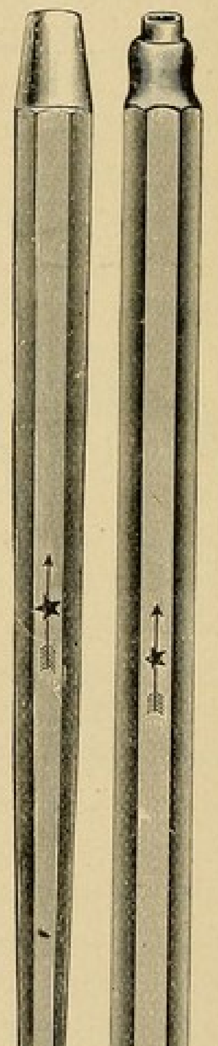

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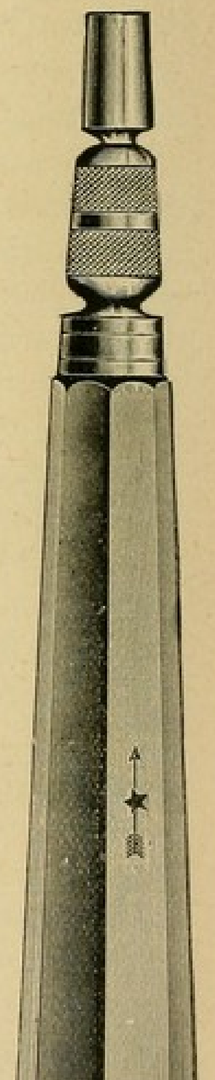

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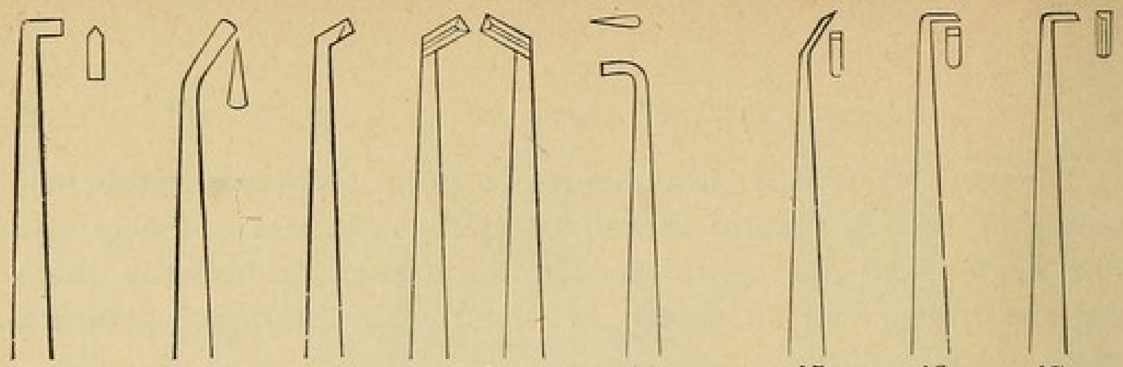
Shanks. The taper from handle to point is for the better balancing of the instrument as well as giving lightness and delicacy. The angles and curves which occur in shanks, or between them and the blade, will be shown in illustrating the more complex forms of excavators.

Excavators. There are three primary forms: the hatchet, in which the *width* of the blade is in line with or parallel to the axis of handle and shank, Figs. 40-44; the hoe, in which the *width* of blade is at right angles with the axis of handle and shank, Figs. 45-49; the spoon or scoop, whose blade, in the simple forms, bears the same relation to the axis of the handle and shank as do the blades of the hoe; the blades of this form are either round, pear-shaped or pointed. Figs. 50-52. From the great variety of complex forms of curves and angles, only the chief types will be noticed, showing first the single instruments, Figs. 53-61. Those for lateral cutting, which come in pairs, rights and lefts, are shown in Figs. 62-68. All round pointed or convex edged instruments are used where a concave surface is desired. All square pointed instruments are used where angles are necessary.

Lancets are designed for the cutting of the soft tissues, for severing the attachment of the gums at the gingival line, prior to extracting; for making incisions for the escape of pus in alveolar abcesses, and in all operations involving the cutting of the soft tissues. The blades are of the knife form, having a very acutely beveled, thin keen edge. The shanks are seldom curved, and any angles between the shank and the blade are governed by the same laws as those governing chisels and excavators. The typical forms are illustrated in Figs. 69-71. The handles, preferably of ebony, bone or ivory, are shown in Figs. 70-71.

Scalers. These instruments are designed for the removal of hard deposits upon the teeth. The blades are similar to the chisel and the chisel form of excavator. The angles and curves of these instruments are also governed by the same laws as those governing chisels and excavators. The principal types are illustrated in Figs. 72-81. Those shown in Figs. 72-74 are designed to be used with a pushing motion in the removal of deap-seated calculus from the roots of the teeth. Fig. 75 is for the same purpose, but is used with the pulling motion. Fig. 76 is also for the same purpose and can be used both to push and to pull. The remaining numbers are for the removal of the heavier deposits about the necks and upon the crowns of the teeth; some of these, notably Figs. 77 and 78, are useful in opening cavities and trimming enamel margins.



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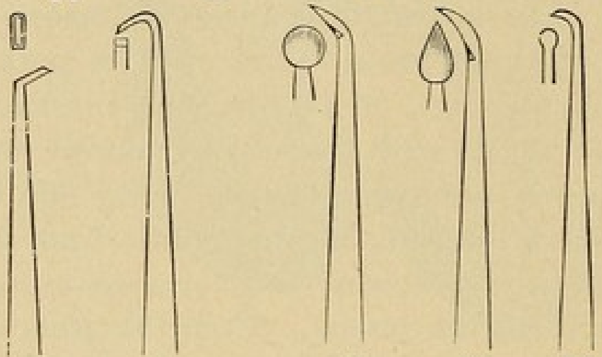

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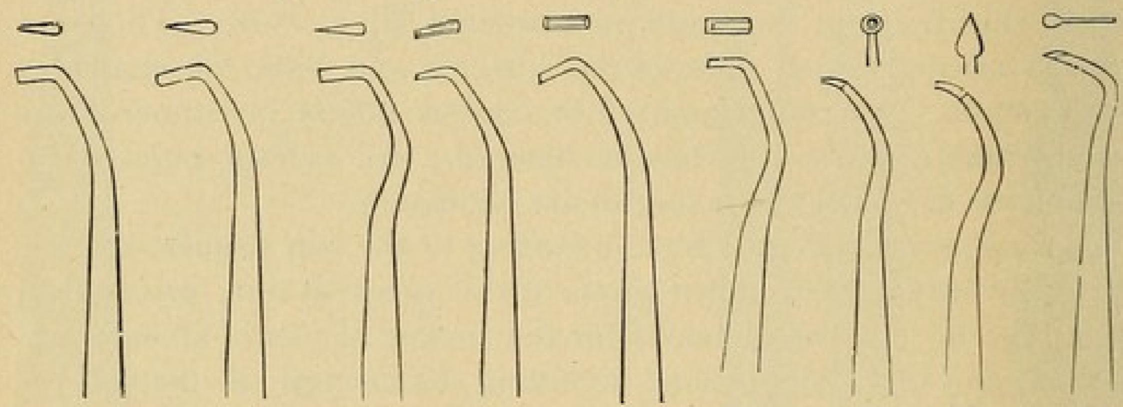

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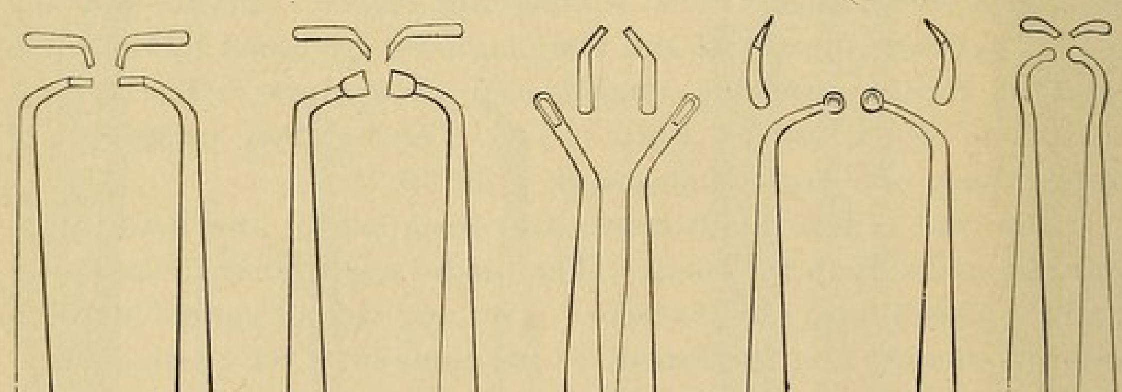

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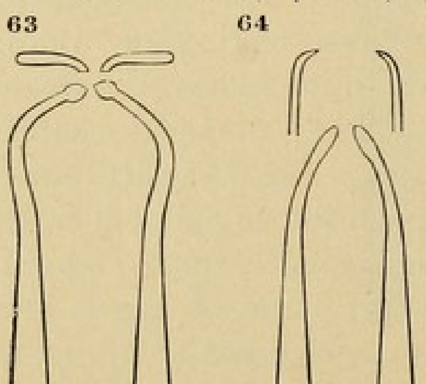

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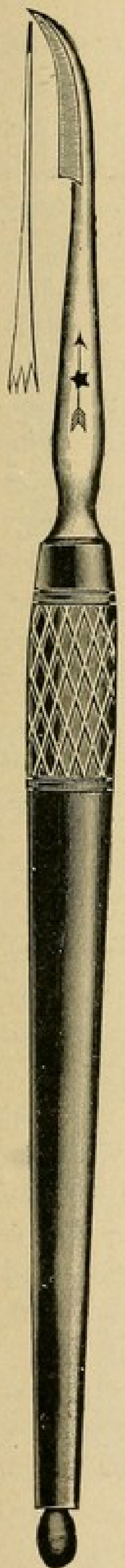

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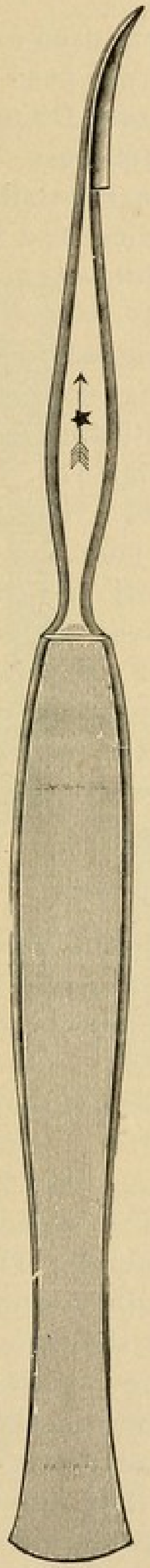

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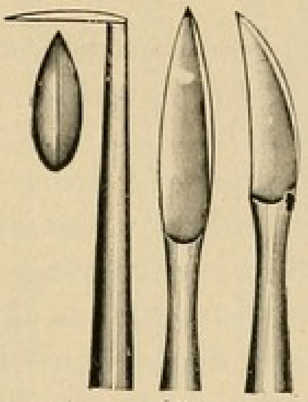

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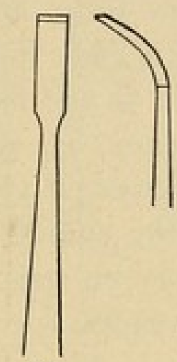

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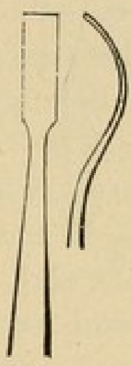

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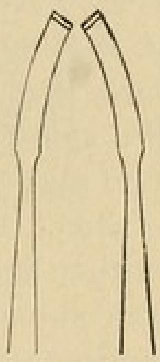

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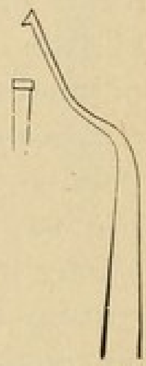

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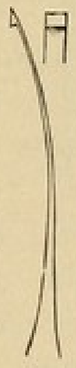

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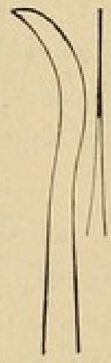

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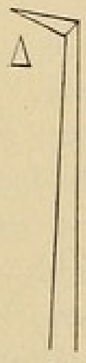

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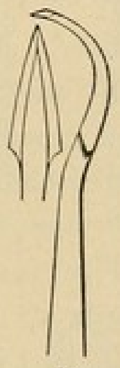

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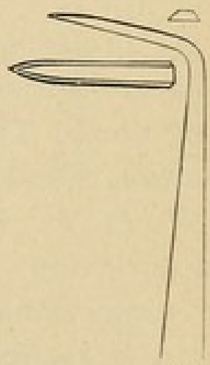

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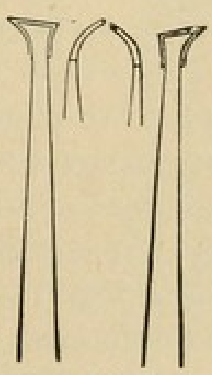

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Drills. These instruments are now seldom used except in the dental engine. In the technic laboratory they are used in a revolving head socket handle. Fig. 82. The Century Dictionary gives under the definition of "drills" not only "dental burs" but all side cutting instruments or "reamers"; under a finer definition we may consider drills as instruments for boring holes, and reamers, or side cutting instruments, as agents for enlarging openings already existing. Many dental burs have the ability to act both ways. The instruments shown in Figs. 83-86, designed for working in root canals, illustrate these three types. Fig. 83 is a drill, Figs. 84 and 85 are reamers. Fig 86 is both drill and reamer. The various forms of drills are illustrated in Fig. 87. The several forms of cavity burs are seen in Figs. 88-97. The round, Fig. 88; the oval, Fig. 89; the pear, Fig. 90; the bud, Fig. 91, and the pointed fissure, Fig. 92, belonging to one family, and cut the same, *i. e.*, leave the same kind of surface, as convex edged, round or pointed, spoon excavators. The cone, Fig. 93; the inverted cone, Fig. 94; the wheel, Fig. 95, and the square or flat end fissure, Fig. 96, are of another family, and may be used for the same kind of cutting as the square end excavators, *i. e.*, where plane surfaces and angles are required.

INSTRUMENTS FOR FINISHING FILLINGS.

Finishing Burs. These are of the same forms as cavity burs, but are larger and finer cut. They are, in fact, single cut, revolving files. There is a newer form which is double cut, made in two forms, round and pear-shaped.

Files. The file is a tool too well known to need special description. The introduction of the dental engine, with its diverse armament of burs, has almost entirely abolished the use of files except for the finishing of fillings. The separating file is still useful in some forms of cavity preparation. The so-called "flexo files" are the favorites, being sufficiently soft to bend without breaking. The "flexo" separating file is shown in Fig. 98.

The chief use of the finishing file is at the cervical margin of fillings on the proximate surfaces. Those known as file trimmers are made with handles similar to those of excavators and scalers, Fig. 99. Those known as files have handles like the "flexo" finishing file shown in Fig. 100, or like the one shown in Fig. 101. Many are made double end, Fig. 102. Of the many forms only a few of the most useful will be illustrated, Fig. 103.

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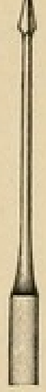

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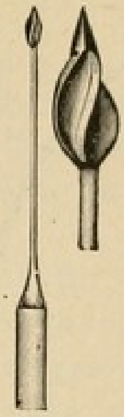

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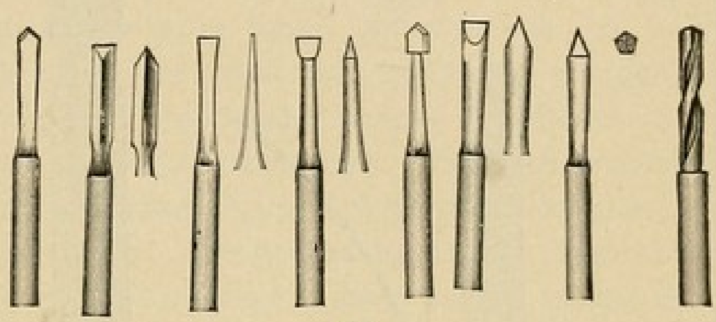

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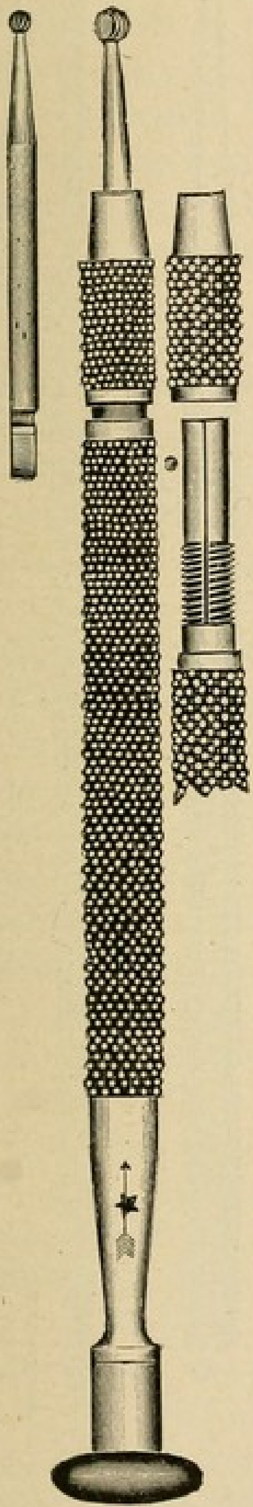

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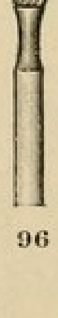

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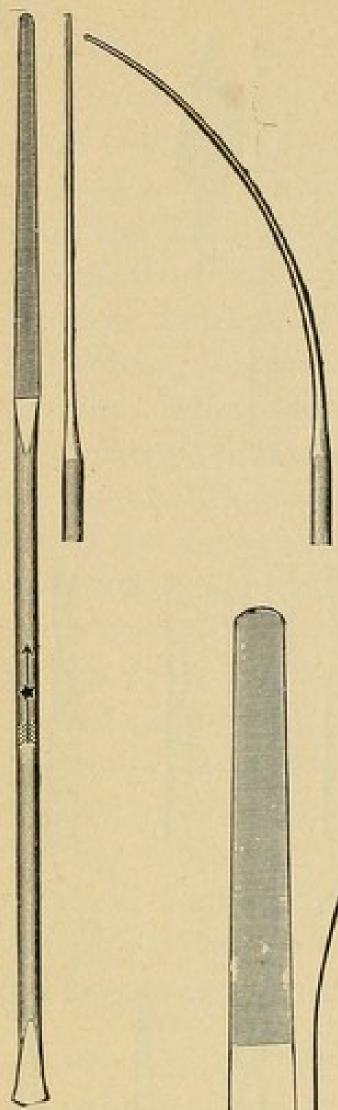
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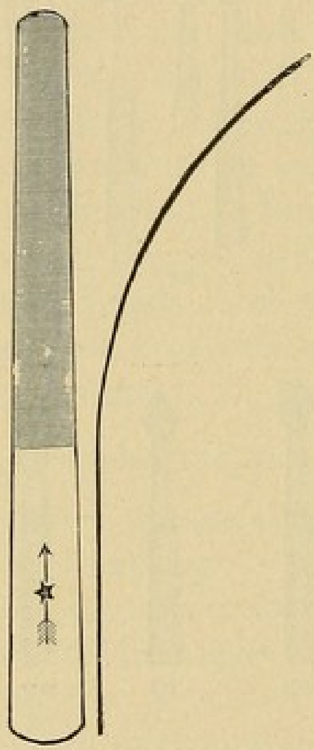
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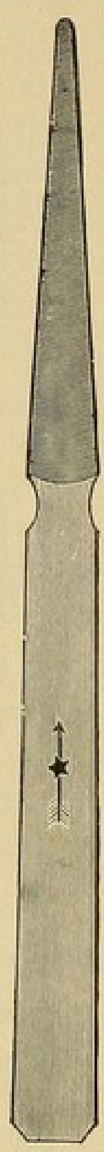
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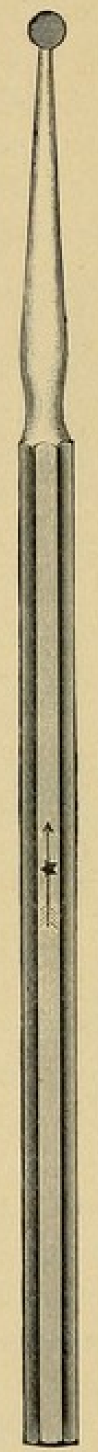
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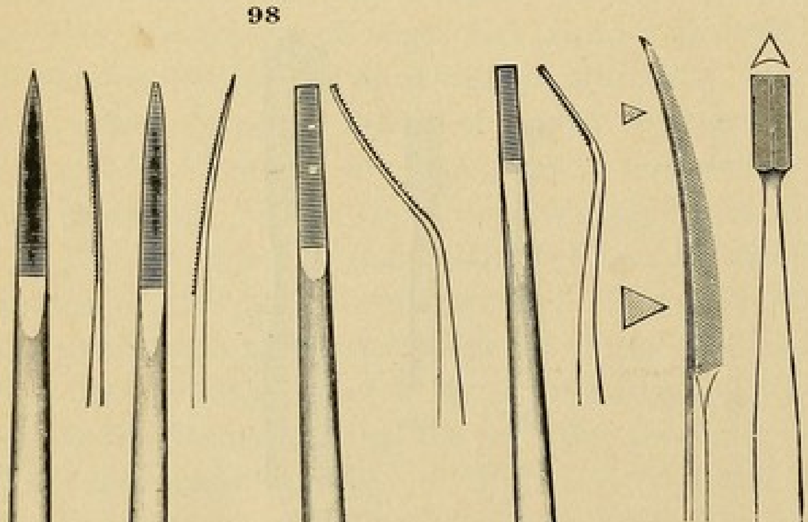
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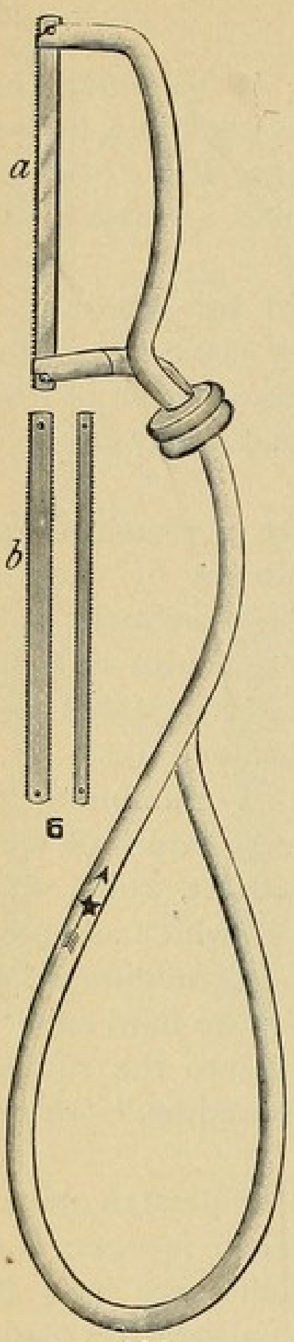
Saws. These are used in separating and in trimming the cervical margins of fillings. They are generally used in a frame, Fig. 104, and are made with teeth on one edge, Fig. 104 *a*, or with teeth on both edges, Fig. 104 *b*. Flexo files are also made for the saw frame.

Trimmers. These instruments are designed for shaving or paring the surfaces of proximate fillings. They have very thin lancet-like or chisel-like blades. The chief forms are seen in Fig. 105. The sickle scalers, Fig. 77, if sharpened, make very effective trimmers.

Grinding Instruments. These are in the form of wheels, disks and points. Wheels are simply small grindstones, of varying thickness, varying in diameter from one-fourth of an inch to an inch. The great variety of disks and points are shown in Figs. 106 and 107. They are made of corrundum, Arkansas, Scotch and Hindostan stones, and of copper charged with diamond dust.

Corrundum is the native crystalline oxide of aluminum; in hardness it ranks next to the diamond. The purest forms of corrundum are the gems, sapphire, Oriental amethyst, ruby, and Oriental topaz. It is the darker, opaque varieties which are pulverized for grinding purposes. In the ordinary corrundum disks and points it is combined with shellac, while in the hard rubber and corrundum combination it is incorporated into the rubber before vulcanizing. A newer form is "carborundum," which, being vitrified, cuts well and wears slowly.

Disks and points of Arkansas, Scotch and Hindostan stones are used in the finer grinding for finishing enamel margins and fillings. The copper and diamond disks and points are used in separating, cutting enamel, and finishing fillings. Disks are made of emery, sand, garnet, and cuttle fish paper. All but the cuttle fish, which is very fine, grade from coarse to fine. Disks of these materials are of three forms: plain, depressed, and safe center, Fig. 108. The last two are in three sizes only, while the plain ones range from three-sixteenths of an inch to an inch in diameter. Cloth and paper strips of the same grits as those on paper disks, are used for finishing the proximate surfaces of fillings. Short pieces of these strips are used in a porte for the engine for polishing other surfaces, Fig. 109. Disks for carrying such polishing powders as pumice, silex, chalk, oxide of tin, and rouge are made of celluloid, felt, and soft rubber. Points for the same purposes are made of wood, leather, felt, and soft rubber. These are useful in polishing teeth and fillings. Instruments for carrying disks and points are illustrated in Fig. 109½.



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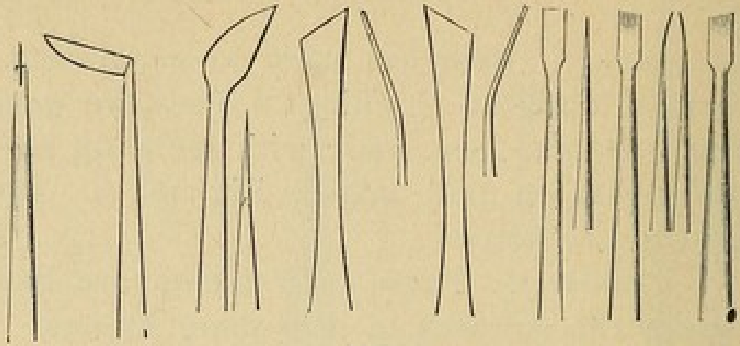

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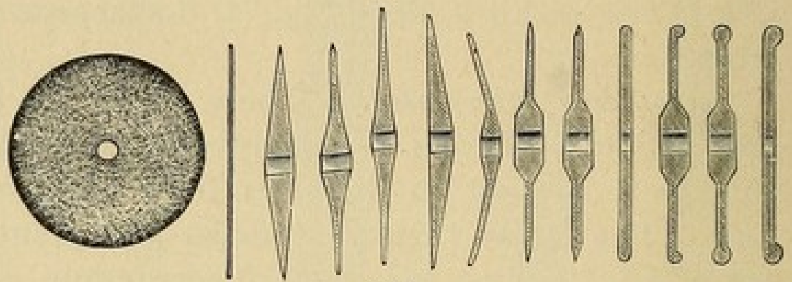

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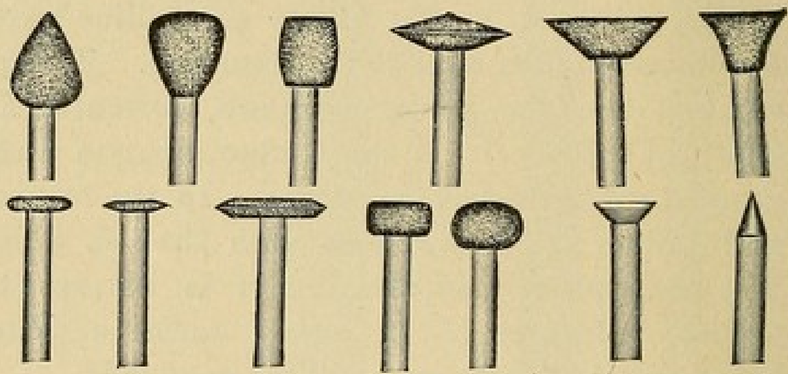

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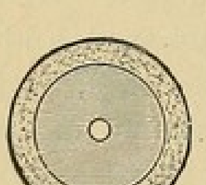

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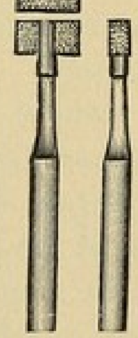

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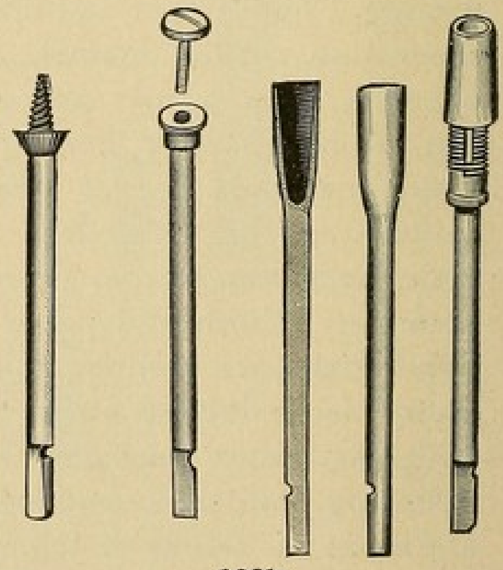

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INSTRUMENTS FOR INTRODUCING AND CONDENSING FILLING MATERIALS.

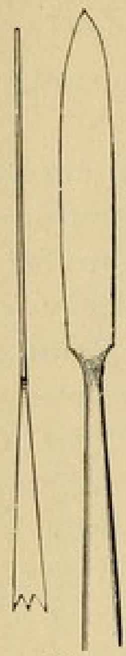
Spatulas. These are defined as instruments "having broad, flat blades with unsharpened edges, used for spreading, smoothing, scraping up, or stirring substances." In operative procedure they are used for mixing cements, introducing the mass into the cavity, and smoothing the filling. With the addition of a round point, a ball end point, and a lancet trimmer, cements may be manipulated entirely with spatulas, or spatula-like instruments. The different forms are illustrated in Figs. 110-113. The ball end and the round points are shown in Figs. 114 and 115. Some forms of noncorrosive instruments, made of platinum, are seen in Figs. 115-117.

Pluggers. This is the name given to instruments for the condensation of gold and other filling materials. Condensing instruments are for the purpose of conveying force or impact from the hand or mallet to points inaccessible to the hand or mallet. The solidity, homogeneity, or density of fillings is attained in one of three ways. By introducing the material in a plastic condition and allowing it to harden ; by wedging or interweaving folds or rolls, made from very thin sheets of metal ; or by welding small pieces of metal together in the cavity. Each of these methods requires instruments peculiar to itself.

Instruments described for the introduction of cements with the addition of the serrated points, Figs. 118 and 119, comprise the necessary forms for the introduction of amalgam, gutta-percha and zinc plastics.

Tin and noncohesive gold are introduced by wedging or interdigitation ; instruments must have wedge-shaped points, and all serrations must be sharp and deep. In Figs. 120-129, are shown the several forms of points, also the angles and curves in the shanks which are necessary to bring the points into direct action upon all surfaces. These instruments are used chiefly by hand pressure.

Cohesive gold is introduced in small pieces, welded, or fastened together in the cavity. To accomplish this, the points of instruments must have "faces," which will bring the surfaces of the gold into *perfect contact.* These faces are either flat or convex, with fine, shallow serrations. Pluggers used with the mallet have handles like Fig. 130. The faces have various outlines, circular oval, square, oblong, pear-shaped and triangular. The points are



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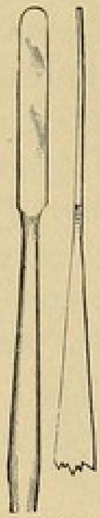

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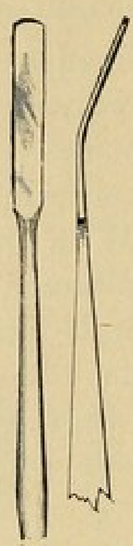

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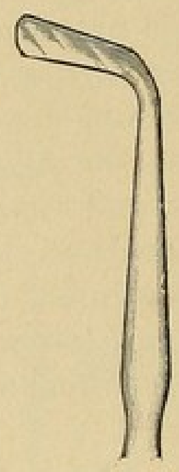

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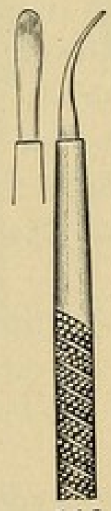

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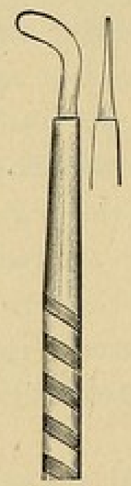

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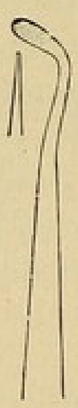

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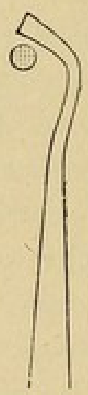

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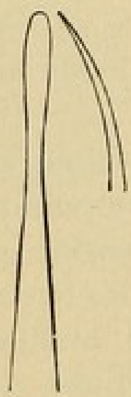

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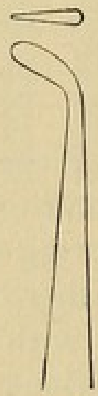

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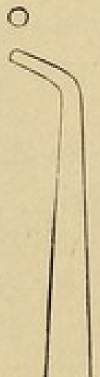

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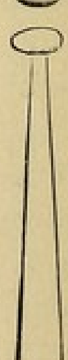

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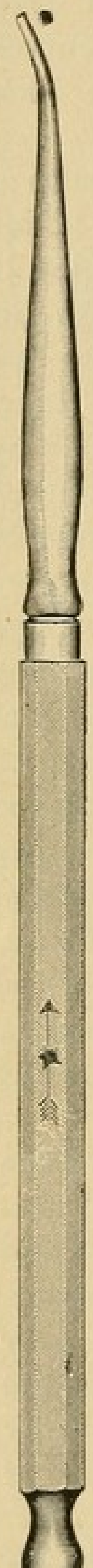
plain, as illustrated in Figs. 130–132, or foot-shaped, as in Figs. 133–138. The shanks of pluggers have various styles of curves, the single curve, Fig. 132, the bayonet, Fig. 127, and the cork-screw, Fig. 129.

Curves in the shanks of pluggers are for the same purpose as in other instruments, *i. e.*, to bring the point into direct action upon surfaces inaccessible to straight instruments. Angles in shanks do not divert the force. If a plate of steel, shaped like Fig. 139, is struck with a hammer at A, or at any point on the end between A and B, the force will be delivered from C, in the direction indicated by the arrow, *i. e.*, on a line parallel with the long axis of the figure. If portions of the plate, E and F, are cut away, leaving D, D, D, the result of a blow at A, will be the same as before, provided there is no spring in the angles. The law of force, as applied to pluggers, is, that whatever the curve or angle in the shank, the force is delivered on a line parallel with the long axis of the instrument, provided that the *face* of the point is at *right angles* to this axis. Force is delivered at right angles with the face of the instrument. If two perfect spheres, A, are placed upon a smooth plane surface, Fig. 140, and struck simultaneously with the end of an oblong figure, B, they will roll along the dotted lines *c c*. The same spheres struck with a wedge-shaped figure, Fig. 141, will travel along the lines *c c.*, *i. e.*, at right angles to the surface that struck them. If the spheres are struck with a disc, B., Fig. 142, they will travel along the lines *c c* at right angles to the surface at the point of contact.*

From these illustrations the conclusion will be readily drawn that when spreading of the filling material is desired, a *convex* surface is preferable to a flat one. In Fig. 143, is shown a ball end plugger with serrations running over on the side; a sectional outline is represented by B, Fig. 142. This instrument is not only effective in spreading the gold, but its spherical form enables the operator to deliver the force in any direction he desires simply by bringing different points of the face in contact with the surface of the filling.

In Figs. 144-146 are shown three bayonet pluggers with triangular foot points, having convex faces, serrated longitudinally only. They are designed for matrix fillings in disto-occlusal surfaces of bicuspids and molars, the pointed foot making it easy to

* NOTE.—The author is under obligations to Dr. E. A. Royce for the suggestion of the illustrations of force, as shown in Figs. 139-142. Dr. Royce is also the designer of the ball end pluggers illustrated by Fig. 143.



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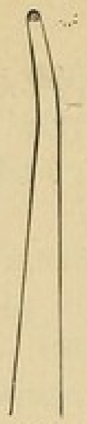

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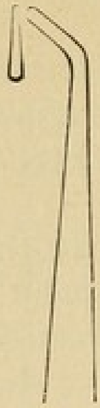

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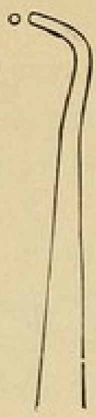

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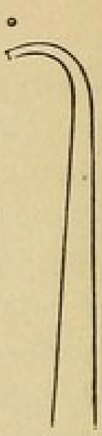

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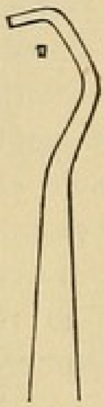

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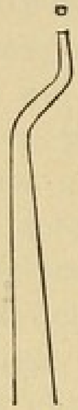

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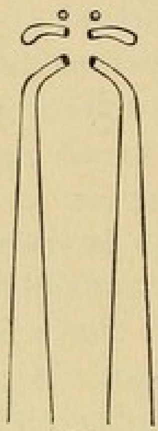

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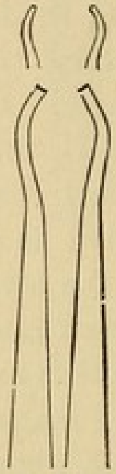

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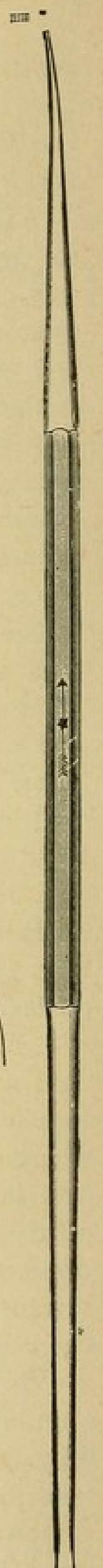

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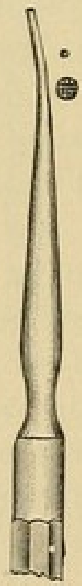

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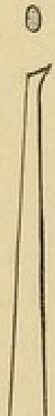

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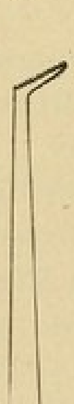

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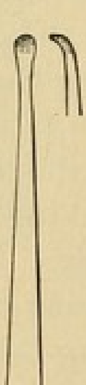

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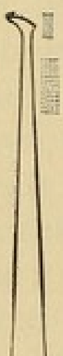

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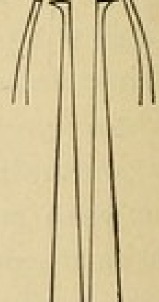

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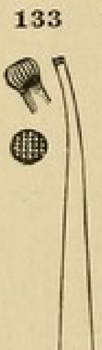

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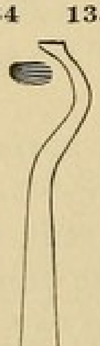

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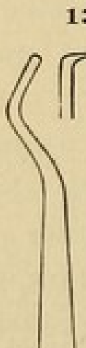

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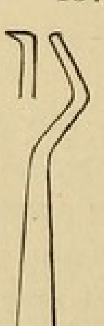

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carry the gold well into the joint between the matrix and the margin of the cavity.

Burnishers. These instruments, made of steel, agate and bloodstone, are used in spreading and smoothing metallic fillings, also in the insertion and adaptation of cement, gutta-percha, and amalgam. The various forms are shown in Figs. 147-152. Burnishers are hand instruments, but they are also made for use in the engine.

MISCELLANEOUS INSTRUMENTS.

Explorers. Cavity explorers are for searching out cavities in the teeth, and should be of a spring temper with very delicate points. The most useful forms are shown in Fig. 153. Canal explorers are delicate, pointed instruments with a long taper. An exceedingly delicate form called a bristle, mounted in an ebony or rubber handle, is very useful in following intricate canals, Fig. 154.

Broaches. The instruments described as canal explorers are also known as smooth broaches. Another form, Swiss broaches, are square and hard tempered. When the temper is drawn they are useful in carrying medicaments and wiping canals; their square form making it easy to cover them with cotton.

Barbed broaches are those which have a row of barbs on one side, Fig. 156, and one of a different style of barbs in Fig. 157. Hooked extractors have been noticed in the practical work; Fig. 158 showing the form of the ones manufactured by the students, while Fig. 159 shows another form. All small canal instruments are more easily manipulated if they are inserted in small handles like Fig. 154, or in broach holders, Figs. 160 and 161.

Clamps. Rubber dam clamps are designed to hold the rubber dam in position on teeth where simple ligatures will not retain it. They are made of thin spring steel, in many forms, and are applied by means of forceps designed for that purpose. Figs. 162-165 show four clamps which are a very satisfactory selection for students. Figs. 162 and 163 are molar dip clamps, right and left; the dip flange carries the rubber below the cervical margin of buccal cavities. Figs. 164 and 165 are irregularity clamps, right and left, and are to be used on bicuspids or third molars.

Matrix Clamps. These are for the purpose of holding a thin strip of metal in position around a tooth having a mesio-occlusal or a disto-occlusal cavity, for the purpose of converting it into a simple cavity and shaping the proximate surface of the filling. They are of two forms, the spring and the screw clamp. Fig. 166 illustrates the spring and Figs. 167 and 168 show the screw.

FIG. 139.

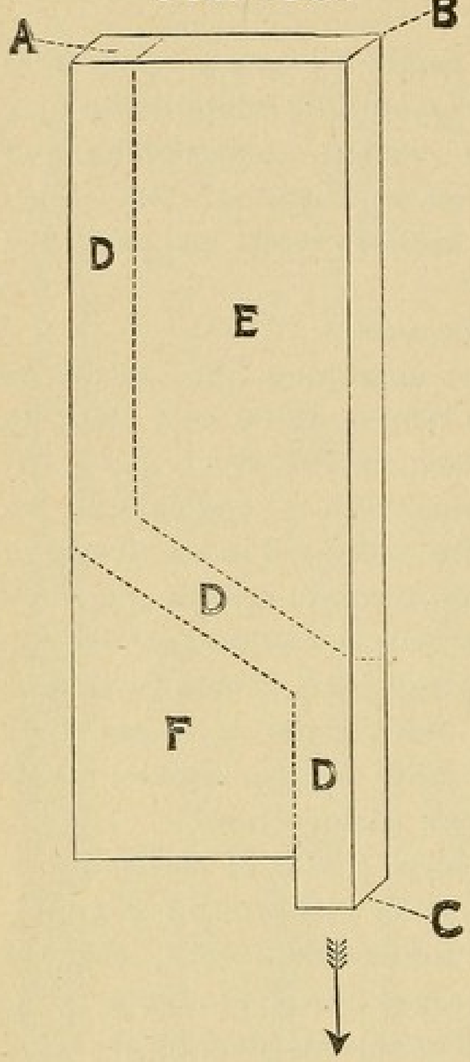


FIG. 140.

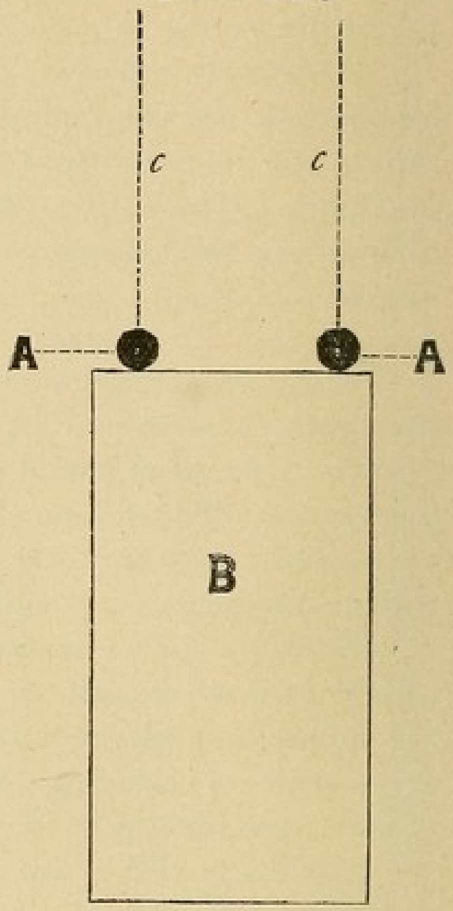


FIG. 141.

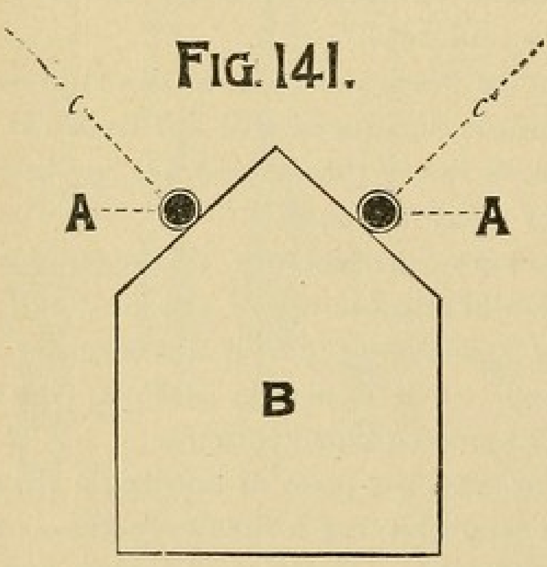
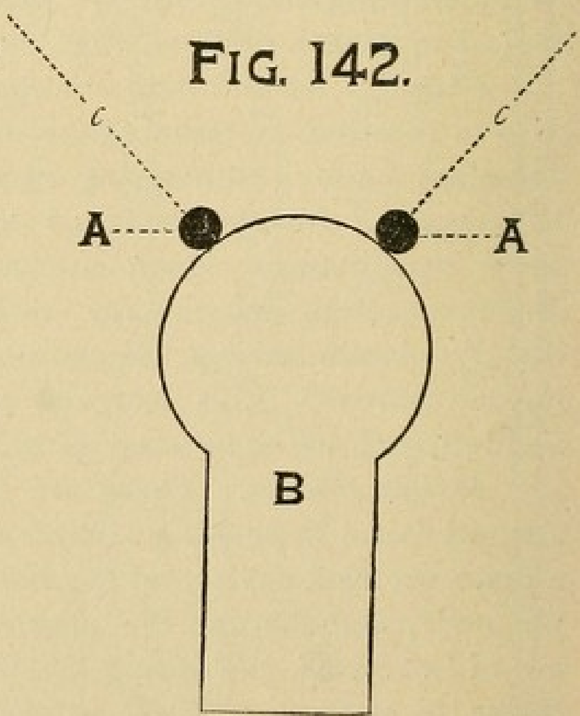


FIG. 142.



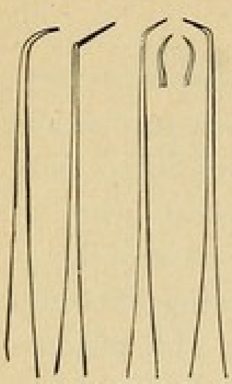
Separators. The general rule is that in proximate cavities, space for filiing should be gained by cutting, and space for finishing should be gained by wedging, separating sufficiently to permit the manipulation of disks or strips. The simplest way to accomplish this is with a wooden wedge, or a block of wood, inserted to hold the space which has been gained by forcing between the teeth to be separated, an instrument like Fig. 169, but the operation may be performed with less pain by the use of one of the screw separators. These are of three kinds; those which wedge or force the teeth apart by the approach of two points, Fig. 170; those which draw the teeth apart by the separation of two pairs of points, Fig. 171, and those which act in both ways, Fig. 172.

Mallets. Hand mallets are made of wood, steel, lead, and many other materials. The handles are long or short, round or flat, as the operator may fancy. The author, however, has found most satisfactory to both operator and patient, a mallet of lead in a brass case, having the ends covered with leather, and a handle similar to those in riveting hammers, Fig. 173.

Mechanical mallets are of four kinds: the pneumatic, in which the blow is delivered to the end of the plugger by a loaded piston projected by the sudden pressure of air; the electro-magnetic, in which the end of the plugger is struck by a hammer operated by the opening and closing of an electric circuit; the mechanical, in which the blow is delivered by a rapidly revolving disk having a hardened steel projection let into its rim; the automatic, in which the blow is delivered by releasing a spring. The last form is now made double end, to operate either a direct or a return plugger, Fig. 174. The one which delivers a blow most resembling that of the hand mallet is the pneumatic.

ADJUNCTS.

Matrices. These appliances are of various forms from the simple slip of polished metal, held in position against the margins of the cavity by a wedge, to the continuous band with its several methods of adaptation. Matrices are of three forms; those occupying but one interdental space, depending upon the presence of an adjoining tooth for their retention, Figs. 175-177; those occupying but one interdental space, not dependent upon an adjoining tooth for retention, which partially encircle the tooth and are retained by the spring or screw clamp, as shown in Figs. 166 and 167, and those which occupy two interdental spaces, that are tightened



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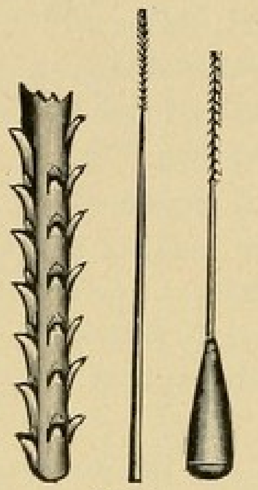

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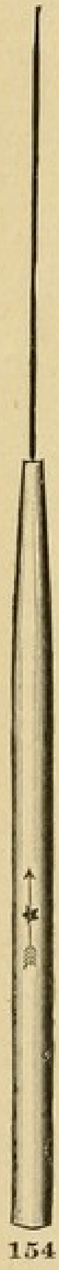

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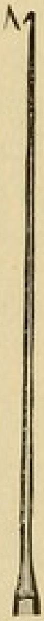

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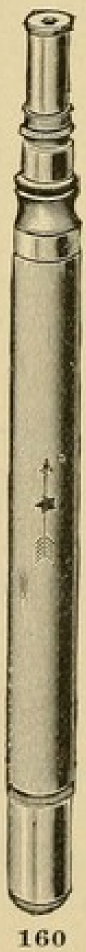

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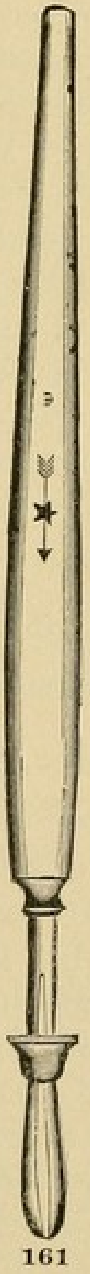

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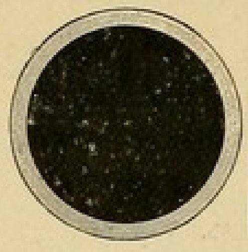

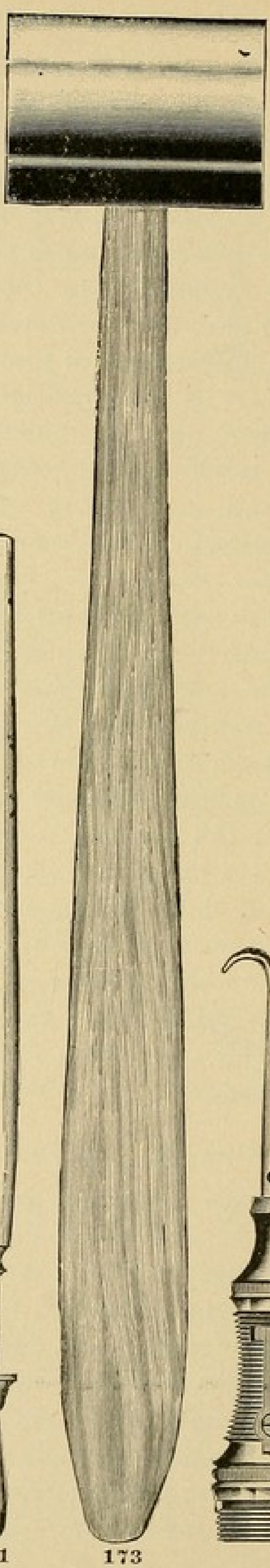

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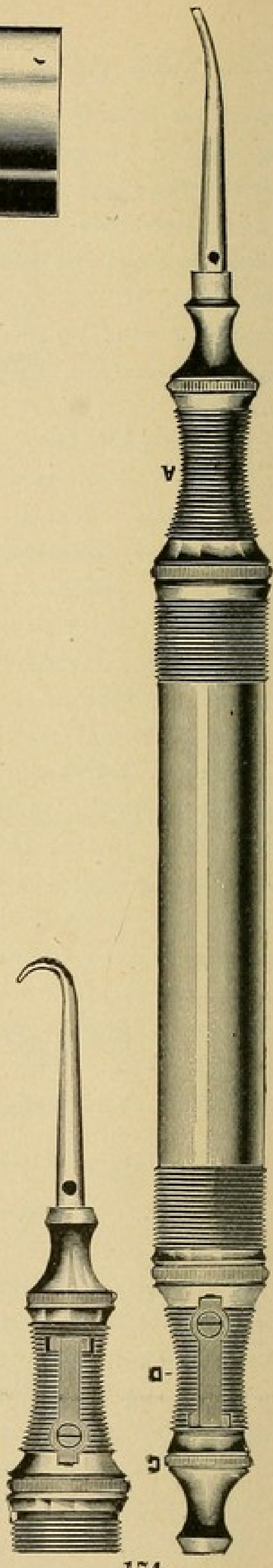

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about the tooth by the various devices shown in Figs. 178-180 and in Fig. 168. The slips or bands of metal forming the matrix are of varying composition, form and thickness. The general rules are, that the material should be either steel or German silver, highly polished, thin enough to be readily adapted, not occupy too much space, and of such shape as to insure perfect adaptation, and give to the completed filling the desired contour.

Wedging materials. For slow wedging in those cases where space for operating must be gained, some material which is capable of expansion should be inserted, increasing its bulk from time to time, until the space is sufficient. The materials employed are dry wood, cotton, and rubber.

RUBBER DAM AND MATERIALS FOR EXCLUDING MOISTURE.

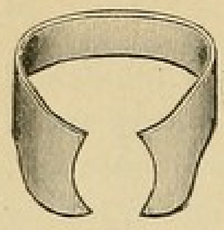
For short operations teeth may be isolated and protected from the saliva, by surrounding them with small napkins properly folded or rolled, cotton rolls, or some of the paper or cottonoid preparations. For more protracted operations rubber cloth of medium thickness should be used. In its application, the teeth to be isolated are passed through round holes, formed with a punch, and the edges of the rubber encircling the teeth turned rootward. If the teeth are conical or if the tissues exert a contra pressure the rubber is held in place by ligatures or by the steel clamps.

Ligatures. That the gums may be injured as little as possible, and that the ligature shall not be in the way, the ordinary knitting silk is used for the retention of the rubber dam. Floss silk, hemp thread known as "gilling twine," and small sea grass fish line are sometimes used; the last being very efficient where much strength is necessary, as in regulating.

Absorbents. Cotton prepared in such a manner as to absorb moisture readily, spunk, and a thin absorbent paper known as "bibulous paper," are the chief agents used for wiping and drying the surfaces of the teeth, and cavities.

Mirrors. Mouth mirrors are used for reflecting the light into cavities and for showing cavities upon such surfaces as are out of direct line of vision. Those which magnify concentrate the light and enlarge the reflected image, so that by their use operations are performed with less eye strain.

Pliers. Instruments known as foil carriers and dressing pliers are the only form of pliers which will be noticed here. They are not only for conveying gold to cavities but for all small objects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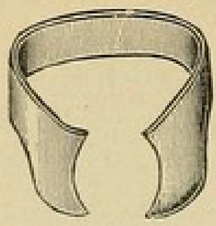
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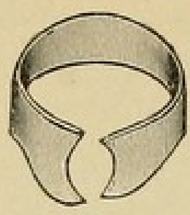
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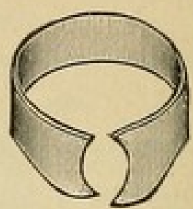
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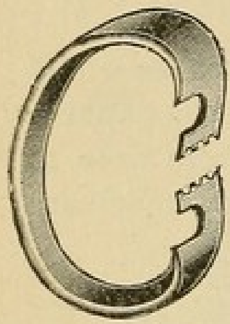
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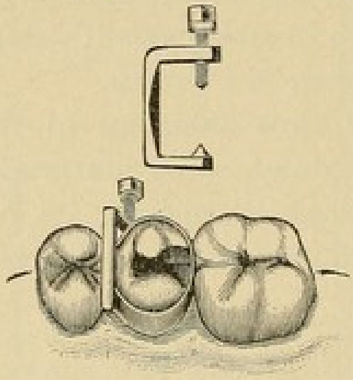
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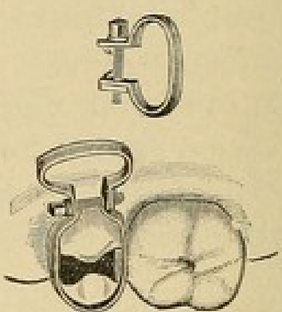
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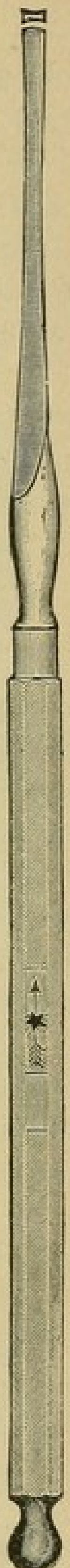
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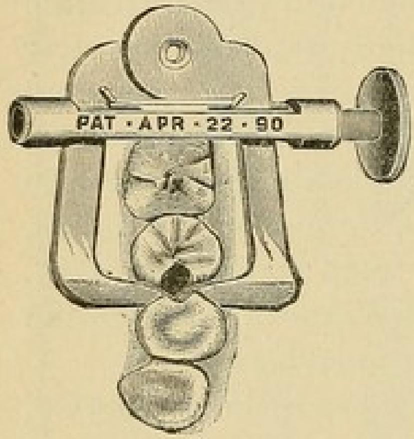

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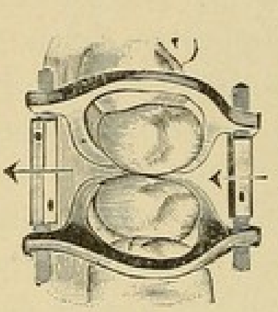
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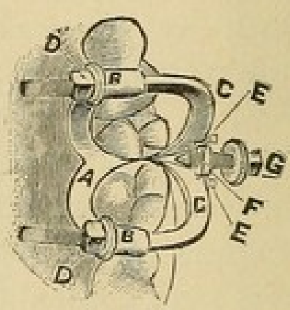

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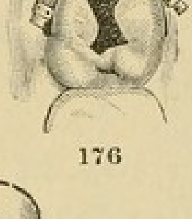
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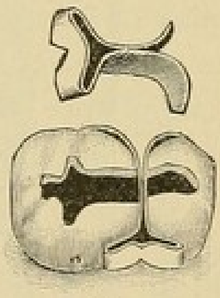
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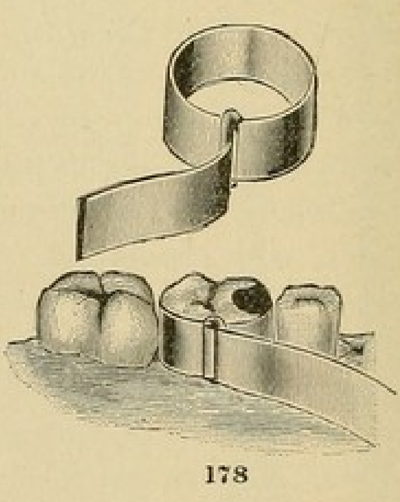
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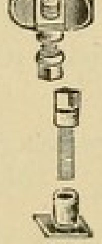
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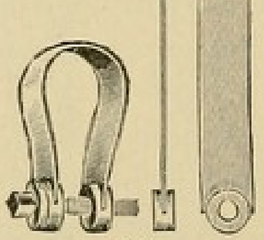
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which are handled in operating, and carrying cotton charged with various medicaments. For this last purpose one pair made of non-corrosive metal should be provided.

The various other adjuncts in the operative armamentarium will not be noticed in this course except as they appear in some of the procedures treated in other divisions.

CHAPTER III.

CANAL TREATMENT.

(Blackboard Diagram.)

Opening into Canals.	Apply rubber dam. Open cavity or penetrate crown to pulp chamber. Remove decay. Enlarge point of penetration to the diameter of the pulp chamber.
Canals with recently devitalized pulps.	Remove pulp. Enlarge canals. Dry thoroughly. Fill canals.
Canals containing putrescent pulps.	Render inert the contents of canals. Remove contents of canals. Ream if necessary. Render aseptic. Dry. Fill, if there are no pericemental complications.

Having learned the *forms* of instruments, a knowledge of their *use* follows sequentially. Gaining entrance to canals and cleansing them, brings into use chisels, excavators, drills, burs, reamers, explorers and broaches; chisels to break down enamel, excavators to remove decayed dentine, drills, burs and reamers to make and enlarge openings into pulp chambers, explorers to follow, and broaches to cleanse canals.

Before proceeding, instruction should be given on the rubber dam, and the students exercised in its application; first without ligatures or clamps, then with their assistance. The following rules should be inculcated as the basis of instruction in the use of the rubber dam.

When the cavity has been rendered aseptic in teeth having living pulps, the fluids of the mouth should not again be allowed to enter.

In pulpless teeth, when a pulp chamber has been penetrated for treatment, the fluids of the mouth should not again be allowed to enter.

Sufficient space should be left between the holes to allow the rubber to easily cover the festoon of gum between the teeth so that this point of gum tissue will not be strangulated in one or the other of the holes.

Ligatures or clamps should not be used unless absolutely necessary, and ligatures should be as small as possible.

Rubber dam should never be applied until it has been thoroughly sterilized. This is best accomplished by boiling.

PRACTICAL EXERCISES.

1. Applying the rubber without ligatures to two or more teeth.
2. Ligating, using the several forms of knot.
3. Applying the rubber on molar tooth and adjusting the clamp.
4. Carrying the rubber to position on molar tooth *with* the clamp.
5. Applying rubber to incisor or cuspid having labial cavity near gingival line, carrying it below cervical margin of the cavity and retaining it with copper wire.
6. Applying rubber on molar tooth and ligating glass beads in position for its retention.*

CANALS.

Gaining Entrance to Canals. If there is no cavity, or if existing cavities have fillings which it is not desirable to remove, entrance should be made at the point which will give the most direct access to pulp chamber, and leave the greatest strength to the tooth. The point where the drill should be inserted in each tooth is indicated in Fig. 181. If there be more than one canal the drill should be held as nearly as possible in line with the principal one. The initial opening made by the drill should be sufficiently enlarged with burs or reamers, to permit of perfect access to every part of the pulp chamber, and to all canals.

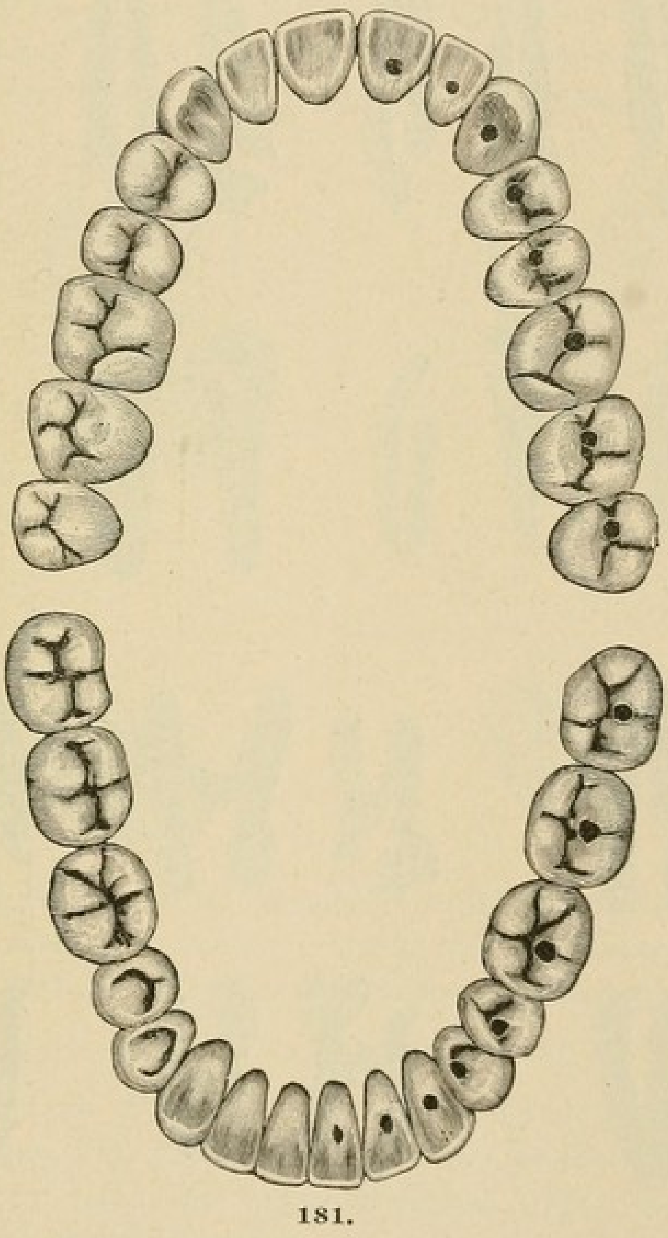
If there is a cavity in the tooth, entrance to the canals should be made through it. The first step should be the free opening of the cavity and the removal of all decay; the next, the opening into the pulp chamber or the enlarging of existing openings until the walls of the pulp cavity, the pulp chamber and the canals are continuous. The openings into canals should be as nearly funnel shaped as conditions will permit. Fig. 182 shows the form for

*The various operations in all practical exercises should first be performed by the teacher in the presence of the class.

each tooth; the labial and buccal views give the form where entrance is gained through a cavity, and the mesial aspects illustrate the enlarged openings made by the drill.

PRACTICAL WORK.

When the teeth are selected for the exercise in arrangement care should be taken that each articulator contains a tooth of each



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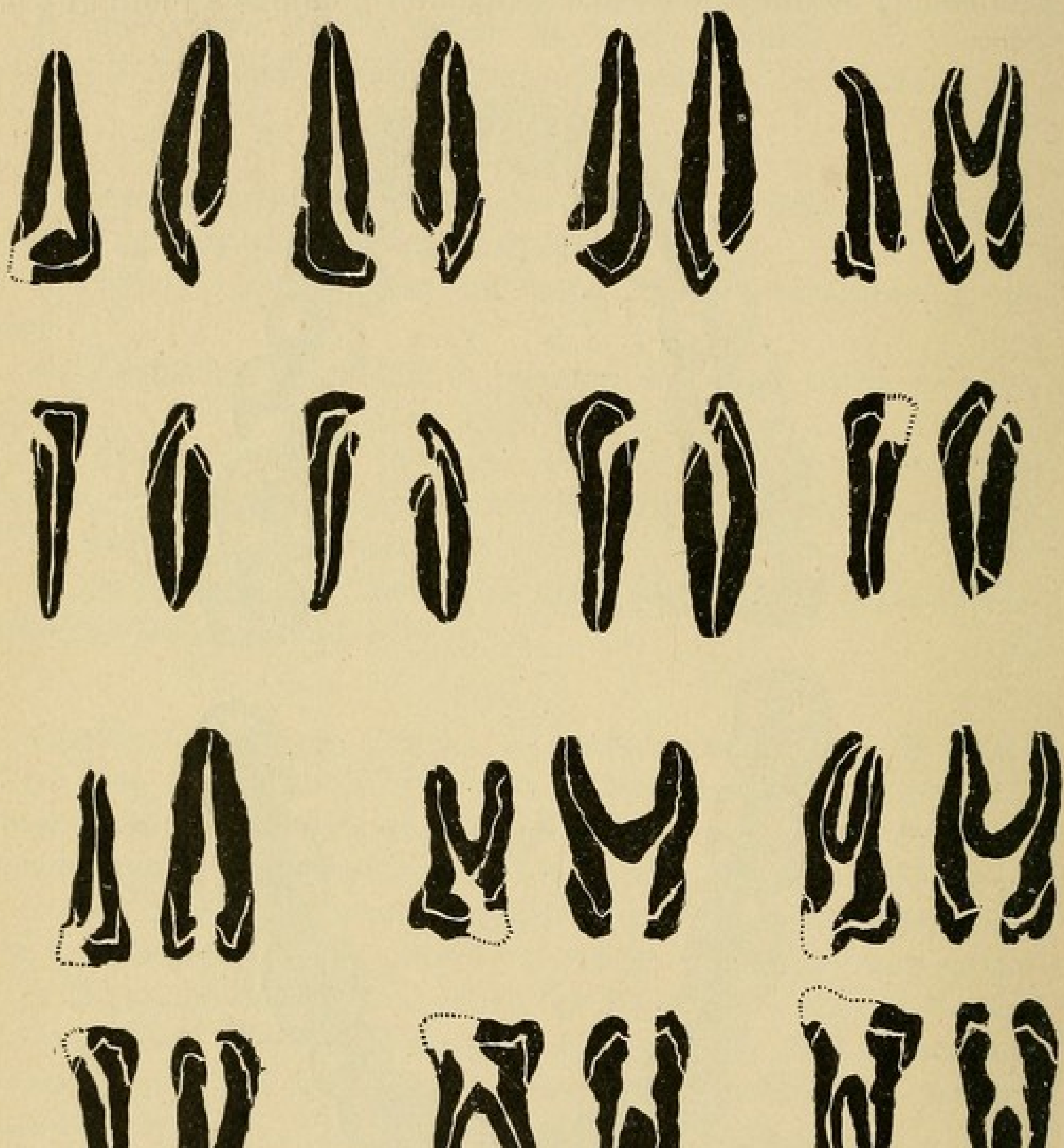
class, having a cavity in which the pulp is penetrated. The student should now be directed to perform his practical canal work upon these teeth.

For the initial exercises in the use of chisels and excavators the badly decayed teeth which are useless for filling or for sections may be utilized to good advantage for practice in enamel cleavage and the cutting of dentine, before the student uses these instruments upon the teeth mounted in the articulator.

Opening the Cavity. The enamel should be cut away until the cavity is freely opened, as in Fig. 183. This should be done with



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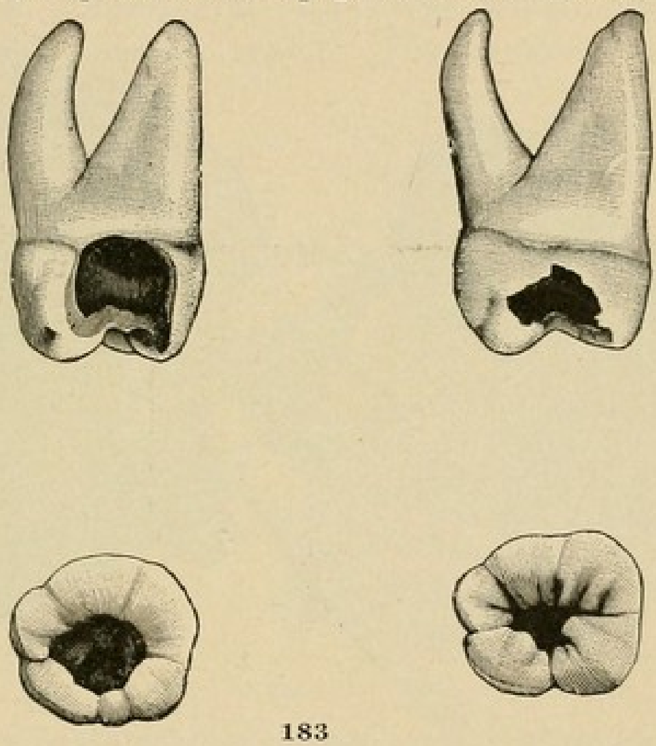
enamel chisels, Figs. 12, 13 and 29. The two ways of holding the chisels are illustrated in Figs. 184 and 185. For this first exercise the student need not confine himself to the positions necessary when operating for patients, but he may approach the cavity from any point which affords the most direct access.

Removal of Decayed Dentine. All disorganized dentine should be scooped out. For this purpose spoon excavators are used, the strokes being made from the center toward the periphery. This exercise gives training in the use of the direct spoon, Figs. 50 to 52, and the rights and lefts, Figs. 65–68. The cutting should be continued until the point of entrance to pulp chambers is fully exposed.

Enlarging the Opening. If the cutting or reaming is done with a bud shaped bur, Fig. 91, manipulated by means of the revolving head bur holder, Fig. 82, this step gives some familiarity with the



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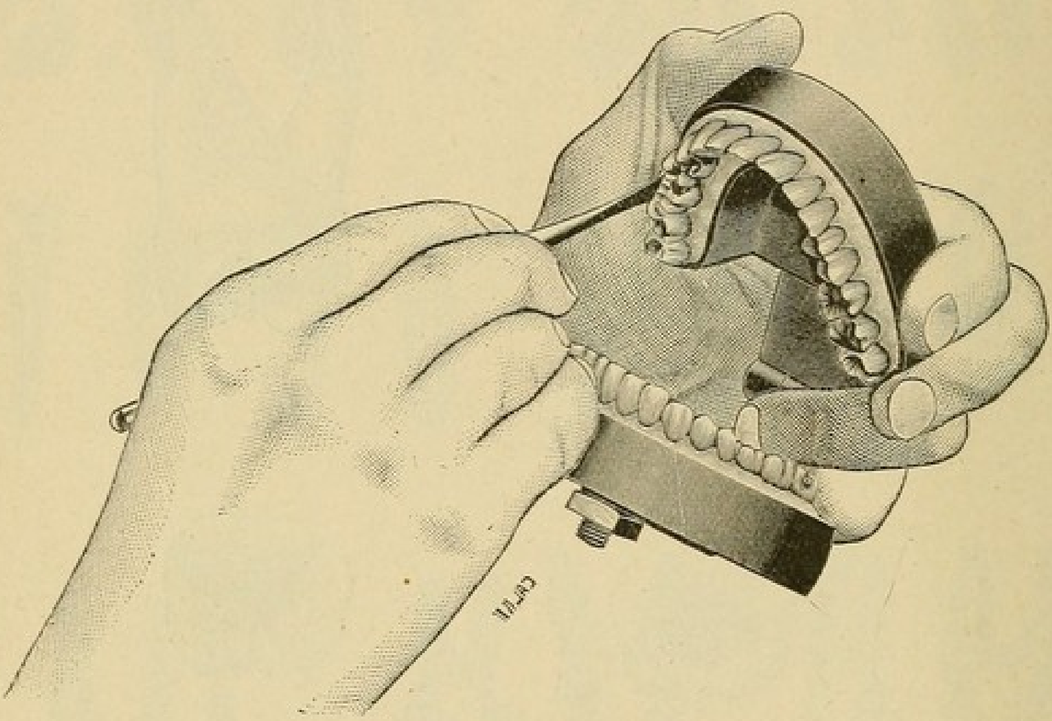
use of burs. The opening should be enlarged to the diameter of the pulp chamber, if possible. Up to this point the procedure is the same for both recently devitalized or putrescent pulps.

CANALS WITH RECENTLY DEVITALIZED PULPS.

Removal of the Pulp. This may be accomplished with the barbed broaches, Fig. 155 or 157; with the hooked extractors, Fig. 158 or 159; or with the Swiss broaches which have first been wrapped with a shred of cotton.

Enlarging Canals. If canals are enlarged at all they should be *reamed,* not *drilled.* The only safe instruments are those shown in Fig. 84 or 86; the latter have a safe or guiding point. The advantages of reaming are that it insures the thorough removal of all pulp tissue and renders less difficult the insertion of the filling material. Attention is called to the shape of the various canals as shown in the silhouettes of both longitudinal and transverse sections, and emphasis is given to the fact *that all attempts at enlarging flattened or tortuous canals are attended with the danger of perforating the side of the root.* Hence we draw the conclusion that the canals which it is *safe* to enlarge are those which are round and straight. When there is necessity for enlarging canals which are departures from this form, the greatest care should be exercised.

Drying Canals. In cases of recent devitalization, after the



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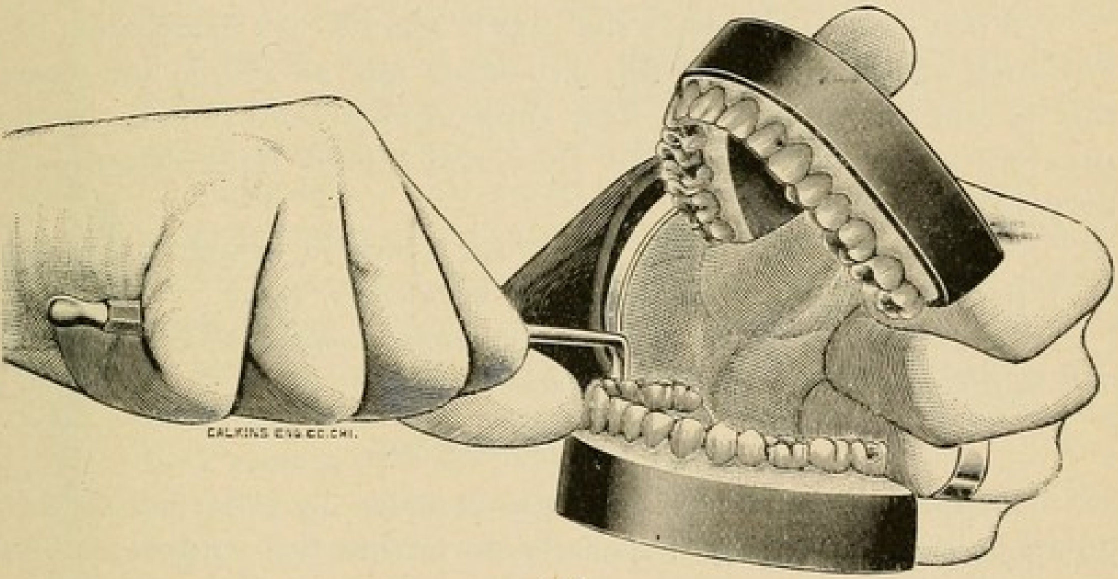
removal of the pulp and the enlargement of the canals, if the saliva has been excluded there is an aseptic condition, and the canals are ready for filling. Before its introduction, the canals should be thoroughly dried. Wiping them with absorbent paper points or broaches wrapped with absorbent cotton is not sufficient. All moisture should be evaporated with a current of hot air or by the direct application of heat, by means of one of the several forms of metallic root driers. Success in filling canals depends much upon the removal of moisture from the tubuli.

Filling Canals. The object is to seal the ends of the tubuli, and stop the apical foramina against the entrance of anything which might favor putrefactive changes. The requisites for a canal filling material are that it should be nonirritant if forced through the apical foramina; it should be capable of easy introduction into intricate canals; it should be indestructible under the conditions in which it is placed, and it should possess the power of preventing putrefaction of the remaining fibrillæ. The materials used are gutta-percha, wood, copper, gold or aluminum points, and chloro-percha, oxyphosphate or oxychloride of zinc.

CANALS CONTAINING PUTRESCENT PULPS.

Render Inert the Contents of the Canals. Canals treated under this head contain decomposed pulp tissue, which may be either moist or dry, but is always septic. The danger of crowding or



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pumping some portion of this septic matter through the apical foramina makes it advisable to render it inert, aseptic, before attempting its removal. This may be accomplished by the presentation of some substance, one element of which possesses a strong affinity for decomposed tissue. Two compounds of this nature are kalium natrium and hydrogen dioxide. The latter is the more desirable, as its action is less violent, and it does not leave a solid residue. If the preparation of $H_2 O_2$, known as pyrozone, three per cent, is applied slowly, without pressure, the contents of the canals are gradually asepticised, and the subsequent cleansing made easy.

Remove Contents of Canals. After the treatment with pyrozone, by means of hooked extractors and fine Swiss broaches wrapped with cotton, the canals are easily cleared of their contents. Always use the greatest care to avoid pumping anything through the foramina.

Reaming. The same rules apply as in the case of recently devitalized pulps.

Render Aseptic This is accomplished by sealing into the canals some antiseptic and germicide. Among the many, we notice bichloride of mercury, carbolic acid, oil of cassia, and Black's "one, two, three," the formula for which is:

Carbolic acid (melted crystals)................	1 part.
Oil of cassia................	2 parts.
Oil of wintergreen.........................	3 parts.

Mix the oils and add the melted carbolic acid crystals.

When oils are used the tooth should be desiccated before their application. If the antiseptic has an affinity for water this is not so important. The application should remain in the canal for a sufficient length of time, and should be repeated until asepsis is assured.

Dry Canals. The rules given for teeth in which the pulps have been recently devitalized apply with equal force.

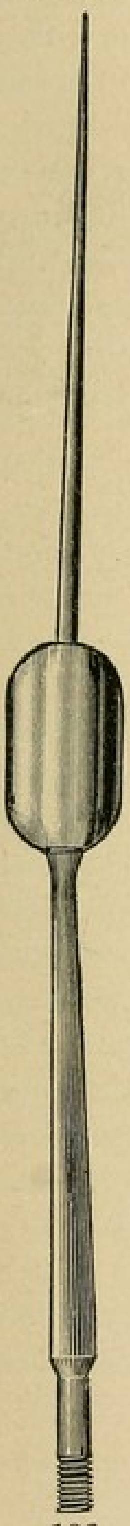
Fill Canals. If there is no pericemental complications the canals may be filled as soon as asepsis is complete.

PRACTICAL EXERCISES.

Wrapping Broaches. Thorough practice in covering smooth broaches with cotton is necessary to enable the student to use these valuable adjuncts without making pistons of them.

Select a small broach, lay a few fibers of cotton on the ball of the index finger, rest the broach upon it in such a way that the cotton will project a little beyond the point of the broach; then roll the broach to the right, between the thumb and finger, bringing pressure first upon the point, continuing until the cotton covers the whole length of the broach. This prevents the point from being uncovered when inserting the broach into a canal and insures the even covering of the whole broach. Emphasis is laid upon the necessity for using small broaches, especially for cleansing canals of putrescent contents.

Using Broaches. After enlarging the openings into the pulp chambers of the several teeth in the articulator, which have been selected, moisten the dried pulps to soften them; for this purpose dilute alcohol, cassia water, or pyrozone may be used. Care should be exercised not to insert explorers or other instruments into the canals before using the broach. The first attempt at extracting a pulp should be in an upper incisor or cuspid.



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A *fine* barbed broach should be presented with its barbs against the walls of the canal, and inserted until its point reaches the apical end of the canal; give one or two turns to the right and withdraw it carefully. The canals of the other teeth may then be operated upon in like manner. In canals where the barb fails to remove all of the pulp, or in very small canals, the small hooked extractors may be used. These will not permit of so much rotation. The canals should be further cleansed with pyrozone, applied with a platinum-iridium broach for the smaller canals, and a wooden broach for the larger ones. Japanese toothpicks serve this purpose nicely. Steel broaches or instruments should never be used with pyrozone.

Reaming. Such small canals as are round or nearly so, may be enlarged with the reamers Fig. 86, used in the revolving head bur holder. The exercise may be continued with larger reamers in larger canals which are supposed to have contained putrescent pulps. One or two roots may be prepared for the reception of a dowel pin, by enlarging their canals with the reamer Fig. 85.

Drying. The canals, which have been moist up to this time, may now be dried; first, with slender conical points cut from firm, fine grained blotting paper, then with absorbent cotton on Swiss broaches; completing the operation with the canal drier, Fig. 186.

Filling. Four methods of filling will be given. First, with gutta-percha points moistened with eucalyptus oil; Second, with gutta-percha points and chloro-percha; Third, with parafine and copper points; Fourth, with chloro-percha and gutta-percha point at apex, remainder of canal with oxychloride of zinc. Preparatory to filling, a student should make some chloro-percha by dissolving shavings of pink base plate gutta-percha in chloroform, and cut some small triangular pieces of pink base plate and roll into slender conical points on a warm glass slab. Roll some similar points of parafine. With a file make some very small, slender points of copper. Flood one of the larger round canals with eucalyptus oil;

dry canal and warm it with the root drier; dip a gutta-percha point in eucalyptus oil, ignite the oil and allow it to burn off, dip again in the oil and insert it in the warm canal, driving it home with a blunt, strong broach. Into another canal, pump some chloro-percha with a fine smooth broach; dip a gutta-percha point in the chloro-percha and force it home. In one of the very small canals, place one of the parafine points, melting it and causing it to flow into the canal with the root drier; heat one of the copper points and force it into the canal. Select a canal in which the pulp was supposed to be putrescent; fill its apical portion with chloro-percha and gutta-percha point, and the remaining portion with oxychloride of zinc.

CHAPTER IV.

CLASSIFICATION AND PREPARATION OF CAVITIES.

Cavities of decay which are found on the surfaces of all the teeth, are the result of two great predisposing causes; first, structural imperfections; second, prolonged contact of any surface with the results of fermentation, or with the secretions from diseased tissues. Structural imperfections result from imperfect coalescence of the enamel, usually at the point of union of the several developmental lobes; or from arrested development. Consequently they occur on surfaces where grooves are sharpest and deepest, or in those grooves which cross labial or lingual surfaces at right angles with the long axis of the tooth, indicating an arrest of development at some period in the growth of the tooth.

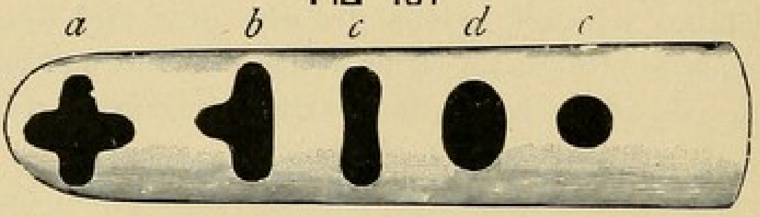
As the occlusal surfaces are usually kept clean by the act of mastication, and the greater portion of the labial or buccal and lingual surfaces are cleansed by the action of the tongue and lips, we naturally turn to the proximate surfaces, and to that portion of the labial and lingual surfaces next to the gums, to find cavities which are the result of the second cause. Although a satisfactory classification on this basis is difficult, separation into classes is necessary for purposes of study. We will classify according to the form and location of the cavity and the completed filling. Cavities upon all surfaces other than proximate are formed and filled under the same general rules. In cavities upon the proximate surfaces of incisors and cuspids, these rules are modified by the location and shape of the surface and the extent of the cavity. For similar reasons, cavities upon the proximate surfaces of bicuspids and molars are governed by rules peculiar to themselves. These facts form the basis for our classification:

(Blackboard Diagram.)

Class 1.	All cavities on any surface other than proximate.	A. Cavities arising from structural imperfections in pits and fissures.
		B. Cavities on labial, buccal or lingual surfaces, caused by contact with secretions from diseased tissue, or the products of fermentation.

Class 2.	All cavities on the proximate surfaces of incisors and cuspids.	A. Cavities which do not involve the mesial or distal angle.
		B. Cavities which involve the restoration of the mesial or distal angle.
Class 3.	All cavities on the proximate surfaces of biscuspids and molars.	A. Cavities which include the marginal ridge, but do not involve any sulci or grooves upon the occlusal surface.
		B. Cavities which involve not only the marginal ridge, but also sulci or grooves upon the occlusal surface.

FIG 187



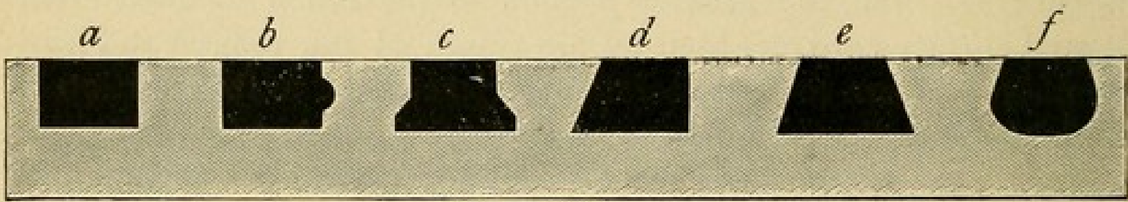
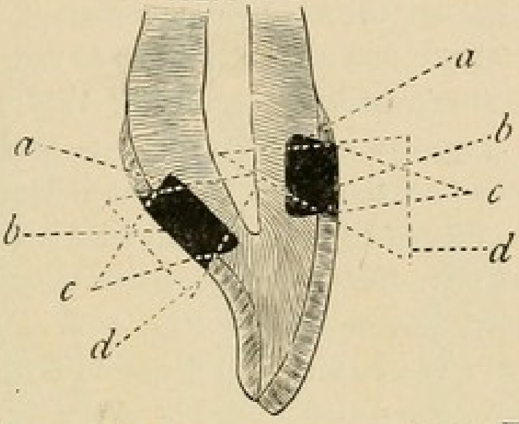
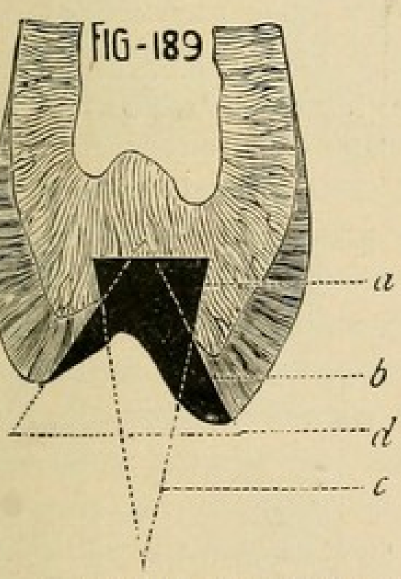


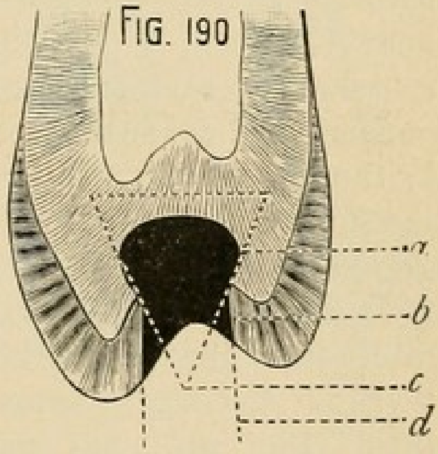
FIG. 188

As fillings in cavities of the first class are upon either plane, slightly convex, or slightly concave surfaces they are simple inlays. Any surface which is to receive an inlay must have a recess for its reception; this recess must correspond in outline with the inlay, and may be called a mortise. Some of the forms of inlays for cavities of the first class are shown in Fig. 187. When the inlay is in one piece, as is necessary if it be made of glass or porcelain, the mortise should have parallel, perpendicular sides, Fig. 188, *a*. Such inlays are held in position by adhesion or by the perfection of their adaptation to the mortise. Where the inlay is introduced in pieces or sections, or in a plastic condition, the mortise is given retaining shape, *i. e.*, enlarged in some direction in its interior. There may be grooves on one or more sides, as in *b* and *c*, Fig. 188. These are grooved mortises. One or more of the sides may be sloped, joining the base at an acute angle; as in *d* and *e*, Fig. 188. These are dovetailed mortises. For materials inserted while in a plastic condition, the mortise may be rounded in form, as in *f*, Fig. 188. If cavities in teeth were given any of the foregoing forms, except it might be that shown in *a*, Fig. 188, the structure of the enamel is such, that fracture or chipping of the enamel margins would occur when subjected to any force or strain. For this reason, the retaining shape, or dovetail of the mortise is made in the

FIG. 190½





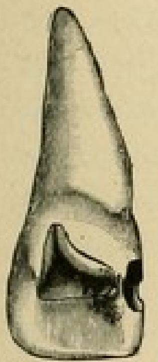


These cuts are made from photomicrographs, 3 in. objective. In outline they are faithful reproductions. The structure is entirely diagrammatic. All the longitudinal sections shown, except Figs. 213 and 227, which are made from drawings, are made in the same way.

dentine, *a*, Fig. 189, and *a*, Fig. 190; the enamel is protected from fracture by beveling it, as in *b*, Fig. 189, and *b*, Fig. 190. For convenience the retaining shape in the dentine will be called the dentinal pyramid, *c*, Fig. 189, and *c*, Fig. 190, and the enamel bevel will be called the enamel pyramid, *d*, Fig. 189, and *d*, Fig. 190. In the dentinal pyramid the amount of retaining shape, or angle of the sides of the pyramid with its base, depends upon the strain to which the inlay, or filling is to be subjected. The sharpness of bevel of the enamel depends upon the character of the material of which the inlay, or filling is composed; the form shown in *b*, Fig. 189, is practicable, if the material possesses ductility, tenacity, or edge strength, as gold; while the form shown in *b*, Fig. 190, is necessary if the material does not possess these qualities, as tin, amalgam, cement, or gutta-percha.

Taking the teeth in their numerical order, we find cavities of division *A*, class 1, upon the lingual surfaces of the upper incisors and cuspids, when there is a sharp groove at the base of the linguo-gingival ridge, or sharp grooves crossing this ridge, Figs. 191 to 197. Cavities in grooves or pits marking arrested development also occur upon these surfaces, in the middle or incisal third, Fig. 198. The labial surfaces of these teeth seldom have cavities arising from structural imperfections except in those pits and grooves which mark arrested development, Fig. 199. The lower incisors and cuspids seldom have cavities of division *A*, class 1. The labial surfaces of upper incisors and cuspids often have cavities, of division *B*, class 1, see Figs. 200 and 201. The lingual surfaces seldom have cavities of this division. The labial surfaces of lower incisors and cuspids sometimes show cavities of division *B*, class 1; the lingual surfaces almost never. On the occlusal surfaces of the upper bicuspids we find cavities in pits at the junction of grooves, and in fissures wherever grooves are sharp and deep, Figs. 202 and 203. The buccal and lingual surfaces of upper bicuspids rarely have grooves marking arrested development, but cavities of division *B*, class 1, occur on the buccal surfaces in the gingival third, Fig. 204; but seldom, if ever, on the lingual surfaces. Cavities of division *A*, class 1, occur occasionally on the occlusal surfaces of lower first bicuspids, and frequently on these surfaces of the lower second bicuspids, Figs. 205, and 206. The buccal surfaces of the lower bicuspids often have cavities of division *B*, class 1, in the gingival third; the lingual surfaces seldom, if ever.

The occlusal surfaces of upper molars have cavities of division *A*, class 1, at the junction of grooves and in deep grooves, Figs. 207, and 208. The buccal surfaces of the upper molars seldom show pits or fissures, except in poorly developed first molars, which sometimes result from an infantile sickness; but the lingual surfaces frequently have cavities in pits and fissures, especially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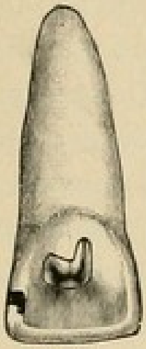
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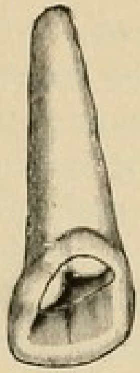
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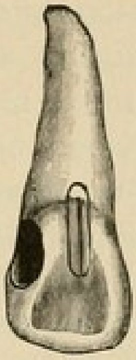
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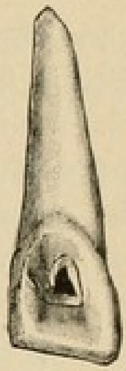
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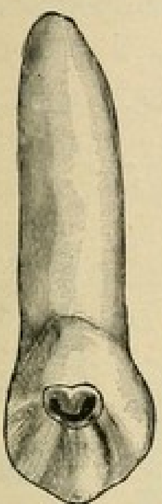
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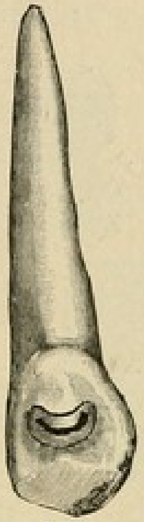
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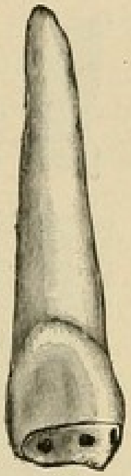
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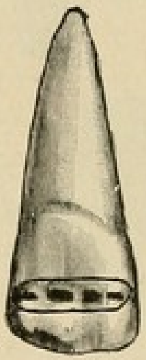
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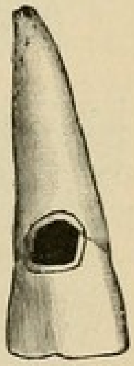
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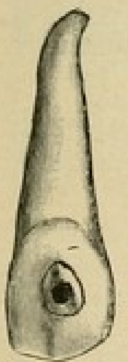
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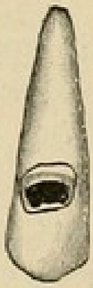
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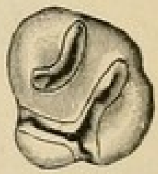
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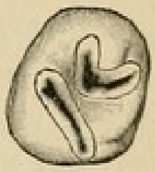
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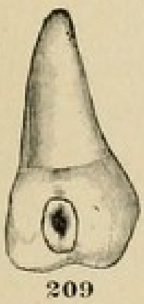
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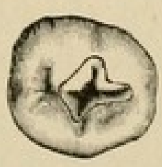
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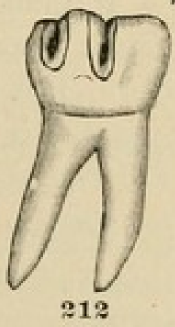
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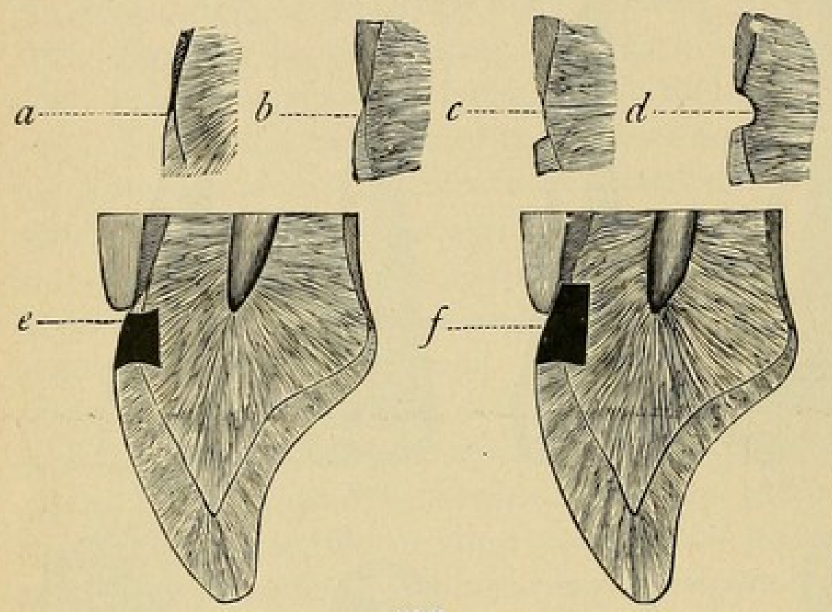
Cuts 191 to 212 inclusive, and 214 and 215, are made from photographs of natural teeth. They are accurate reproductions in outline, but they are enlarged about one and a half times. The unprepared cavities are shown as they appear in the teeth.

when the disto-lingual groove of the buccal surface crosses over to the lingual surface, or when the lingual groove terminates in a pit, Fig. 209. The lower molars have cavities of division *A*, class 1, on the occlusal surfaces, under the same conditions as those noted for the upper molars, Figs. 210 and 211; the buccal surfaces have cavities of division *A*, class 1, in the buccal groove, and occasionally in the disto-buccal groove, Fig. 212. Cavities of division *B*, class 1, are found in the gingival third of the buccal surfaces of both upper and lower molars, but not upon the lingual surfaces, except in cases of recession of the gums. In fact, the buccal and



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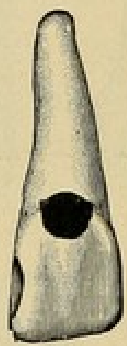

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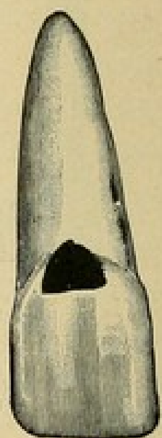

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lingual surfaces of all of the teeth, upper and lower, are liable to have cavities of division *A*, class 1, when the gums have receded sufficiently to expose the gingival line.

In cavities of division *A*, class 1, the general rule for cavity outline is, that *pits should be enlarged until sound walls are obtained, and fissures should be cut to the end, or until the fissure becomes a groove.** If gold or tin is used in filling, the walls of the cavity for the dentinal pyramid should be shaped as in *a*, Fig. 189, and *a*, Fig. 190½. For gold, the bevel for the enamel pyramid may be as great as in *b*, Fig. 189, if the location of the cavity makes it desirable. For tin, the enamel bevel should be as shown at *b*, Fig. 190, or *b*, Fig. 190½. If amalgam, cement, or gutta-percha, is the ma-

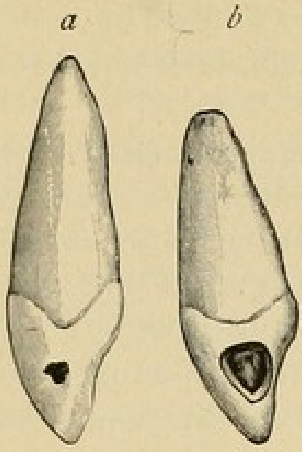
*Lines have been placed on all the cuts to indicate the outlines of the prepared cavities.

terial employed, the dentinal pyramid may be shaped as in *a*, Fig. 190; while the enamel pyramid should have no more bevel than is shown in *b*, Fig. 190, or *b*, Fig. 190½.

In cavities of division *B*, class 1, the cutting mesially, distally, and toward incisal portion, should be enough to insure sound walls, and true lines of beauty; cut rootward sufficiently to place the cervical margin beneath the free margin of the gum, Fig. 213, *f*. If this is not done, the result would be as is shown at *e*, Fig. 213. Where the free margin of the gum is long, it is not necessary to establish the cervical margin of the cavity in the cementum, as seen at *f*, Fig. 213. A short triangle of enamel, such as is shown at *e*, Fig. 213, should never be left. In rare instances, as in Fig. 201, it is not necessary to place the cervical margin of the cavity beneath the gum. The mesial and distal margins of these cavities should cross the line of the gum margin as nearly at right angles as possible, Fig. 214, in order that such triangular areas of enamel as are shown in Fig. 215, shall not be left. This class of cavities are especially annoying when there is a tendency to inflammation of the gingival border, or where there is recession of the gums. Normally, the enamel is slightly overlapped by the cementum, *a*, Fig. 213, but in many specimens this condition does not exist, *b*, Fig. 213. When from any cause such points are exposed by recession of the gums, such structural imperfections are a predisposing cause of decay, *d*, Fig. 213.

Cavities of the second class have two dentinal pyramids; one with its base rootward, *b*, Fig. 216, and *c*, Fig. 217; the other with its base toward the pulp, *a*, Fig. 218, *a*, Fig. 219, and *a*, Fig. 220. They have one enamel pyramid with its apex pulpward, *b*, Fig. 218, *b*, 219, and *d*, 220. As these cavities are on the proximate surfaces of the conical teeth, they have, when prepared, the pyramidal outline seen in Figs. 216, and 217. They seldom occur under good hygienic conditions, except there be broad contact, as in Fig. 221, or when the festoon of the gum is withdrawn from the interdental space. It is necessary to establish the cavity margins outside of the point of contact, with the cervical margin beneath the border of the gum.

In division *A*, class 2, cavities usually appear as in *a*, Fig. 216; when prepared, they should appear as in *b*. Fig. 216 ; the form of the dentinal and enamel pyramids is seen in Figs. 218, 219, and 220. The labial margin should not only be outside the point of contact, but should extend so far upon the labial surface, and have



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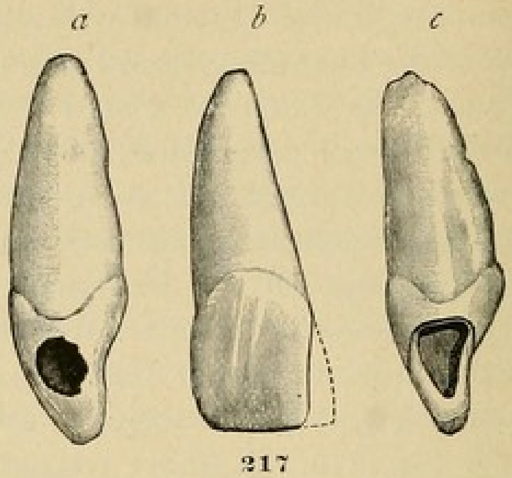
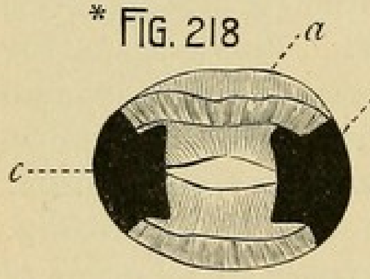


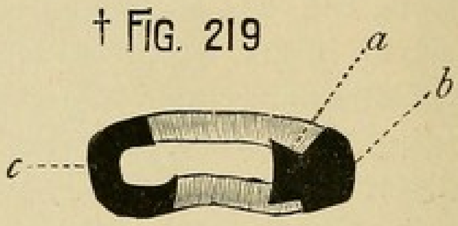
217

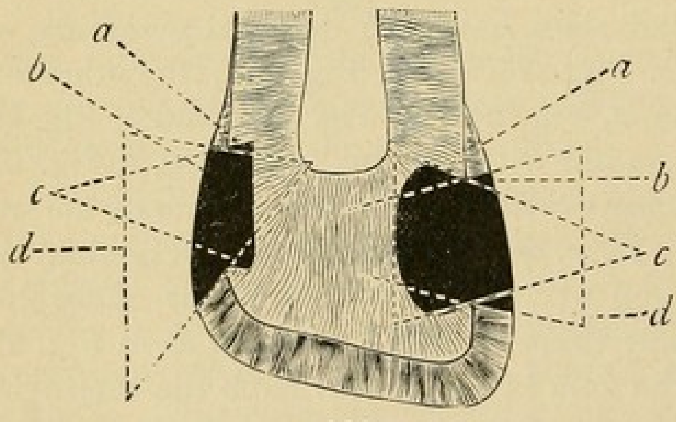
These cuts, as well as Figs. 223 to 226 are made from photographs of teeth having cavities as shown.

* FIG. 218



† FIG. 219





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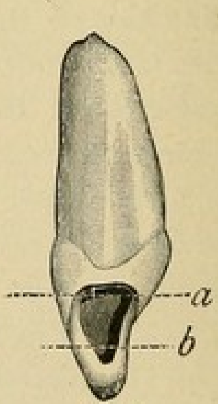
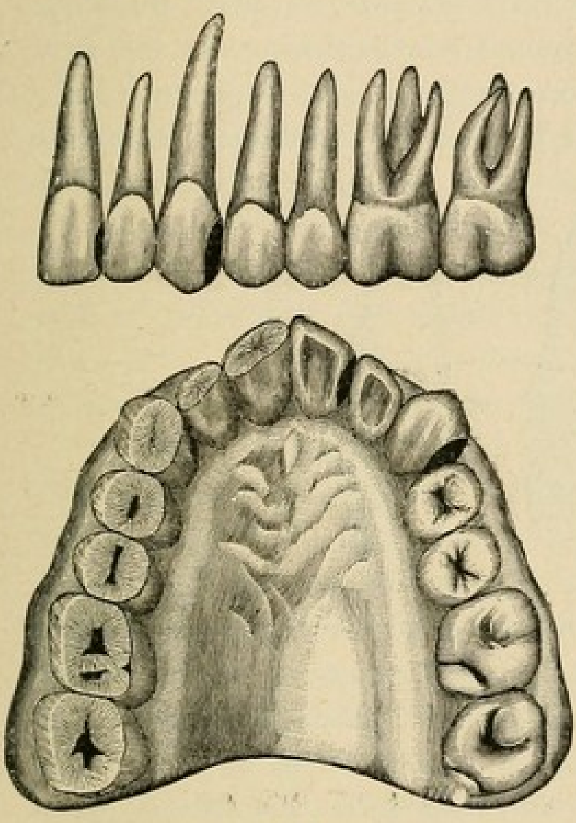


219½

*This cut, in common with all the transverse sections shown, was made from a photograph of a section of a tooth, and is accurate in outline; structure diagrammatic. This section was cut from an incisor at *a*, Fig. 219½.

†This section was cut from an incisor at *b*, Fig. 219½.

such outline as to prevent the gold from being in shadow; if in shadow, it appears as a dark line. The lingual margin should extend so far upon the lingual surface as to insure the cleansing of this margin by the action of the tongue. The occlusal margin should have such enamel bevel as will bring it outside the point of contact. These various points are illustrated in Figs. 221 and 222.



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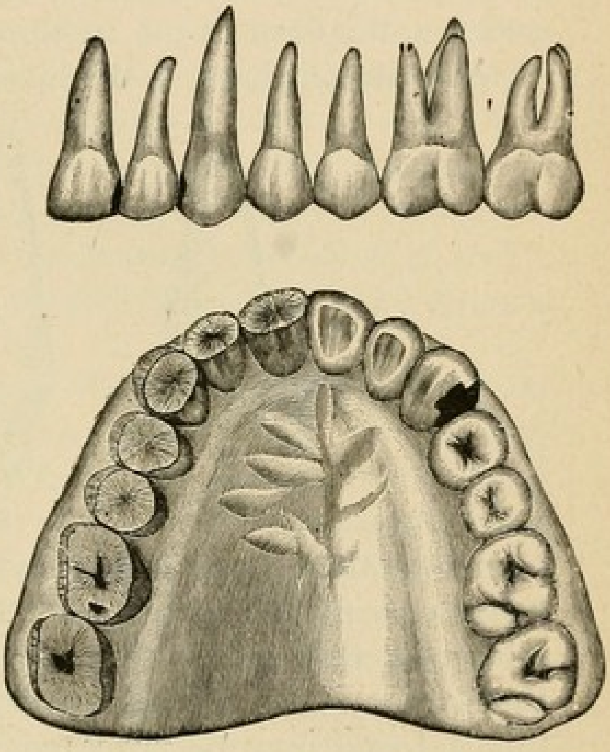

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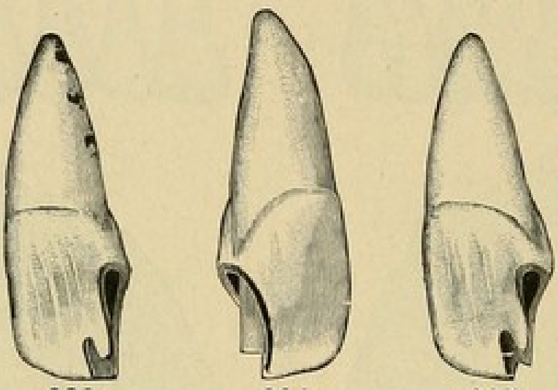
These cuts are reproductions of teaching charts by Dr. W. J. Brady. Fig. 222 shows ideal contact; Fig. 221 shows one of the many departures from the ideal.

The line of demarcation between division *A* and division *B*, class 2, is a disputed point. Which cavities to leave in division *A*, and which to place in division *B*, by involving the mesial or the distal angle, must be left to the judgment of the operator. The chief factors are the strength of this angle after the decay is removed, the shape and structure of the tooth, and the manner of occlusion. The general outline of the prepared cavity, as seen in *c*, Fig. 217, is the same as that for division *A*, as seen in *b*, Fig. 216, except that more of the labial and lingual surfaces are sacrificed, *b*, Fig. 217, and the dentinal pyramid has more retaining shape. Having determined to involve the mesial or distal angle, enough tooth substance must be sacrificed to allow sufficient gold in the incisal portion of the filling to resist the strain of mastication; and the cavity must have enough retaining shape to resist this strain. The usual form of cavity preparation is, in the main, as shown in Fig. 217, and in the outline illustrations, Figs. 218 and 219.

In those teeth which are long and thin, or where the occlusion is such that the teeth will in time become abraded, the form of preparation just described is open to objections. In the first instance, the form of the tooth makes it impossible to secure sufficient retaining shape in the incisal third. In the second instance



223 224 225

such retaining shape is lost by the general abrasion. It is also difficult to fill that portion of the dentinal pyramid in the incisal third of a thin incisor. In these cases, an auxiliary dovetail may be cut upon the lingual surface, as in Fig. 223; or in addition to this, a tenon may be prepared to dovetail into the filling, as in *c*, Fig. 219. The tooth is cut off at the incisal third, and the enamel grooved, as in Figs. 224 and 225; also *c*, Fig. 219. The dentinal pyramid at the base of the filling, in the cervical third, is seen in *c*, Fig. 218.* A form of preparation for cavities in distal surfaces of upper cuspids, is that of cutting a dovetail on the lingual surface. Fig. 222.

Cavities of the third class, occurring upon somewhat broad and flattened contact surfaces, are seldom confined to the proximate surfaces. They usually involve the mesio-marginal or disto-marginal ridge. Where the adjoining tooth has been extracted, these cavities, in many cases, may be filled without cutting through the ridge to the occlusal surface. In such cases, the rules for prepara-

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*These forms of preparation were suggested by Dr. I. C. St. John. See *Dental Cosmos*, Vol. XXXVI., p. 198.

tion are the same as for the preparation of a cavity upon any plane or slightly convex surface.

The usual form of preparation for cavities of division *A*, class 3, is shown in *b* and *c*, Fig. 226. There are two dentinal pyramids, one with its base rootward, *a*, Fig. 227; the other with its base pulpward, *a*, Fig. 228. The form of the teeth gives two enamel pyramids, one with its apex pulpward, *b*, Fig. 228, the other with its apex rootward, *b*, Fig. 227. In division *B*, class 3, a simple cavity in a sulcus or groove upon the occlusal surface is combined with the cavity seen in Fig. *b* and *c*, Fig. 226. This forms an auxiliary dovetail, which has the same pyramidal form in dentine and enamel as is given to cavities of division *A*, class 1. Care should be exercised that the points *e* and *f*, Fig. 229, should be the deepest, as this form gives a firm "seat" for the filling, enabling it the better to resist the strain brought upon it at *g*, and *h*, Fig. 229. The various points of preparation for cavities of class 3, are shown in Figs. 226 to 229.

Emphasis should be placed upon the necessity for flat bases to the dentinal pyramid, with the plane walls rising at a slightly acute angle with the base, in all classes of cavities where gold or tin is used; and upon the latitude which may be permitted when plastics are employed. In the forming of the enamel pyramid, stress should be placed upon the fact that a broad bevel must not be made for any material but gold. All cavity outlines should be on true, smooth lines, *i. e.*, perfectly straight lines and true curves. Jagged outlines not only detract from the beauty of the operation, but increase the difficulty of condensing and finishing the filling. All enamel margins should be carefully smoothed, for the same reasons. All cavities should be prepared step by step: 1st, establish outline of cavity; 2d, remove decay; 3d, make retaining shape; 4th, bevel and finish enamel margins.

PRACTICAL EXERCISES.

The extreme difficulty of preparing typical cavities in dried teeth, makes it desirable to limit such cavity preparation in the teeth mounted in the articulator. Only one cavity of each division of the several classes need be required. In order that the student may have the necessary practice in cavity preparation, some material should be chosen which can be cut more easily than the dry teeth. Dice, and toothbrush handles of bone are employed, but the coarseness of the grain in the bone, makes it difficult to get nice cavity margins. Experiments with celluloid have progressed so far as to indicate that this material may be so prepared as to meet the requirements. It may be easily moulded into tooth form, which will be a great advantage. Having selected *some* material, cavities should be prepared in it before attempting to prepare any in the teeth.

Exercise 1. Prepare on plane surfaces of bone or celluloid five cavities similar in outline to those shown in Fig. 187, having a depth of one-eighth inch, with plane walls rising from the plane floor of the cavity at slightly acute angles, as in *e*, Fig. 188. These cavities are designed for filling with tin. In the preparation of them, such chisels as Nos. 13, 15 and 20, and such excavators as Nos. 14, 44, 45, 46, 47 and 51, may be used. If cavities are desired for plastics, others may be prepared having similar outline and depth, with such shapes as that shown in *f*, Fig. 188. For such cavities the spoon excavators, Figs. 50, 51, 52, 65, 67 and 68, may be used.

Exercise 2. Prepare, for gold or tin, one cavity of division *A*, class 1, and one of division *B*, class 1, in some tooth in the articulator. One of each division may also be prepared for plastic filling. In this exercise, the same instruments may be used as in the first exercise, and the operation should be performed step by step as outlined.

Exercise 3. In the edge of the toothbrush handle, at the thin end, where it resembles the proximate surface of an incisor, or in incisor teeth of celluloid, prepare one cavity of division *A*, class 2, for tin, and one for plastics; also one for gold or tin, and one for plastics of division *B*, class 2.

Exercise 4. Prepare one cavity of division *A*, class 2, for tin, in one of the incisors in the articulator. Prepare one cavity of division *B*, class 2, for plastics, in another incisor in the articulator. Prepare one cavity, division *B*, class 1, in an incisor, cutting an auxiliary dovetail on the lingual surface. In these two exercises, the student may use, in addition to the instruments already employed, the burholder, Fig. 82, with burs of the proper size, shaped like Figs. 88, 94, 95, 96, and 97. These operations also should be performed step by step.

Exercise 5. In the square end of the toothbrush handle, or in a bicuspid or molar of celluloid, prepare one cavity for tin, and

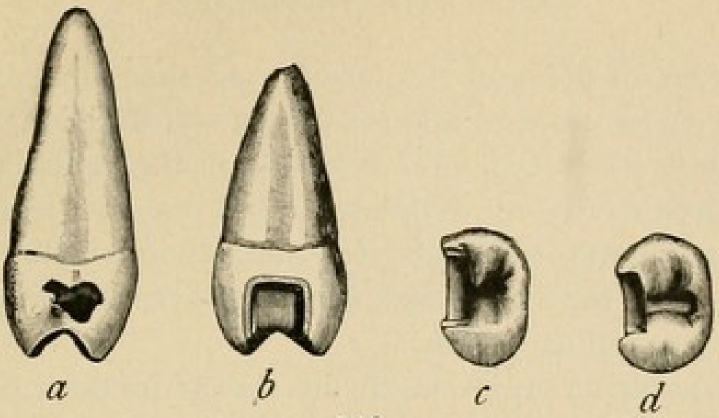

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FIG. 227

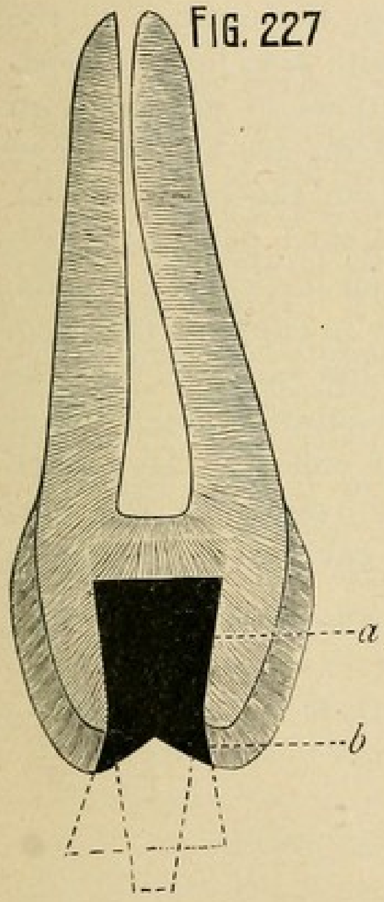


FIG. 228

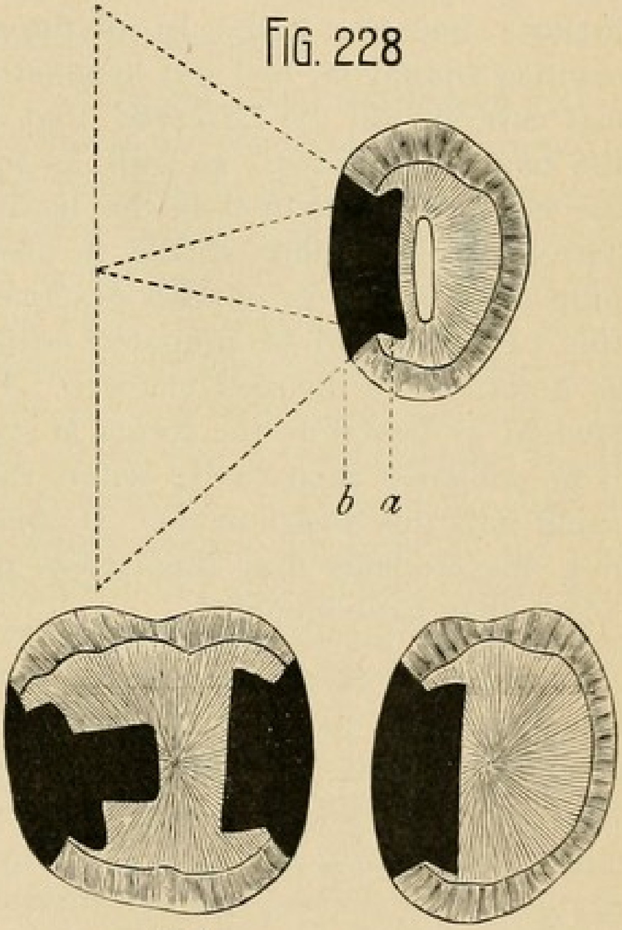
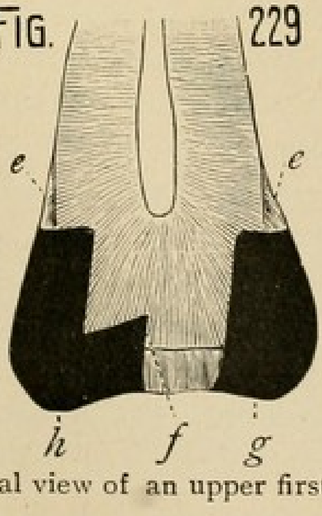


FIG. 229



This section gives a buccal view of an upper first bicuspid.

one for plastics, of division *A*, class 3. In the same material, prepare one cavity for tin and one for plastics of division *B*, class 3.

Exercise 6. In a bicuspid or molar, in the articulator, prepare for plastics, one cavity of division *A*, and one of division *B*, class 3. The instruments employed for the previous exercises are the ones to be used for these two, and the operation should be performed step by step as before.

When operating upon teeth in the articulator, it should be fixed by means of the bolt, so that the incisors are opened two inches. See Fig. 1, *A*. In all the exercises, the outlines of the cavities should be laid out symmetrically with true lines. Especial care should be observed that the margins of the cavity in the bone or celluloid, as well as in the teeth, are smooth, and the margins of enamel in the teeth are given the proper bevel. The same precautions should be observed against penetrating the pulp chamber as in clinical practice. If an exposure *is* made, this cavity should be prepared with a view to capping the pulp, as described in the next chapter. The teacher will find that the student understands the forms of cavity preparation much better if he prepares each cavity before them, in a collossal clay model, using enlarged instruments. If time and conveniences will permit, the students may themselves prepare cavities in clay teeth which they have modeled.

CHAPTER V.

PULP TREATMENT.

CONSERVATIVE AND RADICAL

Conservative treatment: The points to be considered first are the form, location, and environment of the pulp; its composition and structure; its function and relations to the dentine; the conditions to which it is sensitive; its natural protection and its behavior when this natural protection is lost, and its behavior under artificial protection. The cutting of sections and printing of silhouettes gives the student the best opportunity possible for becoming familiar with the form, location and environment of the pulp. The pages of his printing book, of which Fig. 6 is an example, furnish a record which is an ever ready reference. They show that the outline of the pulp chamber, which defines the form of the pulp itself, follows the outline of the teeth in a general way. They show also the location of the pulp in the tooth and that it is surrounded by unyielding walls; imprisoned in a cell of solid masonry. This information the student must possess if he is to prepare cavities intelligently and avoid accidental exposures. In his histological and embryological studies he learns that the pulp is composed of connective tissue, richly supplied with nerves and blood vessels; that it has no lymphatic system; that its outer layer or coat, the membrana eboris, is composed of odontoblastic cells, columnar or pear shaped in form, having processes which fill the dentinal tubuli, and others which anastomose with other cells; that these cells are composed of protoplasm, which is sensitive to heat, cold, touch, and various chemical substances; that the terminals of the nerves of the pulp are among these cells; that the pulp is the formative organ of the tooth, its function being to build dentine, which function ceases when the tooth is complete; however, under certain conditions it is reawakened. He learns also that the pulp, protected as it is from contact of all kinds, is normally sensitive only to heat or cold, and that because of the nonconducting power of enamel, it is protected from all other changes, to which the teeth are usually subjected, when the enamel is intact.

He learns from pathology that when enamel, which furnishes the natural protection to the pulp and its processes in the dentine, is lost, changes in the pulp take place. That such loss of tissue results in irritation to the pulp. When this loss of enamel is slight, the slight irritation consequent, stimulates the activity of the odontoblastic cells, causing them to deposit calcific matter, secondary dentine, within the pulp chamber, at the point nearest the loss of tissue. The second effect of irritation following greater loss of protective tissue, is hyperæmia; the result of this is likely to be a deposit of unattached calcific matter within the pulp in the form of pulp nodules. The result of continued or increased irritation is inflammation, which if not arrested will result in death of the pulp.

Clinical observation teaches that when the materials used to replace lost tissue do not protect the pulp from the ordinary thermal changes to which the teeth are subjected, the same results follow the various degrees of irritation as when no restoration has been made.

The following summary is deduced from these facts. The pulp, properly speaking, is not confined to the pulp chamber and canals, because of the processes of the odontoblastic cells which penetrate the dentine to its periphery. It is not sensitive to ordinary temperature when protected by the normal thickness of enamel, but becomes sensitive in proportion to the loss of this protection. When the enamel is entirely gone at any point, the exposed dentine is sensitive to all the conditions to which protoplasm is sensitive. Pain may occur and inflammation of the pulp ensue, through its fibrillæ or odontoblastic processes, without actual exposure of the pulp. The natural protection of the pulp, when lost, should be restored by such substances as will most nearly fulfill the office of the normal protection.

The conservative treatment of the pulp will be considered under two separate heads, pulp protection and pulp capping. Pulp protection refers to the practice of placing some nonconducting substance between the bottom or axial wall of the cavity and the filling proper, in those cases where there is no exposure of the pulp. The term "intermediate" will be adopted to designate such nonconducting substance. Where decay progresses slowly, changes undoubtedly occur in the pulp which lessen its normal sensitiveness, the result of the effort which nature always makes to repel disease. On this account protection is not always necessary, but in cases where pain results from changes in temperature while preparing the cavity, an "intermediate" should precede the filling. It may be well to consider the much discussed point of leaving affected dentine as a protection to the pulp, rather than to remove it at the risk of making an exposure. All cavities of decay are infected. Semidecalcified dentine which appears normal to the eye may be penetrated by the microörganisms of decay. Such dentine may be so treated as to arrest the further progress of the affection. This is accomplished by sterilizing the affected dentine. Hence we conclude that partially decalcified dentine may be left as a protection to the pulp *if it be perfectly sterilized.* The student, however, should not be misled by this statement, and leave dentine which is badly disorganized in any part of a cavity. He should also be sure that whatever germicide is employed is left for a sufficient length of time to sterilize *all* of the affected dentine. It is in fact good surgery to sterilize *all* cavities of decay.

The chief requisite in a material for pulp protection is that it is a nonconductor. The two materials which possess this quality to the fullest extent are gutta-percha and asbestos. Gutta-percha is cut in the form of a wafer of sufficient thickness for the case in hand, large enough to cover the floor or axial wall of the cavity, warmed, carried to place and fixed in position with a warm burnisher. Asbestos is used by cutting a piece of the paper to correct size, and fixing it in position with thin oxyphosphate or chloro-percha.

Pulp capping is the term applied to operations for the conservation of exposed pulps. Exposures are of two kinds, which we will term surgical and natural. Surgical exposures are either accidental, as when an abnormal shaped pulp is penetrated, or intentional, as when partially disorganized dentine is removed. Natural exposures are those where the pulp chamber is penetrated by decay before the case comes under observation. In surgical exposures, inflammation is seldom present, while in natural ones it usually is. It is sufficient for present purposes to state that pulps which are inflamed in any degree are not promising subjects for pulp capping. If a pulp which is exposed is to retain its vitality, it must be protected from irritation by pressure, from contact with any irritant, and from thermal changes ; consequently a material for pulp capping must be one which is nonirritant to pulp tissue ; one which can be applied without pressure, which will also protect the pulp from pressure, and one which is a non-conductor. Without discussing the merits of the numerous methods and materials, we will select the two substances used as pulp protectors, adding the oxysulphate of zinc, or some of the similar preparations in which the oxide of zinc is combined with some nonirritant liquid to form a mass which will become sufficiently hard for the location in which it is to be placed. Where cavities are so shallow that the capping cannot be protected by a thin layer of cement, from the pressure caused by the insertion of a metallic filling, concave caps of thin metal may be employed to furnish this protection.

PRACTICAL EXERCISES.

These exercises are all upon teeth in the dummy articulator.

PULP PROTECTION.

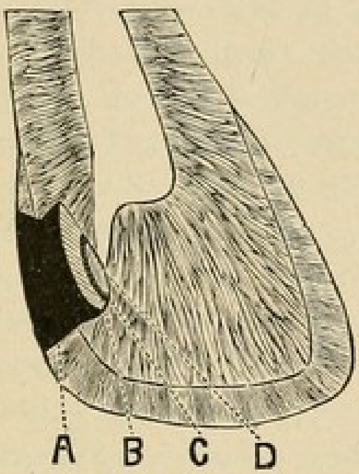
Exercise 1. In the occlusal surface of a molar, select a cavity which is sufficiently deep to allow of an "intermediate." Prepare and sterilize; make wafer of gutta-percha, pink base plate, of the proper size and thickness; soften over heater (see *gutta-percha*, chapter on filling materials) carry to place with warm burnisher, carefully pressing it in position with same instrument. The burnishers shown in Fig. 150 or 151 will serve.

Exercise 2. In an incisor or bicuspid, select, prepare and sterilize a cavity of class 2 or 3 which is too shallow to allow of as bulky an "intermediate" as gutta-percha. Cut a piece of asbestos felt the proper shape and size to cover the axial wall of the cavity; mix some oxyphosphate thin, coat one side of the asbestos with this, and carry it to position, pressing it slightly to insure adhesion. This exercise may be varied by using chloropercha instead of oxyphosphate.

PULP CAPPING.

Exercise 3. In a bicuspid or molar, select, prepare and sterilize a deep cavity in which the pulp chamber is slightly penetrated. Cut a piece of asbestos felt of proper size and shape; coat one side with chloropercha and carefully slide it into position, avoiding any pressure. Lightly press the edges with a small burnisher. After allowing it to dry, insert an "intermediate" of oxyphosphate, mixed thin enough to avoid pressure.

Exercise 4. On the mesial or distal surface of an incisor or bicuspid, select, prepare and sterilize a shallow cavity in which the pulp may be readily exposed. Strike up a concave cap of thin metal, cutting it to the proper size and shape to cover fully the point of exposure. Coat its concave surface with oxysulphate of zinc, or Dickinson's protector and slide it into position. If space will permit, the cap may be lined with gutta-percha before applying the oxysulphate. Where protective caps are necessary, they may be easily made of vulcanite, which is an excellent nonconductor. In these exercises other materials may be employed at the



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D shows the oxysulphate. C shows the metal or asbestos cap. B shows the intermediate, and A the filling.

option of the teacher; the methods are much the same for all materials. The chief point is to *avoid pressure.*

RADICAL TREATMENT.

Surgical devitalization. While the ancient custom of extirpating the pulp with the actual cautery has been abandoned, it is frequently desirable to remove pulps without waiting for the slower method of devitalizing with drugs. The fact that uninflamed pulps are not sensitive at the moment of their exposure, when such exposure is sudden, is taken advantage of by some operators when preparing teeth with healthy pulps, for porcelain crowns. The tooth is girdled with a sharp groove close to the gingival border; is cut off with excising forceps, and the pulp removed *instantly* with a barbed broach or by driving in and immediately withdrawing a hickory or orangewood point having a long taper. While this method is comparatively painless and is practicable for those teeth whose crowns are to be replaced by porcelain ones, it is not applicable to those teeth whose crowns are to be retained and filled. In rare instances pulps may be removed surgically, without pain, after being freely exposed, but the irritation attendant upon the exposure of the pulp is usually sufficient to awaken and increase the sensitiveness of the pulp and there is no shock to obtund this sensitiveness, as there is in the excision of a tooth.

In those cases where the necessities of the case or the judgment of the operator indicate the surgical removal of a pulp, the cavity should be deepened as much as possible without pain. In those cases where local anæsthesia proves inefficient, general anæsthesia may be resorted to, or the operation may be performed during the first or second stages of anæsthesia by ether, chloroform, or the A. C. E. mixture. Burs, broaches and all instruments should be in readiness so that the pulp may be exposed and removed expeditiously. Thus far we have considered only those cases where there was no natural exposure, or at least those where there was no degree of inflammation. Pulps which are inflamed ever so slightly are too sensitive to permit of their surgical removal without anæsthesia, either local or general. In many cases of actual exposure the pulp may be sufficiently anæsthetized, by the application and injection of a strong solution of cocaine, to permit of its painless removal. The author has removed pulps painlessly by the use of a twelve per cent solution of cocaine in carbolic acid two per cent, causing the cocaine to act upon the pulp by electrolysis. The method is to place the negative pole of the galvanic battery, which terminates in a small pad moistened with saline water, upon the gum over the tooth to be operated upon; place in the cavity, upon a pledget of cotton moistened with the cocaine solution, the positive pole, whose terminal is a platinum point. The current, a continuous one, should be applied gradually and at no time should it be strong enough to be unpleasant to the patient.* Aside from the lack of time in which to extirpate a pulp by the application of drugs, the argument for surgical devitalization is that it avoids the pain frequently present during the action of the drug, and is less likely to excite inflammation in the apical region. Surgical removal of the pulp should never be attempted

*This method was published in the DENTAL REVIEW, Vol. III., page 169, by Dr. D. F. McGraw.

until direct access, as nearly on a line with the axis of the principal canal as possible, is obtained and an opening made into the pulp chamber of sufficient size to permit of the removal of the pulp.

Devitalization by drugs. The drugs used in devitalizing pulps are usually escharotic. Those generally employed are arsenious acid, carbolic acid, and chloride of zinc. Arsenious acid is in a sense escharotic, but it acts by directly destroying life; it kills the pulp by irritation, increases the flow of blood to the parts, enlarges the arteries, prevents the return of blood to the veins, thus causing strangulation. Carbolic acid, like other true escharotics, acts by combining with albumen, producing decomposition of the part and forming an eschar. It is somewhat self-limiting and requires repeated applications. Chloride of zinc is also a true escharotic; owing to its great affinity for water and its power of combination with albumen, it penetrates deeply. Many other agents, such as dilute hydrochloric, nitric and chromic acids are sometimes employed, but they will not be further considered. None of the agents used accomplish the object painlessly without previous treatment by, or combination with some anodyne or obtundent.

As arsenious acid, or cobalt, which contains arsenic, are the chief "potential cauterants" used in devitalizing pulps, our attention will be confined to it. On account of its destructive action upon vital tissue, *it must be confined in the cavity;* if allowed to come in contact with the soft tissues surrounding the tooth, it will cause violent inflammation, and may result in necrosis of the alveolar process. It should never have a surplus of the liquid with which it is mixed, for the pressure of inserting whatever substance is used to retain it in the cavity, may squeeze it out, carrying with it sufficient arsenic to do mischief. As the chief action of arsenic upon inflamed pulp tissue will be to cause severe pain, it must not be applied until inflammation is reduced. As deciduous teeth and permanent ones in the mouths of very young persons have large foramina it is unsafe to employ arsenic as a devitalizing agent. It is wiser to destroy such pulps by the slower means of carbolic acid crystals. The length of time that arsenic should remain in a cavity is a disputed point. It accomplishes its purpose in from three to twelve hours, depending upon the structure of the teeth, the idiosyncrasies of the individual, and whether the pulp has been freely exposed; hence there seems to be nothing gained by leaving it longer than twenty-four hours. Again, should the pulp be removed at once, or should it remain until the pulp is ready to slough? It is claimed that because of the penetration of the tubuli by the processes of the innumerable odontoblastic cells of the pulp, if attempts are made to remove the pulp before it is ready to slough; that patches of the membrana eboris may remain. We will say that the pulp should be removed before it reaches the early stages of putrescence, and that the success of the subsequent operations depends much upon the removal of *all* of the pulp.

As our only object is to give the student sufficient data to enable him to perform the practical operations intelligently, the subject will not be pursued further. The knowledge and judgment necessary to enable the student to differentiate in his prognosis, cannot be obtained until he has clinical experience; hence the teaching in the technic laboratory should be confined to those points which will aid him in his work there.

PRACTICAL EXERCISES.

Surgical devitalization. The exercises under canal treatment have given employment for the same instruments, and in much the same manner as they are used in surgical removal of the pulp, and as the conditions found in vital teeth can only be imagined in dried ones, the practical instruction under this head may be confined to demonstrations by the teacher.

DEVITALIZING BY DRUGS.

Exercise 1. Select a cavity in which there is exposure of the pulp; moisten $\frac{1}{40}$ grain of arsenious acid with oil of cloves; apply the mixture to the concave surface of a metal cap, prepared as in exercise 4, pulp capping, and carry the cap to position over the exposure. Fill the cavity with low grade gutta-percha. At the next meeting of the class, remove the filling and cap; wash the cavity thoroughly; apply tannin and glycerine on a small pledget of cotton; refill the cavity with gutta-percha, and let it remain for one week. At the expiration of that time remove the pulp and proceed as in practical exercises under canal filling.

Exercise 2. In another cavity apply the arsenic and oil of cloves on a minute pledget of cotton or on a bit of asbestos paper, protecting it and sealing it in the cavity with cotton moistened with sandarac varnish. At the next meeting of the class, remove application, extract the pulp, and fill at once. The time is specified in these exercises merely to impress these things upon the mind of the student. He should also be impressed with the importance of excluding the saliva during all these operations.

CHAPTER VI.

FILLING MATERIALS.

Only such materials and preparations of materials as are used by the student in his primary work will be considered; dealing with the elementary principles which govern the filling of teeth; treating each material under the subdivisions of characteristics and composition, preparation, introduction and finishing.

Rents, fissures, holes or cavities in any object are best mended with a substance possessing the characteristics of the object itself. The other factors which govern the selection and application of a filling material are the location, environment and use of the object.

Considered as objects having holes or cavities to be mended or filled, the teeth present surfaces having great variety of form, and resembling glass or porcelain in density and color. Examination discloses that the object has a covering or shell. That this shell is made up of blocks or rods arranged upon the surface of the tooth much as blocks are laid in a pavement; the rods are held together by a cement substance. That when a hole is once made in this shell the rods or blocks around its border may, under sufficient strain, be cleaved or split off in small sections.

Further examination shows that the substance beneath this shell much resembles bone except that it is harder and more dense. That the tooth substance when denuded of its shell at any point is sensitive to thermal changes, and that in its center is a cavity or chamber which contains an organ still more sensitive. The thinness of the shell and its liability to fracture indicate that the filling for any existing cavity would better be inserted in the substance underlying the shell. This is necessary when the cavity penetrates the substance of the tooth.

From our investigations of the tooth as an object, we conclude that its characteristics demand a filling material which will present a hard surface, highly polished or enameled, bluish white or yellowish white in color, and that it must possess nonconducting properties, or be preceded by some substance which is a nonconductor.

As masticating apparatus we must consider the location of the teeth, their environment and their use. We find them situated in the oral cavity, and arranged in two rows bent in the form of an arch, with the crown of the arch presented to the opening of the cavity. The arches are hinged at their base in such a manner as to permit the teeth to separate some two and one-half inches at the widest point. The teeth are close together, and practically immovable in their sockets. As cavities appear upon all surfaces, there are many to which access is difficult. These conditions demand that filling materials be capable of introduction piecemeal, or in a plastic condition; and to fulfill the requirements indicated under characteristics, the material must form a homogeneous mass not subject to such molecular change as would affect its integrity.

Further observation reveals the fact that the cavity in which the teeth are situated is warm and moist and that substances are taken into it which undergo chemical change; that portions of the surfaces of the teeth are constantly in contact with the results of these changes. Hence another quality is demanded of a filling material, the ability to resist chemical solution.

Lastly, we observe that as the two rows or arches come in contact with each other in the act of mastication, the cutting or grinding surfaces are subjected to more or less wear. For this reason filling materials for cavities on these surfaces must have the ability to resist mechanical abrasion.

To summarize, filling materials must possess density and hardness, tenacity, resistance to strain or wear, low conductivity, ease of introduction, freedom from chemical action, freedom from molecular change, capability of polish, and a color which will harmonize with or make a pleasant contrast to tooth color.

The materials to consider, are gold, amalgam, tin, cement, and gutta-percha. As much knowledge of gold and tin is gained from a study of amalgam alloys, they will be considered first.

AMALGAM.—A combination of a metal or an alloy with mercury, by the mercury. Amalgams must be considered as alloys in which all or part of the combination or mixture has been accomplished by the mercury. Amalgam alloys should be composed of such metals as will form an amalgam having density, tenacity, good plasticity, low conductivity, freedom from the action of such chemical agents as are found in the oral cavity, and having such fusing points and behavior in hardening as to overcome, in the greatest degree, the spheroidal tendency imparted by the mercury.

ALLOY.—A combination (fusing together) of two or more metals by heat. "An alloy is either (1) a solution of one metal in another, (2) a chemical combination, (3) a mechanical mixture, (4) or a mixture of two or all of the above." (Matthiessen.) Solutions retain to a greater or less extent, the properties of their component parts as do mechanical mixtures. Chemical compounds are generally formed in definite atomic proportions, and exhibit properties differing from either of their components. Nearly all alloys belong either to the 3d or 4th class of Matthiessen. Tenacity is usually higher in an alloy than that of its components. Malleability and ductility, are usually lessened in alloys. Conductivity is usually lower in alloy than that of its components.

To give the greatest amount of information in small space the following tables are presented, the metals employed in amalgam alloys are arranged in the order of their importance; under proper heads are given the properties or characteristics which may exert an influence in the resultant compound. When the relative rank is given, the grading applies only to the metals enumerated in their relation to each other.

NAME.	LATIN TERM.	SYMBOL.	SP. GR.	FUSING PT. (F.)	EXPANSION.†
Mercury	Hydrargyrum.	Hg.	13.5	39°	....
Silver	Argentum	Ag.	10.4	1873°	4th Rank
Tin	Stannum.. ...	Sn.	7.29	442°	3d "
Copper	Cuprum.......	Cu.	8.94	1996°	5th "
Gold	Aurum........	Au.	19.26	2016°	6th "
Zinc	Zincum	Zn.	7.20	773°	2d "
Platinum ...	Platinum......	Pt.	21.50	above 3500°*	8th "
Cadmium ...	Cadmium	Cd.	8.54	442°	1st "
Antimony...	Stibium	Sb.	6.71	842°	7th "
Palladium...	Palladium.....	Pd.	11.80	above 3500°	9th "

(* In oxyhydrogen flame.) († When raised from 32° to 212° F.)

NAME.	TENACITY.	MALLEABILITY.	DUCTILITY.	CONDUCTIVITY.	
				HEAT.	ELECTRICITY.
Mercury	....	....	....	....	....
Silver.......	3d rank	2d rank	2d rank	1st rank	1st rank
Tin........	6th "	4th "	7th "	5th "	5th "
Copper	1st "	3d "	4th "	2d "	2d "
Gold	4th "	1st "	1st "	3d "	3d "
Zinc	5th "	7th "	6th "	4th "	4th "
Platinum ...	2d "	6th "	3d "	6th "	6th "
Cadmium ...	7th "	5th "	8th "	....	....
Antimony...	brittle	brittle	brittle	....	....
Palladium...	2d rank	8th rank	5th rank	....	....

NOTE.—The electrical state of all the metals except mercury is positive.

SOLUBILITY.

Mercury—Soluble in dilute nitric, and hot sulphuric acid.

Silver—In nitric and hot, strong sulphuric acid.

Copper—In hot mineral acids; slowly attacked in air and moisture by vegetable acids, alkalies, and saline solutions.

Gold—In aqua regia; not affected by single acids or alkalies.

Zinc—In dilute acids, and solutions of the alkaline hydrates.

Platinum—Is dissolved slowly in aqua regia.

OXIDATION OR CORROSION.

Mercury—Not affected by air or moisture.

Silver—Not acted upon by air or water; but readily by sulphuretted hydrogen.

Tin—Oxidizes very slowly.

Copper—In moist air becomes coated with a green carbonate; is tarnished by sulphuretted hydrogen.

Gold—Unaffected by air, water or sulphur.

Zinc—Tarnishes slowly; is coated with carbonate in moist air.

Platinum—Unaffected by air or water.

Cadmium—Tarnishes slowly in air and sulphuretted hydrogen.

Antimony—Oxidizes badly when amalgamated.

Palladium—Does not oxidize easily, but is acted upon by iodine.

COMBINATION WITH MERCURY.

Silver—Forms definite crystalline chemical compounds with mercury.

Tin—Unites with mercury in atomic proportions, forming a weak crystalline compound. (Kirk). Mitchell says it does not.

Copper—Does not form definite compounds with mercury; but in the form of crystals, is dissolved by it in varying proportions.

Gold—Is dissolved by mercury in all proportions; but does not form a definite atomic compound.

Zinc—Unites with mercury in atomic proportions.

Platinum—Only unites with mercury when reduced to a spongy condition.

Palladium—The union with mercury is probably chemical.

COMBINATION WITH OTHER METALS.

Mercury—Dissolves all metals but iron.

Silver—Has affinity for platinum.

Tin—Has affinity for gold and platinum.

COPPER—Unites with zinc in all proportions; and in certain proportions forms definite compounds.

GOLD—Unites with silver in any proportion; and is rendered very brittle by the least trace of antimony, palladium or lead.

ZINC—Unites in all proportions with gold and tin; forms chemical compounds with platinum.

PLATINUM—Unites in definite proportions with silver and cadmium.

NAME.	COLOR.	CONSISTENCY.	CRYSTALLIZATION.*
MERCURY.	Silver white, lustrous.	Fluid at ordinary temperatures.	Spherical above 39° F.
SILVER.	Pure white, lustrous.	Soft between Gold and Copper.	Regular system.
TIN.	White, brilliant.	Soft.	Quadratic system.
COPPER.	Red.	Soft, hardens by hammering.	Regular system.
GOLD.	Yellow, lustrous.	Soft, hammering or burnishing hardens.	Regular system.
ZINC.	Bluish white.	Brittle unless heated and rolled.	Rhombic system.
PLATINUM.	White, tinged with blue.	A little softer than copper.	Practically amorphous.
CADMIUM.	White, with blue tinge.	Between tin and zinc.	Regular octahedrons.
ANTIMONY.	Bluish white.	Hard; brittle.	Rhombic system.
PALLADIUM.	White.	Hard as platinum.	Regular system.

PROPERTIES IMPARTED TO AN ALLOY BY THE VARIOUS METALS.

MERCURY, being the controlling metal, imparts its spherical tendency to the amalgamated mass; especially in those alloys which are "solutions," or "mechanical mixtures." This tendency is greater with those metals having a low fusing point, cooling slowly, and when amalgamated setting slowly, as tin; and less with those which melt at a higher temperature, cool quickly, and set quickly when amalgamated, as silver and copper.

SILVER controls hardening or setting because of its crystalline form and chemical affinity for mercury; it maintains the bulk in-

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*"Regular crystals expand equally in all directions; rhombic and quadratic ores expand differently in different directions."—*Enc. Brit., Vol. XVI., p. 64.*

tegrity of the filling, and should be the largest component of an alloy. The silver sulphide formed by the action of sulphuretted hydrogen is supposed to have prophylactic action against decay.

TIN should be next in quantity, because it increases plasticity, prevents discoloration, and reduces conductivity. It also retards setting, reduces edge strength, and favors spheroiding; hence, should not be used in such proportions as to become the controlling metal.

COPPER diminishes shrinkage, hastens setting, and adds to the present and possibly to the permanent whiteness of the filling. It is also supposed to have greater compatability with tooth substance and pulp tissue than other metals, and has been shown to have antiseptic action.

GOLD lessens shrinkage, resists corrosion, increases edge strength, increases smoothness and plasticity, and hastens setting; all these to a greater degree in small quantities than any other metal, 5 to 7 per cent being all that is advantageous to use.

ZINC controls shrinkage, hastens setting, improves color, and imparts a peculiar smoothness in mixing.

PLATINUM—Authorities differ in regard to the influence of this metal; some claiming that it increases setting, hardness, stability, and improves color; while others contend that it imparts no properties which cannot be obtained by a judicious combination of other metals; which seems to be true.

CADMIUM having been proven to be dangerous to pulp vitality, should never be used.

ANTIMONY blackens so badly that the properties of controlling shrinkage, and increasing plasticity which it imparts, do not seem to be of sufficient advantage to warrant its employment.

PALLADIUM does not improve alloys, but amalgamated alone with mercury, furnishes an amalgam which does not shrink or discolor, but its expense hinders its universal use.

It is an open question whether freedom from discoloration is a desirable attribute; it is certainly true that cavity surfaces under leaky fillings which have become coated with a black oxide or sulphide, have remained free from decay for years. We hold that unsightliness is the principal objection, unless such chemical compounds are formed as will cause wasting of the filling or prove detrimental to the health of the patient.

Since these tables were prepared aluminum has been introduced as a constituent of amalgam alloys. Its sp. gr. is 2.6; the lightest of the metals. Fusing point, 1300°F. Its tenacity, in proportion to its weight, is equal to steel. Malleability next to silver. Ductility next to copper. Conductivity about the same as copper. It does not oxidize or corrode and prevents oxidation when combined with other metals; but only a small per cent can be combined in an alloy. It is not readily acted upon by mercury. In amalgam alloys it is supposed to whiten them and prevent discoloration.

An amalgam is produced by precipitating pure copper, in the form of crystals, from a saturated solution of sulphate of copper into mercury, in which form it is capable of solution in mercury. This precipitation is accomplished by galvanic action or by placing a rod of iron in the solution. The galvanic method is preferred When the solution has been carried to the limit, the mass is put in a wedgewood mortar and triturated thoroughly; the surplus of mercury is removed by squeezing in a chamois skin bag. This process is repeated, resorting to heat to soften the mass, as it becomes necessary, until amalgamation is complete; it is then moulded into small ingots and allowed to harden. As this preparation possesses characteristics peculiarly its own it will be considered apart from ordinary amalgams.

The qualities which commend amalgams are density, hardness, ease of introduction, and cheapness. The objections to it are its color, or rather its disposition to discolor, a lack of ductility and tenacity—edge strength—a tendency to molecular change in hardening, a liability to chemical or electrical changes in the mouth, and its conductivity. Compatibility with tooth substance and prophylactic action are disputed points.

Density and hardness are qualities which all amalgams possess to a degree which enables fillings to withstand all strain and wear to which they are likely to be subjected, and to receive a perfect finish.

Ease of introduction, which is probably its strongest recommendation, is liable to abuse, as its peculiarities demand the greatest care in its manipulation. Cavities should be as thoroughly prepared for its reception as for gold. It should be as carefully introduced, condensed, and finished as is gold. When this is done its other advantage, cheapness, is greatly modified. Cheapness should be the last quality considered. It is better to fill teeth well with amalgam than to allow them to be lost because the patient cannot afford gold, but ordinarily the choice of materials should be based on higher considerations.

Color, while classed as an objection, is frequently an advantage; an oxidation of the surface having been proved by clinical experience to exert a prophylactic action against decay.

Lack of that ductility or tenacity which results in crumbling of the edge next the margins of the cavity, is a fault which can be overcome in cases where enamel margins are strong and cavities can be shaped as in Fig. 190; but where enamel margins are frail or must be shaped as in Fig. 189, few amalgams have sufficient tenacity—edge strength—to resist the force of mastication. It is also difficult to insert and finish amalgam perfectly where the enamel bevel is long.

Liability to molecular change is the objection most difficult to overcome. Reducing metals to a plastic condition by mercury is somewhat similar to fusing them by heat; in either process, as metals lose their solid form the molecules change their position—separate; coming together again as the mass regains its solidity. These are natural conditions over which we have but limited control.

Chemical and electrical changes are certain to result when the conditions of the mouth are favorable. A thorough knowledge of chemistry and the intelligent application of its principles, alone can combat this objection.

Compatibility and prophylactic action are qualities which depend almost entirely upon chemical action; whether this action exerts a good or evil influence depends also upon the recognition and careful observance of chemical laws.

Conductivity is an objection which can be overcome in most cases by the insertion of a nonconducting "intermediate."

The extent and manner in which its weak points may be overcome has already been stated, except that of molecular change. The results of the many experiments which have been made seem to indicate that the change incident to crystallization must be reduced to the minimum. First, the alloy must be one which, when amalgamated, crystallizes under the regular system; second, the mass must have a minimum of mercury, or it must be introduced after crystallization has begun. After choosing an alloy in which the change from crystallization is small, the best results are obtained by expressing all the mercury possible, driving the molecules into the closest possible apposition.

In mixing, the smallest amount of mercury should be used which will amalgamate the alloy; the mass should be thoroughly mixed in a mortar, that the mercury may come in contact with every particle of the alloy; any surplus mercury may be expressed by squeezing in chamois skin with strong flat nose pliers. The mass should be introduced into the cavity in small pieces, and thoroughly condensed with instruments having convex faces; any surplus mercury should be taken up as it appears on the surface; very dry pieces should be used in finishing, warming the instruments if necessary.

Copper amalgam is prepared for use by slowly heating one of the ingots in an iron spoon until globules of mercury appear upon the surface, when it is triturated in a mortar. The subsequent manipulation is similar to that for other amalgams. In copper amalgam the tendency to molecular change is slight; thus one of the greatest objections to amalgam is overcome. It has also great edge strength. The experiments of bacteriologists show that it has marked antiseptic action. It is easily manipulated and has a bright silvery appearance when finished. In some mouths it turns black and sometimes blackens the surface of all other metallic fillings in the mouth as well as the teeth themselves. When it turns black it retains its bulk integrity and preserves the teeth. When it retains its silvery whiteness it wastes away; in some cases the surface softens so much that it can be scraped off with the finger nail. This uncertain behavior has led to its abandonment to a great extent. The conclusions seem to be that it is not wise to employ copper amalgam where there are other metallic fillings, or in mouths in which there is much chemical decomposition.

The deductions we draw from this study of amalgam are, that considered under the requisites for a filling material, it possesses sufficient density and tenacity to resist attrition and strain, and sufficient edge strength where enamel margins can be properly prepared; that it transmits thermal changes so readily that an "intermediate" is necessary where the tooth is sensitive to such changes; that because of its plastic condition it is very easy to introduce; that it is susceptible to chemical changes to such extent that this tendency must not be ignored, in any case where the elements conducive to such changes exist; that its tendency to molecular change must be combated in every way possible; that it is capable of receiving the necessary finish, but that its color and tendency to discolor give results which are neither harmonious, nor a pleasant contrast to tooth color; hence it is not suitable for cavities which are exposed to view.

TIN.

The qualities of tenacity, ductility, malleability, conductivity, oxidation or corrosion, color and consistency, have been considered in the tables. Tin for filling teeth must be pure. It is prepared for dentists' use by beating or rolling it into foil, which is put up in books of uniform size. The number indicates the weight or thickness of a leaf; the numbers are 2, 4, 6, 8, 10, 30, 60 and 120. The heavier numbers only are rolled. For introduction into cavities, strips of the foil are rolled in a napkin, twisted into ropes or folded into ribbons; cylinders are made by rolling the ribbons upon small smooth broaches. It is also prepared for fillings by fixing a round ingot in the lathe and turning off shavings for immediate use. It is claimed that tin is cohesive when prepared in this form. As tin possesses to a limited degree, if at all, the property of cohesion, or welding without heat, its homogeneity depends upon wedging or interdigitation. On this account it can only be employed in cavities of class 1, or of division A, class 2, and in those cavities of division A, class 3, where the marginal ridge is not involved, *i. e.*, cavities must have continuous walls.

Density and hardness. Considered under the demands for a filling material we find that tin fulfills the first requisite, density, to only a limited extent, and it is not sufficiently hard to withstand the wear of mastication.

Tenacity is lacking to a degree which precludes its use in those cavities where restoration of contour is demanded and it cannot be used in cavities having such enamel bevel as is shown in Fig. 189.

Low conductivity. Platinum excepted, tin is the poorest conductor of the metals employed for fillings. For this reason it may be used in those cavities which are so sensitive to thermal changes as to render the use of gold or amalgam unwise.

Ease of introduction. With proper instruments, a proper preparation of both the cavity and the material, tin may be introduced with much facility into such cavities as are easy of access.

Freedom from chemical action. While tin corrodes slightly, and in some mouths considerably, it is not readily acted upon by the fluids of the mouth.

Freedom from molecular change. As the crystallization of tin is not interfered with in its introduction, there is no subsequent change in its bulk integrity.

Capability of polish. While a tin filling may be given a highly burnished surface, it does not retain it, because of the softness of the material.

Owing to its inherent qualities, tin is somewhat limited in its application. Its use is not indicated for large cavities on occlusal surfaces which are subjected to much wear. Its use is not indicated in those cases where lost contour must be restored, or for proximate fillings where its surface might be roughened or disturbed by efforts at cleansing with toothpicks. It may be used to advantage in children's teeth and in all cases where the use of gold is not indicated or where it is undesirable to use amalgam.

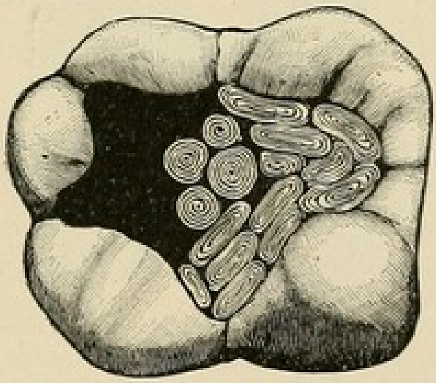

Fig. 231.

Cavities must be formed for its reception as is shown in Fig 190½, a. a., with no more enamel bevel than is absolutely necessary for its protection.

Plugger points for the insertion of tin should be wedge shaped, with sharp and deep serrations. When the wedging is complete, the surface may be condensed with convex faced foot pluggers having smoother and shallower serrations. Finally the filling may be burnished, the surplus trimmed off with sharp instruments, and again burnished. Tin fillings may also be finished with files, emery or sandpaper disks and strips of increasing fineness until the proper polish is obtained. Fig. 231 shows the manner of placing and condensing cylinders in the cavity. Each cylinder is condensed against those which have preceded it; the operation is continued until only a small space is left in the center; this space is filled by wedging small cylinders into it.

Fig. 232 shows the manner of inserting a rope or ribbon by doubling it upon itself. In the insertion of either preparation of tin, the filling is arranged in concentric layers; is solidified by crowding each layer against those which have preceded it, always exerting the force toward the walls of the cavity. The cylinders or folds should project above the walls of the cavity sufficiently to permit of condensing and finishing.

GOLD.

The tables show that gold possesses tenacity, malleability, ductility, and conductivity in a marked degree; that it does not

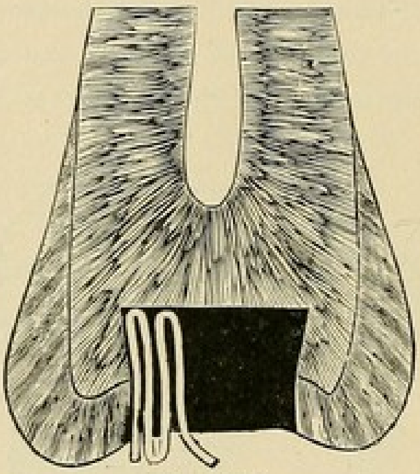

Fig. 232.

oxidize or corrode; that while it is a soft metal, it becomes hard by hammering, rolling, or burnishing; and that its color contrasts more agreeably with the color of the tooth than does any other of the filling materials.

Density and hardness. Gold is sufficiently hard and dense to enable it to withstand the wear to which it is subjected.

Tenacity, resistance to strain. These qualities, together with malleability and ductility, are possessed by gold to such an extent that it not only resists strain when employed to restore lost contour, but it is possible to use it where the enamel bevel is necessarily long; a combination of qualities possessed by no other material used for filling teeth.

Low conductivity. Gold is the best conductor of the filling materials, consequently it oftener demands a nonconducting "intermediate."

Ease of introduction. It is generally conceded that gold is the most difficult material to manipulate, yet when its qualities are thoroughly understood, it responds readily to careful and intelligent effort.

Freedom from chemical action. It is not affected by any chemical action present in the mouth.

Freedom from molecular change. There is no change in the integrity of a gold filling after its proper condensation.

Capability of polish. Gold is capable of receiving either a burnished or a polished surface.

Good color. It is not harmonious in color with the teeth, but its peculiar yellow color forms a pleasant contrast.

In addition to these qualities it possesses the property of cohesiveness. Its freedom from oxidation makes it possible to unite separate pieces of gold by pressure without the aid of heat; heat is used only for the purpose of burning off impurities and softening the gold.

From the foregoing it appears that the popularity of gold as a filling material is based upon the fact that it fulfills more of the requirements for a filling material than any other substance employed.

Gold for use in filling teeth must be as nearly chemically pure as it is possible to make it. The greater amount comes to us in the form of foil, or cylinders and blocks made from foil. There are several other preparations produced by reducing gold to its crystalline state, under various processes and bearing various names, as crystal, sponge, crystal mat, etc. Only foil and the various forms in which it is prepared for use will be noticed.

Gold foil is prepared by beating or rolling (rolling for the heavier numbers only), and is put up and numbered in the same way as tin foil. Unlike tin, gold foil is supplied in several grades —one, in which the natural cohesive quality of gold has been destroyed by some process; this is known as noncohesive. Another, in which this property of cohesion is destroyed only in part—this is known as semicohesive. The other form is that in which the cohesive property is retained to its fullest extent; this is known as cohesive, or extra cohesive. Manufacturers mark their products as "soft," "semicohesive" and "cohesive" or "extra cohesive." The term "soft" is a misleading one. Softness is not synonymous with noncohesiveness. All of the grades may be, and are, under the best processes of manufacture, soft; this is a natural property of gold before the particles are driven into closer contact by condensation. Gold which has been made hard by condensation may again become soft by heating to redness. This is independent of the cohesive property. Pellets, blocks, or cylinders of gold in which the cohesive quality has not been destroyed, become hard more quickly under manipulation than do those which have been made noncohesive; this is because the particles of cohesive gold stick together at all points where two surfaces come in contact, while the surfaces of noncohesive gold slip or slide upon each other.

The fullest exhibition of the cohesive property depends upon the absolute cleanliness of the surfaces. Moisture, fatty matter, or gases, especially sulphuretted gases, modify or completely destroy cohesion. To insure the absence of any or all of these, the gold is heated to redness over a flame in which combustion is complete. This is called annealing; its purpose is two-fold; first, to cleanse the surfaces; second, to secure the fullest degree of softness. If there is any doubt of the perfect combustion in a flame, the gold may be heated in a mica tray.

The principles governing the introduction of noncohesive gold are the same as those governing the introduction of tin. Because of the hardness which is possible in a noncohesive gold filling, the range of cavities where it may be employed is much greater than for tin. As has been stated, the amount of inherent strength necessary to the filling in any given cavity is equivalent to the amount of strain to which the filling is subjected; this governs the amount of cohesiveness necessary in the gold for any given cavity. Those cavities where lost contour must be restored, usually require the full extent of the cohesive property. Where density of surface is required and the mass of the filling is subjected to little strain, a noncohesive filling may be faced with cohesive gold. This is accomplished by mechanical union between the noncohesive and the cohesive—i. e. a layer of cohesive foil is interdigitated with the noncohesive mass. This method is applicable to cavities of class 3, whose axial depth is great. These cavities when prepared as in Fig. 226, have retaining shape throughout their whole depth. The cohesive gold need only be employed to a depth necessary to allow of a sufficient mass of cohesive gold to be retained in the cavity, and to resist the strain brought upon it. This is illustrated in Fig. 233.

The advantages of noncohesive gold are that it is more readily adapted to the walls of the cavity, and it can be introduced in larger pieces and be perfectly condensed in a much shorter time, thus saving fatigue to both patient and operator. The same instruments for wedging, condensing, and finishing are employed for noncohesive gold as for tin. The instruments for cohesive gold should have fine shallow serrations and possess such points as are shown in Figs. 130 to 146. Owing to the tendency of the surfaces of cohesive gold to stick together, force should be exerted in such

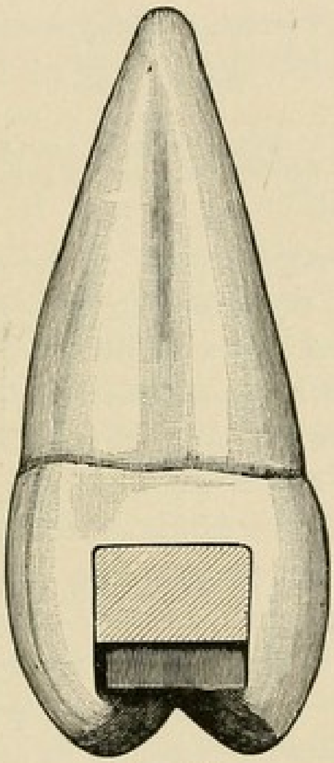

Fig. 233.

direction, and instruments employed having such faces as will insure the perfect adaptation of each layer to the walls of the cavity.

Gold foil is prepared for insertion into cavities in the same forms as tin. Where the cohesive property is retained, the individual pellets, ribbons, blocks, cylinders, or mats should be of looser structure, also flatter and smaller than for noncohesive gold or tin. Cohesive gold fillings are made by uniting the separate pieces, layer upon layer, thoroughly condensing each layer before another is added.

The only combination with other metals to be noticed is gold and tin. The two foils are combined in blocks or cylinders so that the layers of gold and tin will alternate; the tin should never predominate. This combination is useful at the cervical third of large cavities of Class 3.

ZINC PLASTICS.

Oxychloride of Zinc	Powder, calcined oxide of zinc. Liquid, deliquesced chloride of zinc.
Oxyphosphate of Zinc	Powder, recalcined oxide of zinc. Liquid, deliquesced glacial phosphoric acid.
Oxyphosphate of Zinc,—with gelatinized liquid for capping.	
Oxysulphate of Zinc	Powder, calcined oxide and calcined sulphate of zinc. Liquid. gum arabic and sulphite of lime dissolved in distilled water.
Dickinson's Capping	Powder, oxide of zinc and iodoform. Liquid, beechwood creasote and eugenol.

As none of these preparations can be considered as permanent filling materials, their response to the requirements of a filling material will be summed up as follows. They have sufficient density and hardness, have low conductivity, are easy to introduce, do not change in bulk integrity, and have good color. They lack in tenacity, resistance to strain or wear, receive only an indifferent polish and are soluble in the fluids of the mouth.

Oxychloride. As this preparation has been proved to be so temporary in its nature, it is used only where its peculiar power to prevent decomposition of devitalized tissue is desirable; as for filling root canals in which the pulps were putrescent, or as a lining or temporary filling, where its ability to obtund sensitive dentine by destroying the terminals of the fibrillæ, make it advantageous. Its combination is a chemical union, and it should be thoroughly mixed upon a glass slab, to the consistency of cream for canal fillings, and to a putty like mass for linings and temporary fillings. As it is white in color it is useful as a lining in teeth which have been bleached, or in large cavities where the gold or other filling material will show through the enamel if some lining material is not employed.

Oxyphosphate of zinc is harder, better resists wear, and is less irritant to vital tissues. It is, however, soluble in certain fluids of the mouth, notably in the mucous secretions. Its union is a chemical one, but it does not unite so readily as oxychloride; the powder should be added to the liquid in small amounts, thoroughly spatulating or kneading the mass, with force. It should be mixed to a putty-like mass, unless it is to be introduced without pressure, as when it is used as an "intermediate" over a pulp capping, when it must be of the consistency of cream. There are many preparations of varying excellence; the best results seem to be obtained from those in which the powder is finely pulverized, is heavy, and breaks apart, falling in masses, as the bottle is revolved, and those in which the liquid is thick and syrupy in appearance and sticky in feeling. Samples possessing these characteristics, and which mix unwillingly but make a fine smooth mass, so sticky that it is removed from the slab and spatula with difficulty, and losing this stickiness if rolled a little in the fingers, rebounding with a metallic ring when a pellet of it is dropped upon any hard surface, and breaking with difficulty after fifteen minutes, showing a clean fracture, generally wear well if they are carefully introduced and finished, and the moisture is excluded until the mass is hard.

Oxyphosphate with gelatinized fluid, oxysulphate of zinc and Dickinson's material, are not filling materials, but are intended as nonirritant, antiseptic pulp protectors or cappings. They are useful in all cases of exposure or where a thin layer of semidecalcified dentine remains over the pulp. They are used in conjunction with asbestos paper or a metal cap.

GUTTA-PERCHA.

This product of the gutta-perch tree is too tough and unyielding in its natural state, to be utilized as a filling material. For dental use, oxide of zinc or some earthy matter is incorporated with it. It comes to us in two forms, pink, which is used for base plates, and white, the white in several grades. It has sufficient density, tenacity and strength for ordinary purposes but not sufficient to resist the strain and wear of mastication. It is an absolute nonconductor. It is easy to introduce. While it is free from chemical action, it becomes soaked and rotten after long exposure to the oral fluids. Being introduced warm, it shrinks in cooling. Although incapable of polish, the so-called white varieties harmonize well with tooth color. Its characteristics make it one of the best "intermediates," as well as one of the best canal filling materials, where too much bulk is not required, but precludes its use as a permanent filling, except in cavities upon buccal surfaces of molars and bicuspids. It is also very useful in deciduous teeth.

The white gutta-perchas are prepared in three grades, "low heat," "medium," and "high heat." The degree of heat necessary to soften it depends upon the amount of oxide or other substance which it contains. The several grades soften as follows:

"Low heat"	softens	at	from	140.°	to	200.°F.
Pink, base plate	"	"	"	150.°	"	180.°F.
"Medium"	"	"	"	200.°	"	210.°F.
"High heat"	"	"	"	216.°	"	230.°F.*

All those which soften below the boiling point should be softened over boiling water; the "high" grade must be softened on a glass or porcelain slab over a flame. None of the preparations should be softened in direct contact with the flame, because of the danger of burning.

Warm instruments should be used in its manipulation. The "medium" preparations seem to give the best results. The pink base plate makes the best points for canal filling. The chloro-percha which is used in pulp capping and canal filling is prepared by dissolving small shavings of pink base plate in chloroform. It has been suggested that iodoform or some antiseptic be added to the solution, but as any such substance would be so firmly fixed against solution, its efficacy seems doubtful.

Practical Exercises.

Before students begin their practical exercises the teacher should demonstrate each operation. The cavities, which were prepared in the large clay models with enlarged copies in brass of the instruments which the students used in cavity preparation, may now be filled; use enlarged pluggers of brass, with colored cotton rolls to represent cylinders of tin or gold, and ropes and ribbons of sheet wadding (cotton) to represent ropes and ribbons of tin or gold,† soft clay of another color, or putty may be used to demonstrate the use of plastics.

A little ingenuity will enable the teacher to vary the exercises to hold the interest of the students and to prevent the work becoming irksome.

The author is now able to present an illustration of a "rubber tooth form for use in operative technics," Fig. 234, which will take

*Flagg.

†This was suggested by Dr. D. M. Cattell.

the place of the toothbrush handle; the bottom of the base is slightly convex in order that the cavities shown in Fig. 187 may be made in it. The teeth are typical forms thus giving opportunity for the formation of typical cavities. The material is much easier to cut than dentine or bone, but dense enough to give good margins. Another advantage is that the character of the material demands sharp, keen edged instruments. The teeth are placed far enough apart to permit of easy access to all surfaces, consequently the student will gain practice in contour for *form* only. Practice in contour for *contact* and the preservation of the interproximate space must be gained by filling cavities (with plastics) in teeth in the dummy articulator.

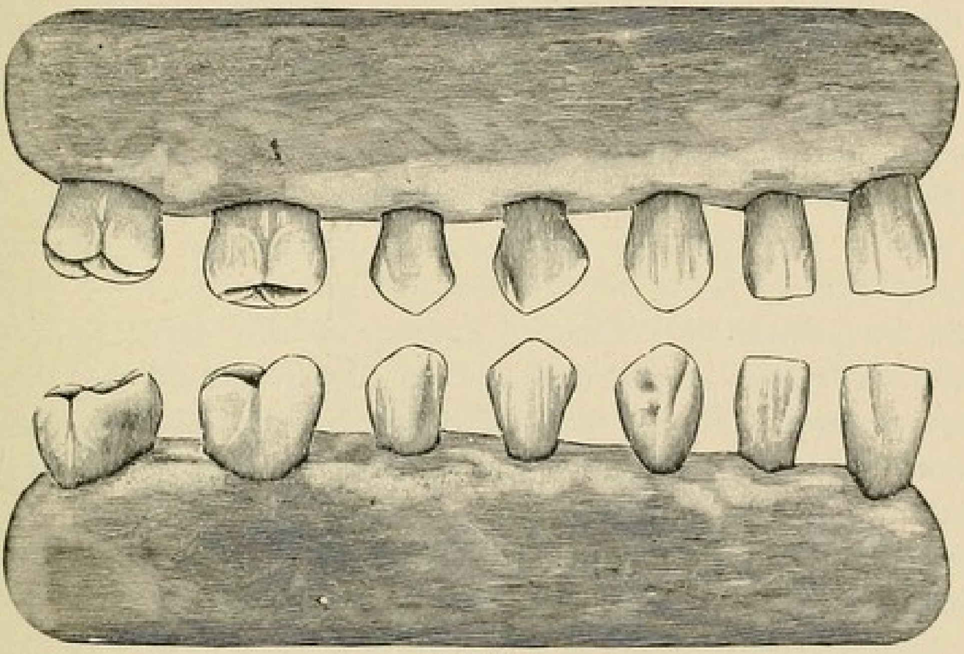

Fig. 234.

The three points of contour, contact, and occlusion should be carefully studied, taking as a basis a thorough recitation and drill of pages 130 to 153 of Black's Dental Anatomy, supplemented by the arrangement of the teeth in the dummy articulator, and by the study of models.

Exercise 1. Gutta-percha. The teacher selects several cavities in the teeth in the dummy articulator which the student fills with gutta-percha, pink base plate. One cavity is filled with a pellet of sufficient size to fill the cavity, which is softened over boiling water or on a Flagg's gutta-percha warmer. It is then inserted in the cavity with warm instruments, the surplus is removed and the surface finished with warm burnishers. Another cavity is filled with smaller pellets, softened as before, using cold instruments, trimming off the surplus with sharp trimmers after the mass has hardened. The surface may then be finished with a pad of cotton or spunk wet with chloroform.

It is presumed that the student has already had some experience in handling gutta-percha in his pulp protection, and canal filling exercises; but the teacher should require such further exercises as will thoroughly familiarize the student with the different grades of this valuable material.

Exercise 2. Oxychloride of zinc. After some preliminary exercise in mixing this cement, the student is required to insert some in large cavities as a cavity lining; to insert one filling, keeping it dry until the mass is perfectly set or hard, also one which he may bring in contact with saliva before it is thoroughly set; this is done that he may note the different results. Finish with lancet trimmers and sandpaper strips.

Exercise 3. Oxyphosphate of zinc. The preliminary exercise should be thorough instruction and practice in mixing this cement, making tests of the various mixes. Several varieties should be presented. Then a number of the partially prepared cavities in teeth in the dummy articulator should be filled to restore contour and contact. Fillings in cavities involving the proximate surfaces of bicuspids and molars should be inserted with the aid of Dunn's hand matrix. Some of the fillings should be protected from moisture until perfectly hard, others should be brought in contact with saliva while they are hardening, the student taking careful notes of the results in each case. Finish the same as oxychloride. Students should be allowed all the opportunity possible to become familiar with the peculiarities and possibilities of this material. If possible, the teacher with the assistance of the class should make a batch of oxyphosphate.

Exercise 4. Amalgam. Students will be much benefited if they are allowed to assist in the manufacture of an amalgam alloy and of copper amalgam. Whether this is practicable or not, they should mix amalgam, both soft and dry, and test the mixes by inserting them in glass tubes which are subsequently immersed in aniline dye. One cavity should be filled with a soft mix and one with a dry mix, which should be allowed to harden before the filling is finished. One cavity should be filled with a soft mix and one with a dry mix which should be wafered and finished at once. Wafering is the expression of all surplus mercury before the mass is inserted in the cavity. Careful notes should be taken of the results under the different manipulation. The partially prepared cavities in the teeth of the dummy will give ample practice in the inserting, contouring, and finishing of amalgam. All amalgam fillings must be carefully finished after they are thoroughly hard, with finishing strips and discs of increasing fineness.

Exercise 5. Making ropes of tin foil. Cut a leaf of No. 4 tin foil into three strips; roll each strip in a clean folded napkin; then grasping the ends with the thumb and index finger of each hand, twist into a rope, tight or loose as is desired. This preparation is applicable for gold also, except that for *cohesive* foil the roll should not be twisted. *Cohesive* gold should never be touched by the fingers.

Exercise 6. Making ribbons of tin foil. Cut the leaves of No. 4 foil as for ropes; with a paper folder fold each strip lengthwise to the desired width. This is the best form of preparation for *cohesive* gold foil.

Exercise 7. Making cylinders of tin foil. Prepare ribbons of the width desired for the length of the cylinders. Roll each ribbon on a small, square, smooth broach, holding it tight between the thumb and finger; the size of the cylinders is governed by the length of the ribbon. This form of cylinder is applicable only for tin and noncohesive gold.

Exercise 8. Tin fillings of ropes or ribbons. In cavity *C*, Fig. 187, insert a rope of tin as shown in Fig. 282, beginning at one end, pressing or crowding each fold against those which have preceded it. In folding the ropes or ribbons, be sure to leave sufficient amount protruding from the cavity to permit of condensing and finishing. When enough has been introduced into one end to insure the wedging of the mass, fill the other end in the same manner. As the two masses approach each other, that portion next the walls of the cavity should be in advance of the rest; in this way a small opening will be left in the center of the filling. After the mass has been thoroughly condensed laterally by the use of wedge-shaped instruments in this central opening it may be filled with smaller ropes. Instruments used in this exercise should be shaped as in Figs. 121, 122, 123 and 124. After the cavity is wedged full the surface should be thoroughly condensed with foot instruments having convex faces, as in Figs. 135 and 136. This exercise should be by hand pressure only. The surplus may be trimmed off with files and the surface finished with sandpaper or emery paper strips of increasing fineness, using chalk or whiting and rouge on a chamois skin strip, to polish; or the surplus may be trimmed off with sharp lancet trimmers and the surface burnished.

Exercise 9. Tin fillings of cylinders. In cavity *d*, Fig. 187, place a row of large cylinders around the circumference of the cavity, next the wall, as shown in Fig. 231, flattening them against the wall. Continue placing cylinders in concentric layers, crowding each row against those which have preceded, until only a small opening is left in the center. This opening may be filled with a conical cylinder, or with a rope, as in Exercise 8. After the cavity is full the surface must be condensed as in Exercise 8. The same instruments are used as before. The remaining cavities, *a*, *b* and *c*, may be filled, using ropes, ribbons, or cylinders of heavier foil, as the teacher may direct. One or more cavities may be filled with shavings of tin, prepared as described on page 83. A compound or double dovetailed cavity resembling Fig. 226, should be prepared in either end of the toothbrush handle or in the base of the rubber tooth form, which involves the surface and the end. One of these cavities should be filled with ropes of tin foil, the other with tin and gold ropes or cylinders for the basal two-thirds of the cavity, filling the remaining third with gold. As noncohesive gold works very much as tin does, tin instead of noncohesive gold may be used to give the students practice, but one small filling of noncohesive gold should be inserted to impress the student with the points of difference.

Exercise 10. Tin and gold. Ropes or ribbons of tin and gold are prepared by placing a strip of tin foil upon a strip of noncohesive gold foil, rolling or folding it with the tin inside of the gold. Cylinders of tin and gold ribbons may be made in the same manner as cylinders of gold or tin alone. These preparations are inserted in the same manner as described for tin in cavities which the teacher shall select.

Exercise 11. A cavity of division *A*, class 2, Fig. 216 should be filled with cohesive gold, beginning with semicohesive gold and finishing with extra cohesive gold. The gold for this exercise should be short pieces cut from ribbons made of leaves of No. 4 foil cut into four strips. All gold fillings should be finished with fine files or file trimmers, and polished with fine emery strips and rouged chamois skin strips.

In these exercises all cavities should be inspected and their form and margins passed upon by the teacher before the student is allowed to fill them. Each filling should also be inspected and passed upon before the student is allowed to proceed with the next exercise.

Specimen Course as Used by the Author.

Text-Books. { Black's Dental Anatomy. / Weeks' Manual of Operative Technics.

DENTAL ANATOMY.

1. Descriptive Anatomy of the Teeth.
   - Terminology and Nomenclature.
   - Notation.
   - Form.
   - Arrangement.
2. Structural Anatomy of the Teeth.
   - Macroscopic — Component parts, their form, proportion and relation to the whole.
   - Microscopic — Structure of the component parts.

Study by recitation and practical exercises.

PRACTICAL EXERCISES.—DESCRIPTIVE ANATOMY.

In the Drawing Books. Make outline drawings of the principal surfaces of the teeth.

Model in clay one tooth of each class.

Select a tooth of each denomination from a miscellaneous lot and arrange them upon wax for future use.

STRUCTURAL ANATOMY—MACROSCOPIC, LONGITUDINAL SECTIONS.

Select and mount upon blocks, teeth of one side of each maxilla. File the teeth thus mounted until pulp chambers and canals are exposed, broaching canals with piano wire explorer as the filing progresses.

Make prints in the printing book of every aspect of six teeth of each denomination, superior and inferior.

In longitudinal sections of $\frac{1\text{-}2\text{-}3}{1\text{-}2\text{-}3}$ only la. and m. aspects need be shown, but in $\frac{4\text{-}5\text{-}6\text{-}7\text{-}8}{4\text{-}5\text{-}6\text{-}7\text{-}8}$ b. li. m. and d. aspects should be shown.

TRANSVERSE SECTIONS.

Cut sections of teeth of one side, upper and lower, as in Figs. 9 and 10 Manual of Technics, showing form at gingival line, mid-root, and apical third. Print on the pages ruled for the purpose, as in Fig. 7, Manual of Technics. Exchange sections and print in this way six pages.

Duplicate sheets of each leaf must be furnished the teacher.

MICROSCOPIC.

Cut and mount one longitudinal and one transverse section of an incisor. Make drawing in drawing book of the several tissues as shown under the microscope.

The student needs for these exercises:

1 stick Am. Ex. sealing wax.
1 half round file, 8 inch, bastard cut, medium coarse.
1 bench vise.
1 alcohol lamp.
1 jewelers' hack saw with 12 saw blades.
1 wax spatula.
1 excelsior ink pad.
1 rubber pad, 3 in. x 6 in. x ¼ in.
1 book for printing, open at end. Leaves ruled as in Figs. 6 and 7, Manual of Technics.
1 drawing book.
Some fine canal explorers.
Some fine sandpaper, 0 and 00.
1 toothbrush.
1 yard cotton cloth.
1 salt mouth bottle with cork.
1 large ointment jar.

To insure uniformity, and to give students advantage of lowest prices, these materials are to be had at the desk.

The teacher provides the teeth for cutting, and the blocks for mounting; also paper tablets same texture, size and ruling as books, and some tablets of similar paper for experimental printing, and clay for modeling.

OPERATIVE TECHNICS.

I.	Instruments.	Classification according to form and uses. Action or use for each form.

II. Canal.	Gaining entrance to canal. Removal of pulp. Cleansing and preparing canals. Filling canals.		
III. Cavities.	Classification from location and causes. Preparation on principles governing.		
IV. Pulp Treatment.	Conservative.	Treatment and protection. Capping.	
	Radical.	Surgical devitalization. Devitalization by drugs.	
V. Filling Materials.	Characteristics and composition. Preparation. Introduction into cavities. Finishing fillings.		

Study by recitation from Manual of Technics, with practical exercises.

PRACTICAL EXERCISES.

Arrange in dummy articulator the teeth selected from miscellaneous lot.

Apply rubber dam in the several ways.

Wrap broaches.

Gain entrance to canals in one incisor, one bicuspid and two molars, removing pulp from same.

Cleanse and prepare canal for filling.

Fill the canals thus prepared.

Prepare cavities as in Fig. 187, Manual of Technics, in toothbrush handle or celluloid teeth.

Prepare cavities of each division of the several classes, in teeth in the articulator.

Treat and cap two or more exposed pulps.

Fill the cavities in toothbrush handle with tin.

Fill the other cavities prepared :

Two or more with gutta-percha.
" " " zinc phosphate.
" " " amalgam.
" " " gold.

All remaining cavities are given proper marginal outlines and the contour of the teeth restored with oxyphosphate or gutta-percha.

Instruments for this work as per list.

Filling materials and medicaments furnished at the desk.

Recitations every session.

Written quizzes are given upon completing each division of a topic and marked.

Marks are given on the cutting of sections, silhouette printing, drawings and operations.

These markings, averaged with those of the final examination, determine the standing of the student.

The examination in dental anatomy is given when the work is completed. That in operative technics at the close of the term.

In the last half of the second semester, those students who have an average of 80 per cent, or above, in their practical work, are permitted to enter the infirmary, to put in practice under the direction of the clinical professor, the principles which have been acquired in the technic laboratory.

No student will be permitted to begin practical work unless provided with the instruments and other necessaries required by the college.

GLOSSARY.

Abrade. To rub or wear away.

Abrasion. The act of wearing or rubbing off by friction or attrition.

Absorb. To drink in; imbibe, as a sponge.

Absorbent. Capable of imbibing, taking up moisture.

Adhere. To stick fast, one thing to another.

Adhesion. The act of adhering; uniting as by cement.

Adhesive. Sticky; tenacious.

Affinity. Inherent likeness between things. In chemistry, that force by which the atoms of dissimilar bodies unite in certain definite proportions to form a new compound.

Alveolar, Alveolus. A deep cavity or socket. Alveolar processes. The processes of the maxillary bones containing the sockets of the teeth.

Alloy. An artificial compound of two or more metals combined while in a state of fusion; result, a new metal.

Amalgam. A compound of mercury with another metal, or an alloy in which the combination is by the action of the mercury.

Amalgamated. Mixed or united with mercury.

Amorphous. Without form; having no regular structure.

Anæsthesia. Insensibility, especially to pain. General, as applied to the whole body; local, as applied to a part.

Anastomose. To communicate or unite; inosculate, or run into one another.

Angle. The difference in direction of two intersecting lines. The figure or projection formed by the meeting of two lines; a corner.

Anneal. To heat; to treat by heating to redness and gradually cooling; to soften.

Annealed. Softened, heated.

Anodyne. Having power to remove pain. A drug which relieves pain, as an opiate or narcotic.

Antiseptic. Anything which destroys the microörganisms of disease, putrefaction, or fermentation, or which restricts their growth and multiplication.

Apex. The tip or point of anything. The end or point of the root of a tooth. Plural, apices.

Apical. Relating to the apex.

Apical Foramina. The small openings in the apices of the roots of teeth, which give passage to the vessels and nerves supplying the pulp.

Arch. In geometry, any part of the circumference of a circle. Dental arch. The curved line of the teeth in their sockets, corresponds to the alveolar border in each jaw.

Articulator. An apparatus for obtaining the correct articulation or occlusion of artificial teeth. The dummy articulator is an apparatus for the correct arrangment and retention of natural teeth for operations in operative technics.

Asbestos. A fibrous variety of horblende, composed of separable filaments.

Asbestos Paper or Felt. A nonconducting substance made from the fibers of asbestos.

Aseptic. Free from the living germs of disease, fermentation, or putrefaction.

Asepsis. Absence of the living germs of disease, etc.

Atom. The unit of matter. The smallest mass of an element that exists in a molecule.

Atomic. Pertaining to an atom.

Attrition. The act of wearing away by rubbing or friction.

Axial Wall. The wall which is parallel with a longitudinal surface and opposed to it. In cavities, that wall which is parallel with an axial surface. This wall has formerly been variously designated as the *floor* or *base.* The author applies the term *base* to that portion of cavities which is at right angles with the axis; as basal wall of a proximate cavity (same as cervical wall).

Axis. The central line of any symmetrical or nearly symmetrical body.

Bevel. The obliquity or inclination of a particular surface of a solid body to another surface of the same body. Bevel of blades, the angle of the cutting edge.

Biscuspid. Having two cusps. The teeth in either jaw which succeed the deciduous molars.

Blade. The cutting part of a knife or any cutting tool or instrument.

Broach. A spit; a stake or any sharp pointed thing. In dentistry a slender, pointed instrument, either smooth or barbed, for use in root canals.

Buccal. Pertaining to the cheeks, or sides of the mouth. Applied to the surfaces of the teeth which are presented toward the cheeks.

Bur. A form of drill or reamer with a circular head, having a series of leaves or cutting edges around its circumference; designed for side cutting.

Burnisher. An instrument of hardened steel or other hard substance, having a highly polished surface; designed for smoothing, polishing and condensing metallic surfaces.

Calcific. That makes or is converted into a salt of lime.

Calcification. The deposition of lime salts in a tissue.

Calcined. Treated by heat for the purpose of driving off impurities or reducing the substance to a friable mass.

Calculus. A general term for inorganic concretions or deposits. In dentistry that substance deposited upon the teeth from the saliva or serum.

Canal. A duct, channel. The channel in the center of the roots of teeth, which contains the elongated portion of the pulp.

Capping. The operation for the covering and protection of an exposed pulp from irritation and thermal changes.

Cavity. A hollow. That portion of a tooth destroyed by caries.

Cement. A composition which being made in a plastic condition becomes hard. The term applied to the several compounds of zinc used in filling teeth.

Cement substance. The intervening substance which unites the enamel rods.

Cementum. The cortical substance resembling bone which covers the roots of teeth.

Cervical. Pertaining to the neck. Applied to the constricted part of a tooth where the enamel joins the cementum.

Chisel. A tool consisting of a handle, shank and blade; designed for heavy cutting.

Clamps. Instruments for holding things in position or for holding two or more things together by pressure.

Cleavage. The act of splitting. That property of enamel which permits it to break readily in one direction.

Coalescence. The act of uniting. Organic union of similar parts.

Cohesive. Having the property of sticking together.

Cohesion. The force by which the molecules of the same material are held or bound together.

Columnar. Having a generally cylindrical form, with greater length than thickness.

Compatibility. The quality of being harmonious, not antagonistic or injurious.

Component. Composing; entering into the composition of anything.

Concave. Hollow. Any part of the circumference of a circle when viewed from the center.

Concentric. An arrangement of parallel circles around a common center.

Condensation. The act of being made compact; consolidation.

Conducting. Conveying; carrying; transmitting, as heat or electricity.

Conservative. Power or tendency to preserve from injury or loss. Conservative treatment of the pulp is that which attempts to save its life or vitality.

Consistency. Physical constitution; as dense, soft, etc., as consistency of cream, mortar, etc.

Contact. A touching of two bodies.

Contour. The outline of a figure or body; contour filling, one which restores or makes form.

Convex. Rounded; arched. Any portion of a circle as viewed from the outside.

Corrosion. The act or process of eating or gnawing away; the disintegration of a surface, especially by chemical agents.

Corrosive. Any agent which will corrode, as an acid.

Decalcified. Deprived of lime. As the lime salts are dissolved out in the process of decay the dentine becomes decalcified.

Deciduous. Living or existing during a definite period; not permanent, or perennial.

Decomposition. The act or process of separating the constituent elements of a compound substance; the process of reducing an organic body to a state of decay or putrefaction.

Deliquesced. Melted or dissolved. To become liquid by absorbing moisture from the air.

Dentine. The principal substance composing teeth. It is made up of very fine close set tubules or canaliculi, whose general direction is at right angles with the pulp chamber.

Denuded. Stripped or divested of covering; laid bare.

Desiccated. Thoroughly dried, deprived of *all* moisture.

Devitalized. Deprived of life, or the qualities which sustain life.

Disk. A flat or approximately flat circular plate of metal or other substance.

Distal. Away from or opposite the median line. Applied to the surfaces of the teeth which are farthest from the median line following the dental arch. Same as posterior.

Disto-lingual. The term applied to the angle formed by the junction of the distal and the lingual surface.

Disto-marginal. The term applied to the angle formed by the junction of a distal surface and a margin.

Dowel-pin. A pin or tenon used for securing together two pieces of anything, as a crown to a root.

Dovetailed. Having the form of a pigeon's tail spread.

Drill. An instrument for boring holes. Specifically an instrument which cuts only at the end.

Ductility. That property of metals which renders them capable of being extended by drawing; as gold into wire.

Edge-strength. That property which renders an extended edge capable of resisting strain.

Electrolysis. The decomposition of a chemical compound into its constituent parts by electricity.

Elementary. Primary; simple; uncompounded.

Embryological. Relating to the subject of embryos.

Enamel. The hardest part of a tooth; it is composed of six-sided prisms or columns and covers the crowns of teeth.

Environment. The aggregate of surrounding things or conditions.

Escharotic. Caustic; having the power of searing or destroying the flesh.

Excavators. Instruments for scooping out decay, enlarging and shaping cavities.

Excision. The act of cutting off, out or away.

Explorers. Instruments for searching out cavities on the surfaces of the teeth; or for examining and following cavities, sinuses and root canals.

Extractors. Instruments for removing or withdrawing pulp tissue from canals.

Faces. The principal surface of anything, the side or part of an instrument upon which its use depends.

Fibrillæ. The delicate threadlike processes of the outer layer of pulp cells, which penetrate the dentine.

Fissure. A cleft; a crack. Fissures in teeth arise from structural imperfections in the enamel.

Foramina. The openings in the apical portion of the roots of teeth which give passage to the vessels supplying the pulp.

Force. Active power; power in motion.

Formative. Having the power to give form or shape. Pertaining to development.

Fracture. Separation of the parts of a solid body by the action of force.

Fusing. Melting; reducing from a solid to a fluid state by heat.

Galvanic. Pertaining to galvanism; current electricity produced by a chemical battery.

Germicide. A substance capable of killing germs or micro-organisms.

Gingival line. The line of attachment of the gums, gingivæ: the line of junction between enamel and the cementum.

Gingival Margin. The free margin of the gums; the margin of a crown surface which borders on the gingival line.

Grade. Relative position or standing as regards quantity, quality, or office.

Groove. A long shaped depression or hollow.

Gums. The soft tissue which covers the alveolar parts of both upper and lower jaws, enveloping the necks of the teeth.

Gutta-Percha. The concrete juice of the Isonandra gutta-percha tree.

Handle. That part of an instrument to be grasped by the hand in using it.

Histology. The science of minute or microscopical anatomical structure.

Homogeneity. Of uniform structure.

Homogenous. Of the same kind; uniform.

Hyperæmia. Excessive accumulation of blood in any part.

Incisal. That which cuts or divides.

Incisors. Incisive or cutting teeth. The two teeth on each side of the median line in both upper and lower jaws.

Inferior. Situated below or in an inferior position.

Inflammation. A morbid condition characterized by heat, pain, redness and swelling, generally the result of irritation of some kind.

Ingot. A mass of metal cast in a mold.

Inlays. That which is laid into or inserted in a surface.

Integrity. Unimpaired condition; soundness of state.

Interdental. Occurring between the teeth.

Interdigitation. State of being interwoven or run into each other.

Intermediate. Intervening; interposing; coming between.

Irritation. The act of evoking some action or change of state.

Labial. Pertaining to the lips. Applied to the surfaces of the teeth presented to the lips.

Lancet. A small surgical instrument for cutting soft tissues, as opening abscesses, etc.

Ligatures. That which serves for tying, binding or uniting.

Lingual. The term applied to the surfaces of the teeth next to the tongue, both upper and lower.

Longitudinally. In the direction of length.

Lymphatic. Pertaining to the vessels which convey lymph.

Macroscopic. That which is seen by unaided vision.

Malleable. Capable of extension by hammering or rolling.

Mallet. A hammer like instrument for driving another tool or instrument.

Manipulation. Management or use of anything by the hand.

Margin. Border; as incisal border or margin of labial surface; gingival border or margin of the gums.

Mastication. Act of chewing. The process of triturating the food with the teeth.

Matrices. Plural of matrix.

Matrix. A mold which gives form to material forced into it.

Matrix Clamp. An instrument for holding a matrix in position.

Membrana Eboris. Term applied to the outer layer of cells of the pulp.

Mesial. Being in the middle. Pertaining to the middle line. The surface presented toward the median line.

Mesio-marginal. Term applied to the angle formed by the junction of a mesial surface and a margin.

Metallurgy. Science of metals. The art of working metals.

Microscopic. That which cannot be seen without the aid of a microscope.

Molar. Belonging to a mill. Term applied to the grinding teeth.

Molecular. Relating to molecules.

Molecule. The smallest mass of any substance capable of existing in a separate form.

Mortise. A hollow or recess cut in any material to receive a tenon or inlay.

Mucus. A viscid fluid secreted by the mucous membrane.

Mucous Membrane. The membrane which lines all cavities and canals in the body which communicate with the air.

Necrosis. The death of a circumsrcibed piece of tissue.

Nodules. A small mass of mineral matter having a rounded form.

Nomenclature. A list of scientific names arranged systematically.

Nonconducting. Incapable of transmitting any force, such as heat, or electricity.

Noncorrosive. Incapable of being acted upon by corrosive agents.

Oblong. Elongated. Having greater length than breadth.

Obtund. To dull, blunt, or deaden. To reduce the violent action of.

Obtundent. An agent which obtunds.

Occlude. To shut or close together.

Occlusal. A term applied to the cutting edges or grinding surfaces of the teeth; those surfaces which occlude.

Octahedron. A solid bounded by eight faces.

Odontoblastic. Pertaining to the odontoblasts.

Odontoblasts. The cells from which dentine is developed.

Opaque. Impervious to light. Not transparent.

Oral. Of or pertaining to the mouth.

Oval. Having shape of a longitudinal section of an egg; elliptical.

Oxidation. The act of combining with oxygen.

Paraffine. A substance obtained by the dry distillation of wood, peat, bituminous coal, wax, etc. Is tasteless, inodorous and resists the action of acids and alkalies.

Pathology. The science of diseased conditions.

Pericemental. The term applied to the membrane investing the root.

Periphery. The outside or superficial part of a body.

Photo-micrographs. Enlarged or microscopic photographs of microscopic objects.

Pit. A hollow or small depression. A round imperfection in the surface of the enamel.

Plastic. Capable of being moulded into new forms.

Plasticity. Capability of being moulded.

Pliers. Small pincers with long jaws capable of handling small objects.

Pluggers. Instruments for driving or packing filling material into cavities.

"Potential cauterants." Possible, as opposed to actual cauterants.

Precipitation. The process by which any substance is made to separate from others in solution, and fall to the bottom.

Prophylactic. Preventive, defending from disease.

Protoplasm. A nitrogenous substance from which nuclei are formed.

Proximate. Next; immediate; without the intervention of a third.

Pulp. The formative organ of the tooth consisting of connective tissue, nerves, and blood vessels.

Pulp Chamber. The chamber in the crown of a tooth which contains the bulbous portion of the pulp.

Pus. The cream like fluid found on the surfaces of abscesses or sores. Matter.

Putrescent pulp. A pulp which has become disorganized; decomposed.

Radical. Pertaining to the root. Thorough. Applied in dentistry to mean the extirpation and removal of the pulp.

Reamer. An instrument for enlarging holes. A side-cutting instrument.

Regular system. Isometric, or having three equal axes at right angles with each other.

Rhombic. A solid bounded by six equal and similar rhombic planes. Diamond shaped.

Rhombic System. Crystallizing into rhombic form.

Ridge. A prominent border. An elevated line or crest on the surface of a tooth.

Root. That part which is fixed in the alveolar socket, and supports the tooth.

Rubber dam. A thin sheet of flexible soft rubber.

Scaler. An instrument used for removing deposits from the teeth.

Semicohesive. Having cohesive property partially destroyed.

Semidecalcified. Partly decalcified.

Sensitive. Having sense or feeling. Capability of receiving impressions from external objects. Applied to a tooth means increase or perversion of normal sensitiveness.

Separators. An instrument for forcing teeth apart to gain space between them.

Septic. Applied to condition resulting from decomposition putrefaction, or fermentation.

Serrations. Notches which give points or teeth, like the notches of a saw.

Socket. An opening or cavity in which anything is fitted.

Solution. Preparation made by dissolving a solid in a liquid.

Spatula. An instrument having flat blade with unsharpened edges.

Spherical. Having the form of a globe or ball.

Spheroidal. In crystallization, globose; bounded by convex faces.

Stability. State of resisting change. Permanency. Continuing in same state or condition.

Sterilized. To render free from living germs.

Stratum granulosum. Applied by some authorities to the dividing line between the enamel and the dentine.

Sulcus, pl. Sulci. A more or less linear and shallow depression.

Syringe. An instrument capable of drawing in fluid and ejecting it forcibly.

Tarnish. To diminish or destroy the luster of. A slight change in surface occasioned by contact with air or liquid.

Technic. That which relates to the practical part. The performance, the manipulation.

Tenacity. Toughness. Having great cohesive force between its particles.

Terminal. The end, limit. The extreme end or boundary of any organ.

Therapeutics. The composition, application and mode of operation of remedies.

Thermal. Pertaining to heat.

Tissue. An aggregate of similar cells and cell products in a definite fabric.

Tortuous. Winding. Full of twists or turns. Crooked.

Traction. State of being drawn.

Triturated. Rubbed or ground to a powder or pulp.

Tubuli. Plural of tubulus; a tube, duct, canal.

Wedge. An acute angled, triangular prism driven between objects to be separated. Ex., an ax.

Welded. United or consolidated.

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