Atresias are caused by excessive union beyond the normal and as a result we get partial or complete closure of the facial orifices.

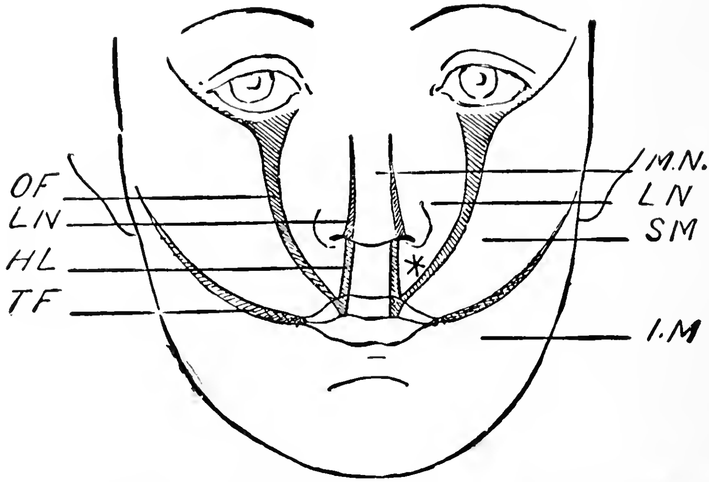

FIG. 6.—DIAGRAM OF CONGENITAL FACIAL CLEFTS. Shaded portions indicate the location of the different congenital fissures. *HL*, harelip; *IM*, inferior maxillary process; *LN*, *, lateral nasal process of frontal plate; *LN*, lateral nasal cleft; *MN*, middle nasal process of frontal plate; *OF*, oblique facial cleft; *SM*, superior maxillary process; *TF*, transverse facial cleft; *, lower part of lateral nasal process which takes part in the formation of the upper lip, but not of its red border; the free red margin of the lip is formed by the union of the lower part of the middle nasal process (*MN*) and the lower part of the superior maxillary process (*SM*). (McGrath.)

The failure of the embryonal processes to coalesce and the resulting clefts is due to deficient development of the processes themselves.

Congenital Deformities

Congenital deformities of the face may be divided into two groups:

(*a*) Those in which the frontal plate or process is concerned. Under this heading we have—1. Lateral clefts of the upper lip and the alveolar process; clefts of the palate may also be included in this group; 2. Median clefts or notches of the upper lip and deformities of the nose; 3. Notching of the wing of the nose; 4. Oblique facial clefts.

(*b*) Those in which the first visceral arch is involved. In this group we have—1. Transverse facial fissures; 2. Median fissures of the lower lip, lower jaw and tongue; 3. Deformities of the lower jaw.

Deformities in which the Frontal Plate is Concerned

These are lateral clefts of the upper lip and of the alveolar process and cleft palate. Clefts of the upper lip and alveolar process depend upon the imperfect union of the mid-nasal process with the superior maxillary processes and to failure of the maxillary bone and its accompanying soft parts to unite with the adjoining portion of the face. These clefts are always lateral and may be present on one or both sides. Clefts of the palate depend on non-union of the palatal process of the superior maxillary process of either side. When both processes are at fault the cleft is median. If one palatal process only is involved the cleft is on the corresponding side of the median line, the opposite palatal process in this case being joined to the lower border of the vomer.

If union has failed on both sides between the mid-nasal process and the corresponding part of the superior maxillary process of either side and between the palatal processes of the superior maxillary processes we have the most extreme variety of deformities. There are found all degrees of this variety from a complete cleft down to a notching of the upper lip, or a bifurcation of the uvula.

Harelip.—This condition may be complete or incomplete. Incomplete harelip consists in a vertical notch in the free margin of the upper lip. It is located to one side of the median line between the middle and lateral segments of the lip. It varies from a slight notch to a fissure which may extend through the entire thickness of

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ARMY DENTISTRY

Thomas Alexander Forsyth

ARMY DENTISTRY

FORSYTH LECTURES FOR THE ARMY DENTAL RESERVE CORPS

EDITED
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DEDICATED TO

THOMAS ALEXANDER FORSYTH, LL.D.

FOUNDER OF THE

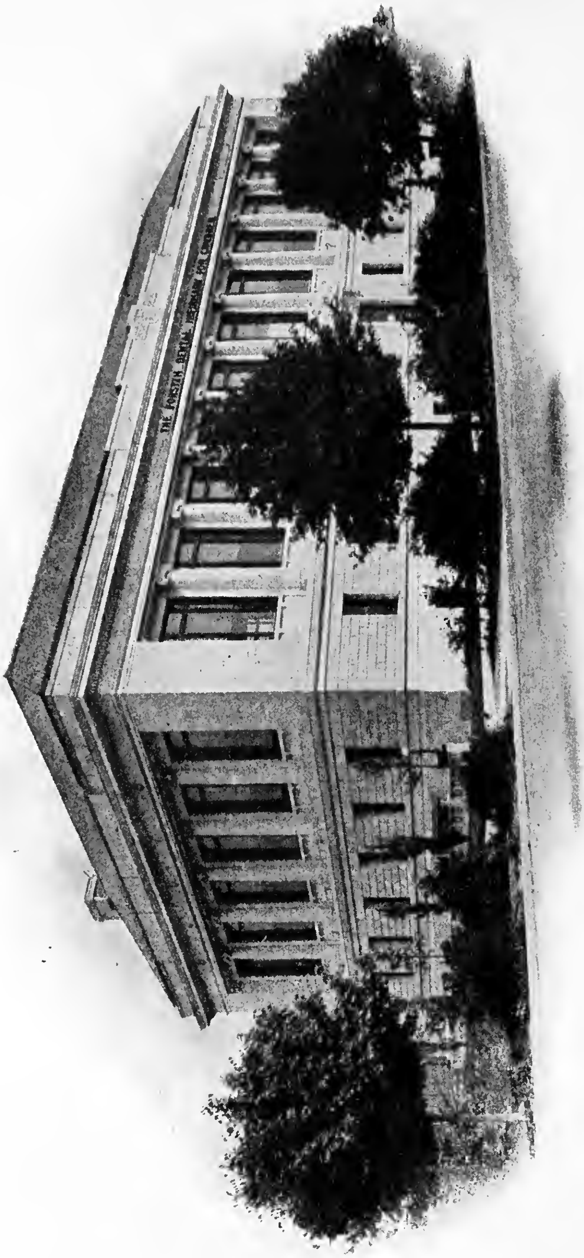
FORSYTH DENTAL INFIRMARY

FOREWORD

The Forsyth Dental Infirmary, the first infirmary of its kind, dedicated to the children of the world by John Hamilton and Thomas Alexander Forsyth in memory of their brothers, James Bennett and George Henry Forsyth, was incorporated in 1910 by a Special Act of the Massachusetts Legislature. The objects of the institution have been summarized as follows: (*a*) to educate parents, teachers, nurses, and children in the hygienic value of healthy mouths and sound teeth, and to furnish instruction as to the best methods of securing the same; (*b*) to prevent dental caries by oral prophylaxis and by the care and preservation of the temporary teeth; (*c*) to investigate the causes and to study the prevention of oral diseases and caries of the teeth; (*d*) to remedy, so far as possible, existing conditions of dental caries and other oral diseases; (*e*) to establish and promulgate a higher standard of dental asepsis; (*f*) to furnish for the dental profession an opportunity for charitable work and for the educative experience of a large clinic.

The Institution consists of many different departments, such as surgical, extracting, orthodontia, Roentgen-ray, research, oral hygiene, library and museum, clinical, etc., embodying a breadth of professional vision unsurpassed in the world. It is ideal for children, dentists, and soldiers. In fact, the Forsyth Infirmary, on account of its modern equipment and excellent staff, has been accepted by the War Department as a Base Hospital for the care of jaw wounds in soldiers returning from the present world's war.

In view of the spirit which moved the founders to



Exterior of Forsyth Institute.

erect this Institution for such worthy aims, it was not strange that the Forsyth Institute should realize its wider possibilities for good when the nation mobilized its youth for war. At the time when war was imminent with Mexico and the Massachusetts militia was called to the colors, in compliance with the request of the Mayor of Boston arrangements were perfected for a free dental service to all members of the Ninth Regiment, Mass.N.G., during Saturday and Sunday, June 24th and 25th. The members of the Visiting Staff were called in addition to those of the regular staff, and the entire 65 chairs in the Infirmary were in constant use throughout the two days. During this time 2,632 operations were performed.

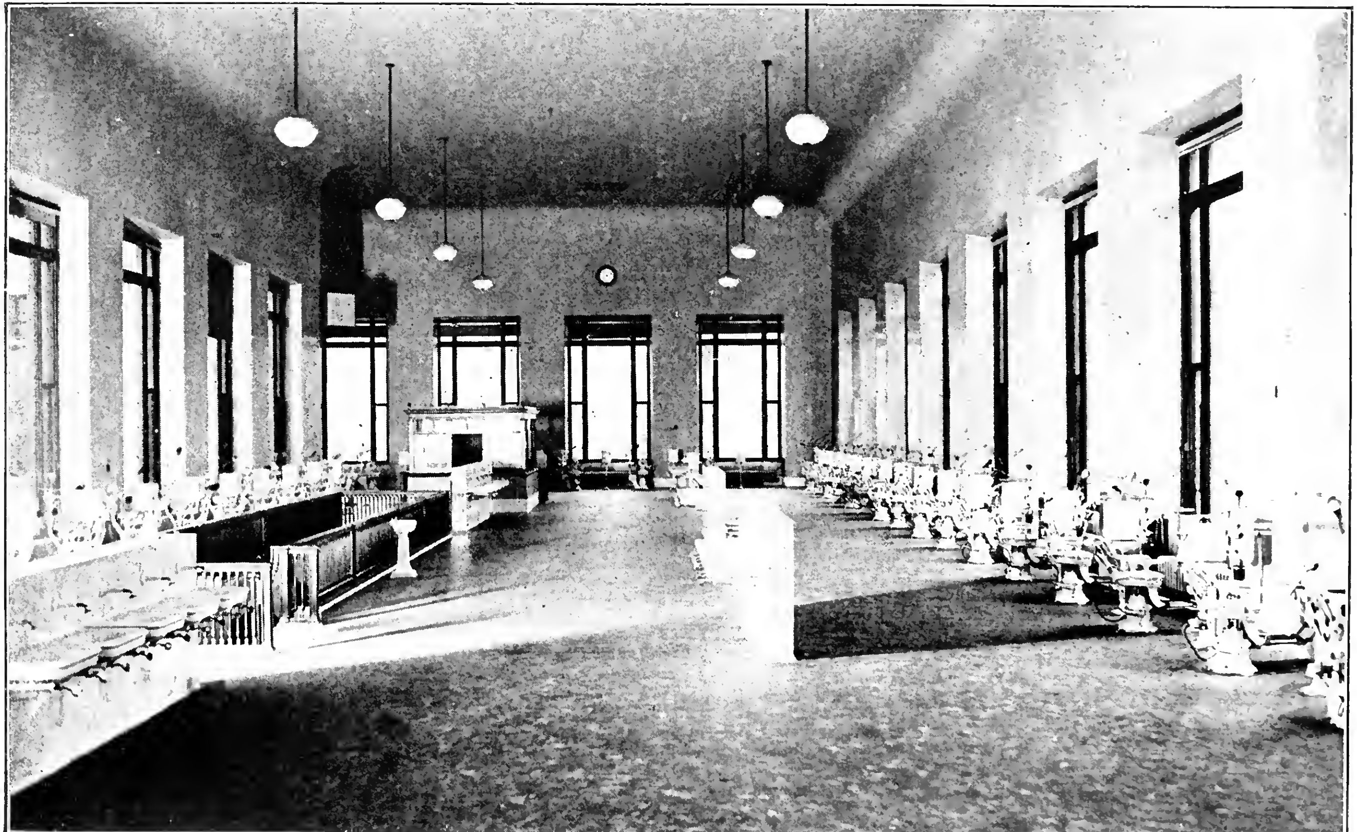
This patriotic service brought forth words of highest praise from the military heads of Massachusetts. Many men who would otherwise be unfit for military service were treated and made efficient soldiers by the proper attention to their mouths.

With a similar end in view the Institution conducted a course in Army Dentistry for the benefit of those dentists who might desire to enter the service of the government in its present crisis. The greater number of the chapters in this book are taken from the lectures then given at the Forsyth Dental Infirmary. They adhere as closely as possible to the following course, which has been authorized by the Surgeon General of the Army and Navy.

PREPAREDNESS LEAGUE

Exhibit "A"

The following course of instruction is suggested for the preparation of candidates to enable them to meet the examination requirements for admission to the Dental Reserve Corps of the Army and Navy in conformity with Dental Section from Synopsis of General Order No. 32, 1916, Officers' Reserve Corps.



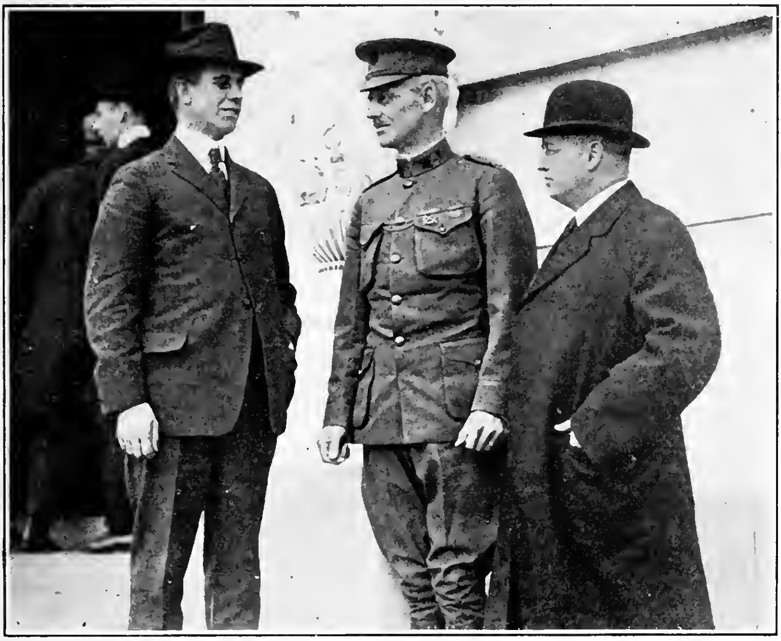
Interior of Forsyth Main Operating Room.

Dental Section. All Grades

Outline of Subjects

1. Administration.—Army regulations, so far as they relate to the dentist as an officer of the army.

Manual for the medical department so far as it relates to the duties of the dental corps.



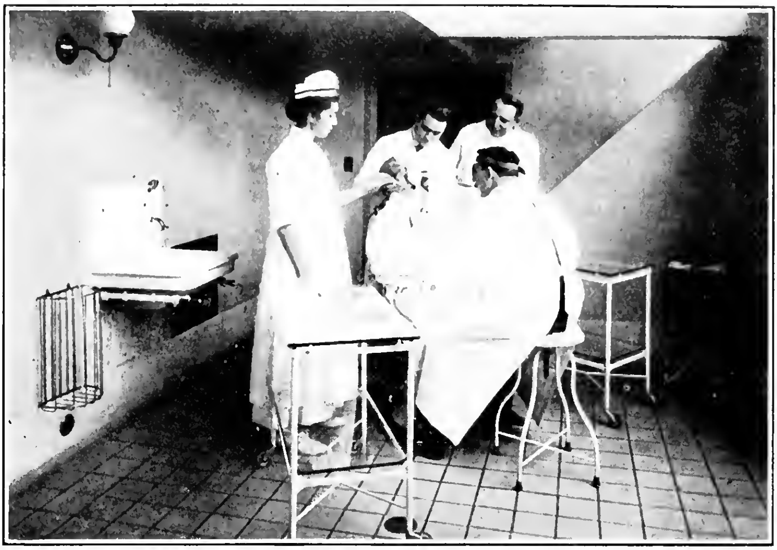
Director Cross of Forsyth — Major Jones, U. S. A., Contributor — Dr. Johnson, Trustee of Forsyth

(Blanks should be furnished and applicants required to exemplify their use in the preparation of reports and returns.)

2. Technical Professional Subjects.—These are prescribed by the Surgeon General, as follows:

Asepsis and antisepsis in relation to wounds involving the mouth and jaws.

Oral hygiene in relation to wound infection.



Nose and Throat Operating Room.

Amphitheater.

Anesthesia.—(*a*) review of the pharmacology and technic of administration of ether, chloroform, nitrous oxid, nitrous oxid and oxygen, etc., when used as general anesthetic agents; (*b*) review of the pharmacology and technic of administration of cocain, novocain and their coproducts for the induction of local anesthesia.

Dental and oral prosthesis.—(*a*) as related to the loss of the hard and soft tissues resulting from wounds involving the mouth and jaws; (*b*) the mechanical treatment of fractures of the jaws by wiring and splinting, and the technic of splint construction; (*c*) the dental preparation for subsequent operations by the surgical staff.

Dental and oral practice in the army and navy.—(*a*) in relation to the service; (*b*) in relation to the Administration and Supply Department; (*c*) in relation to other military duties of dental surgeons.

3. Military Law.—Manual for Courts-Martial (official).

Note. Lectures under Section 1—Dental and Oral Practice in the Army; of Section 2 and Section 3—Military Law, to be given by an Army Dental Surgeon; the time occupied for this part of the course to involve not less than two, nor more than ten, days of the course.

Approved by

Robert E. Noble,
Major M. C., U. S. A.,
for the Surgeon General.

Heartily approved,
W. S. Braisted,
Surgeon General, U. S. N.

FORSYTH LECTURE COURSE

These lectures were attended by over 600 practicing dentists. The course was very intensive, lasting for six consecutive days from 9 A. M. to 7 P. M., and including lectures, clinics, etc.

Before taking the course each man was informed that at its completion he was expected to take his examina-

FIRST CLASS OF DENTISTS ATTENDING LECTURES FOR THE U. S. A.

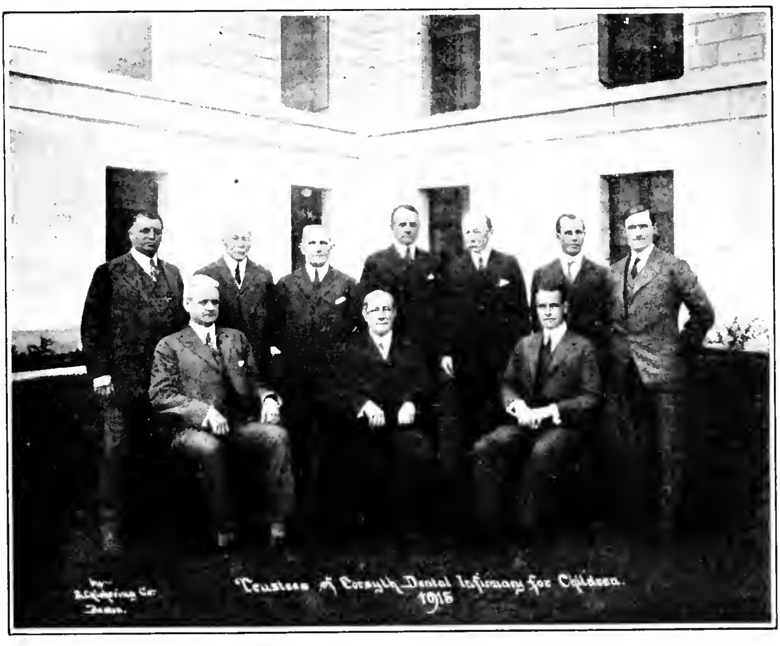
tion for the United States Army immediately and be ready for duty in France at once. Not one applicant refused to take the course. In fact, at the present time all the resources of the examining board have been strained to the breaking point in examining dentists eager to qualify as army dental surgeons.

It is hoped that the compilation of these lectures in book form will aid many dentists throughout the country

Militiamen on Steps at Forsyth Waiting for Dental Services

Militiamen Being Treated by Forsyth Staff.

MILITIAMAN RECEIVING DENTAL TREATMENT.



TRUSTEES OF FORSYTH DENTAL INFIRMARY.

Left to Right, Standing: Dr. Ernest A. Johnson, Dr. Harold Williams, Dr. John F. Dowsley, Dr. Gurdon Mackay, Mr. Nelson Curtis, Dr. Harold DeWitt Cross, Dr. Timothy Leary. Left to Right, Seated: Mr. Edward Hamlin, Mr. Thomas Alexander Forsyth, President, Mr. Chester B. Humphrey.

who were unable to profit by these lectures, to prepare for the Army Dental Corps.

It should be remembered that the book is not intended as a complete text-book but rather a compendium of dental information for review purposes.

We prophesy that our dentists serving in the army for their country and homes will make an enviable reputation and place dentistry in a secure position as one of the noblest and most worthy professions. As Americans and dentists we live to serve our country and our profession. If this book, which is a pioneer in the field of military dentistry, shall enable anyone who reads it to render more efficient service, it will have served its purpose and justified its existence.

The editor wishes here to acknowledge his indebtedness to the various contributors and to the Director and Trustees of the Forsyth Dental Infirmary, without whose help and encouragement the work would not have been possible.

Frederick A. Keyes, D.M.D.

416 Marlborough Street,
Boston, Mass.

December, 1917.

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LIST OF ILLUSTRATIONS

ARMY DENTISTRY

CHAPTER I

SURGICAL ANATOMY OF THE MOUTH

Harry H. Germain, M. D.

DEVELOPMENT OF THE FACE

Oral Plate.—A cross section of the head of the embryo about the twelfth day shows it to consist of two tubes, one in front of the other. The anterior is the blind end of the alimentary canal, while the posterior is the enlarged neural tube which later develops into the brain. The anterior wall of the head end of the alimentary tube is called the oral plate, which marks the location of the head and face.

Visceral Arches.—About the third week there appear on either side of the head end of the embryo four transverse plates separated from each other by deep clefts. The plates are called the visceral arches; the fissures, the visceral clefts. The uppermost of these arches is concerned in the formation of the face and unites in the middle line with its fellow of the opposite side to form the mandibular arch which represents the lower jaw. The three lower arches do not cross the middle line in front, but are continued into a mass of tissue which forms the front wall of the pharynx.

Oral Pit.—Owing to the growth of the visceral arches and the presence of the overhanging forebrain the oral plate becomes depressed into a fossa called the oral pit.

The oral pit represents the future oral and nasal cavities.

Superior Maxillary Process.—On each side of the oral pit there appears on the back part of the first visceral

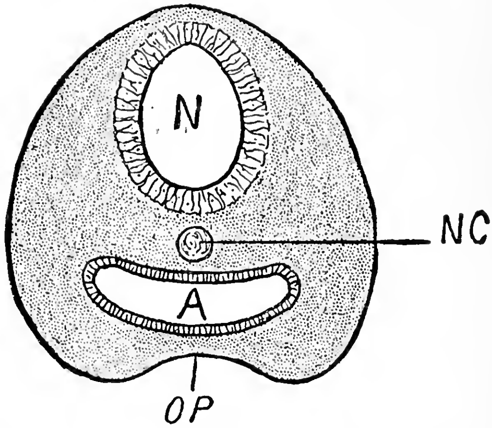


FIG. 1.—TRANSVERSE SECTION OF THE HEAD END OF AN EMBRYO TWELVE DAYS OLD. *A*, alimentary tube; *N*, neural tube; *NC*, notochord; *OP*, oral plate. (McGrath.)

arch of either side a mass of tissue called the superior maxillary process. Superiorly, corresponding to the up-

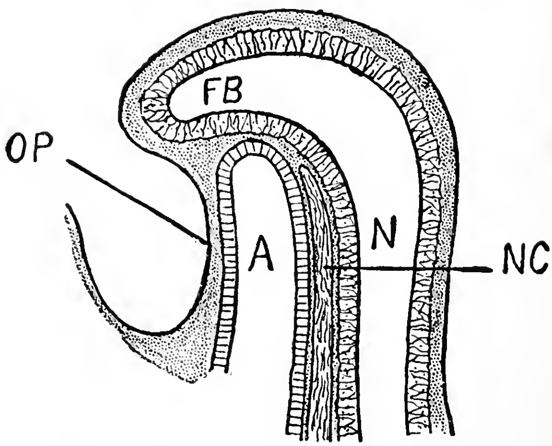


FIG. 2.—SAGITTAL SECTION OF THE HEAD END OF AN EMBRYO TWELVE DAYS OLD. *A*, alimentary tube; *FB*, vesicle of the forebrain overriding the end of the alimentary tube; *N*, neural tube; *NC*, notochord; *OP*, oral plate (site of future mouth), which ruptures during the fourth week. (McGrath.)

per part of the oral pit, is a broad process developed by the downward growth of the anterior wall of the vesicle of the forebrain. This grows downward and plays an important part in the development of the face. The oral pit is now bounded above by the frontal process, below by the mandibular arch, and laterally by the superior maxillary process. The eyes lie on either side of the

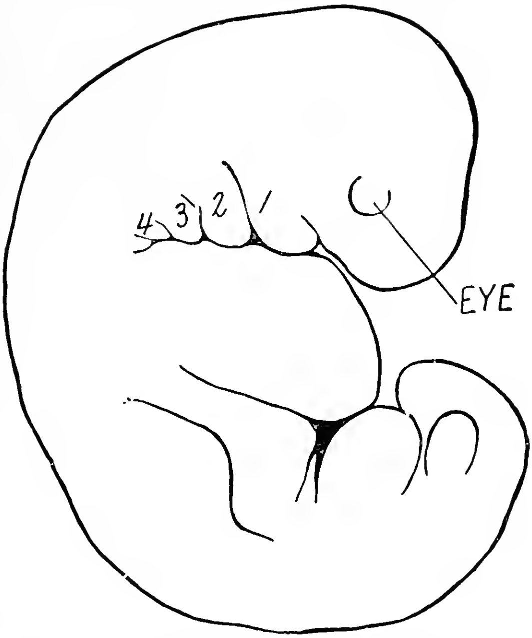


FIG. 3.—EMBRYO ABOUT FOURTH WEEK, SEEN FROM SIDE. 1, 2, 3, 4, visceral arches with clefts between them. (McGrath.)

head between the superior maxillary process and the outer part of the frontal process.

Frontal Process.—The frontal process is broad and consists of a middle portion, the mid-nasal process, and two lateral portions, the lateral nasal processes. The mid-nasal process is broad and notched in the middle. The lateral nasal processes, one on either side of the frontal process, are separated from the mid-nasal process by a notch called the olfactory groove.

Ultimate Conformation of Face.—About the fourth week the oral pit ruptures and establishes a communication from without with the alimentary tube.

About the fifth week the appearance suggests the ultimate conformation of the face. The superior maxillary processes approach the median line, the frontal process

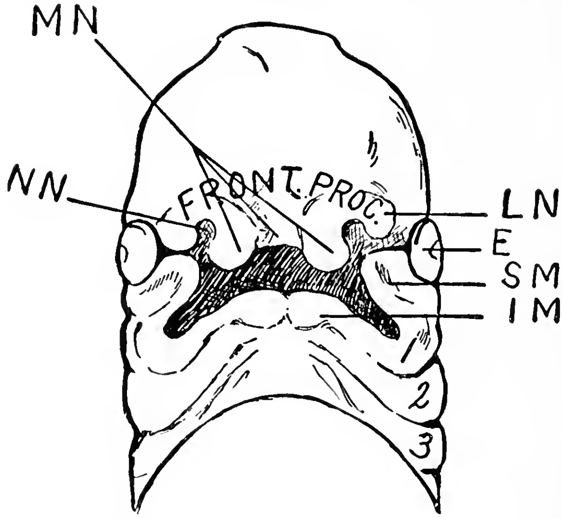


FIG. 4.—FACE OF EMBRYO, FIFTH WEEK. Front view. *E*, eye; *IM*, inferior maxillary process (first visceral arch) joins in middle line with its fellow of the opposite side to form the mandibular arch (future lower jaw); *LN*, lateral nasal process (outer extremity of the frontal process); *MN*, middle nasal process (middle portion of frontal process); *NN*, nasal notch (future nostril); *SM*, superior maxillary process (upper back part of the first visceral arch); 1, 2, 3, first, second, and third visceral arches. (McGrath.)

is longer and its separation into a middle and lateral portion is more pronounced. The eyes are still located on the side of the head.

About the seventh week the superior maxillary process is partly fused with the lateral nasal process of the frontal plate; the line of fusion corresponds with the position of the tear duct. If union does not occur along this line we have a deformity called an oblique facial cleft. At this time the eye is entirely surrounded and is placed more to the front of the face. The middle portion of the frontal plate is still notched; the extremities of the midnasal process have become fused with the lowest part of the superior maxillary process, forming the upper lip and closing the olfactory grooves which are converted into the nostrils. If the superior maxillary process and the middle portion of the frontal plate fail

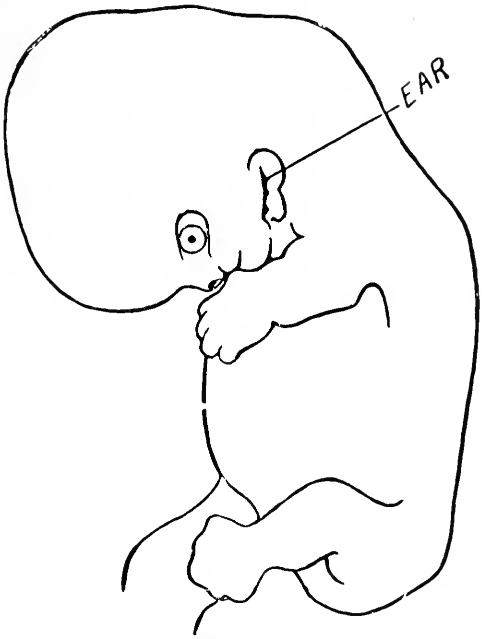


FIG. 5.—EMBRYO ABOUT EIGHTH WEEK. Development of face well advanced. (McGrath.)

to unite we have as a result a harelip which may or may not reach into the nostril.

The lower edge of the superior maxillary process becomes partly united with the upper border of the mandibular process and in this way the size of the mouth is much diminished. If this union is defective we have a deformity known as macrostoma. If union is excessive we may have an extremely small mouth or microstoma. (*See* Fig. 4.)

To summarize: the first visceral arch is eventually developed into the inferior maxillary bone and the adjoining soft parts, including the lower lip and the floor of the mouth, and assists in the formation of the tongue. The superior maxillary process of the first visceral arch is developed into the superior maxillary bone and the adjoining soft parts. The frontal plate and its lateral portion, the lateral nasal process, form the side of the nose, including the nasal bones; its middle portion, the middle nasal process, forms the bridge of integument between the nostrils, reaching from the tip of the nose to the upper lip, and the cartilaginous and bony portions of the nasal septum (vomer and perpendicular plate of the ethmoid), also the middle portion of the upper lip and intermaxillary bone.

Intermaxillary Bone.—The intermaxillary bone is a small, wedge-shaped, bony process which is attached to the anterior end of the vomer and fits into a corresponding triangular space in the anterior part of the hard palate, and carries the four incisor teeth. The line of union between this bone and the palatal processes of the superior maxillary may often be plainly seen in the adult upper jaw-bone. The anterior palatine canal marks the junction of these parts. A non-united, abnormally placed intermaxillary bone often complicates harelip.

Formation of the Palate.—The superior maxillary process of either side gives off on its median aspect a shelf-like plate of bone called the palate process. These processes grow toward the median line and unite, forming the hard and soft palate. The union usually takes place from before backward, the uvula being the last part to unite. Union between these processes is complete about the eleventh week. With the formation of the hard and soft palates, the nasal cavity is separated from the cavity of the mouth. Failure of union between the palate processes gives rise to the various degrees of cleft palate. In front, where the two halves of the hard palate join with the intermaxillary bone, there are a suture line and the anterior palatine canal.

The vomer and the perpendicular plate of the ethmoid are developed from the mid-nasal process and divide the nasal cavity into two parts. The junction between the lower border of the vomer and the hard palate occurs after the two palate processes have united with each other in the mid-line. The nasal cavity opens anteriorly through the nostrils and posteriorly into the naso-pharynx.

The Teeth.—The margins of the upper and lower jaw become prominent and form the alveolar processes; the epithelium covering these processes becomes invaginated, dips down into the substance of the process and forms the teeth. The floor of the mouth is developed from the first visceral arch.

The Tongue.—The anterior portion of the tongue is developed from the first arch, the posterior part from the second and third arches. The anterior portion is developed from the tubercle which appears in the front of the mouth near the junction of the two halves of the first arch. The back part is developed from two tubercles which appear at the junction of the second and third arch. These two parts of the tongue, the anterior and the posterior, become joined, the line of union being indicated by the V-shaped row of papillae upon the dorsum of the adult tongue. At the apex of the V there is a dimple, the foramen cecum, which indicates the point of junction of the parts from which the tongue is formed.

THE DEFORMITIES OF THE FACE

These consist of abnormal clefts and atresias which may be partial or complete. Clefts are due to the entire or partial absence of normal union between the original embryonal processes by union of which the face is formed.

Atresias are caused by excessive union beyond the normal and as a result we get partial or complete closure of the facial orifices.

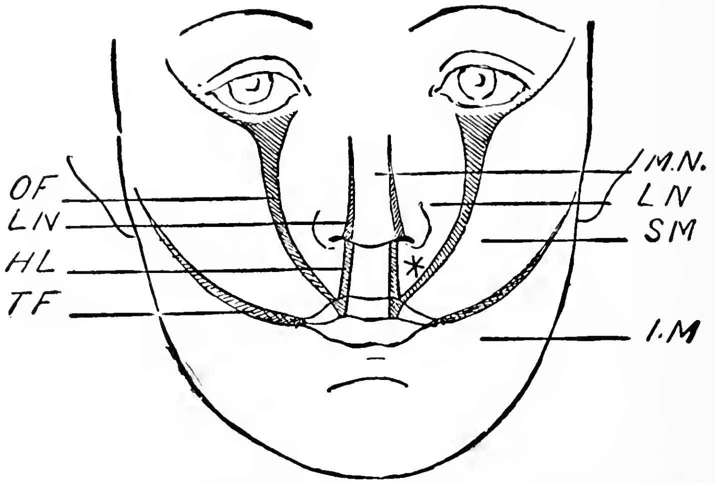


FIG. 6.—DIAGRAM OF CONGENITAL FACIAL CLEFTS. Shaded portions indicate the location of the different congenital fissures. *HL*, harelip; *IM*, inferior maxillary process; *LN*, *, lateral nasal process of frontal plate; *LN*, lateral nasal cleft; *MN*, middle nasal process of frontal plate; *OF*, oblique facial cleft; *SM*, superior maxillary process; *TF*, transverse facial cleft; *, lower part of lateral nasal process which takes part in the formation of the upper lip, but not of its red border; the free red margin of the lip is formed by the union of the lower part of the middle nasal process (*MN*) and the lower part of the superior maxillary process (*SM*). (McGrath.)

The failure of the embryonal processes to coalesce and the resulting clefts is due to deficient development of the processes themselves.

CONGENITAL DEFORMITIES

Congenital deformities of the face may be divided into two groups:

(*a*) Those in which the frontal plate or process is concerned. Under this heading we have—1. Lateral clefts of the upper lip and the alveolar process; clefts of the palate may also be included in this group; 2. Median clefts or notches of the upper lip and deformities of the nose; 3. Notching of the wing of the nose; 4. Oblique facial clefts.

(*b*) Those in which the first visceral arch is involved. In this group we have—1. Transverse facial fissures; 2. Median fissures of the lower lip, lower jaw and tongue; 3. Deformities of the lower jaw.

Deformities in which the Frontal Plate is Concerned

These are lateral clefts of the upper lip and of the alveolar process and cleft palate. Clefts of the upper lip and alveolar process depend upon the imperfect union of the mid-nasal process with the superior maxillary processes and to failure of the maxillary bone and its accompanying soft parts to unite with the adjoining portion of the face. These clefts are always lateral and may be present on one or both sides. Clefts of the palate depend on non-union of the palatal process of the superior maxillary process of either side. When both processes are at fault the cleft is median. If one palatal process only is involved the cleft is on the corresponding side of the median line, the opposite palatal process in this case being joined to the lower border of the vomer.

If union has failed on both sides between the mid-nasal process and the corresponding part of the superior maxillary process of either side and between the palatal processes of the superior maxillary processes we have the most extreme variety of deformities. There are found all degrees of this variety from a complete cleft down to a notching of the upper lip, or a bifurcation of the uvula.

Harelip.—This condition may be complete or incomplete. Incomplete harelip consists in a vertical notch in the free margin of the upper lip. It is located to one side of the median line between the middle and lateral segments of the lip. It varies from a slight notch to a fissure which may extend through the entire thickness of the lip into the nostril. Harelip may be associated with a cleft of the alveolar process and palate. The nose is

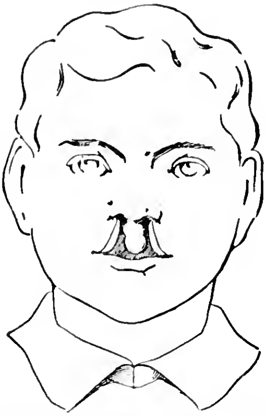


FIG. 7.—DOUBLE COMPLETE HARELIP. (McGrath.)

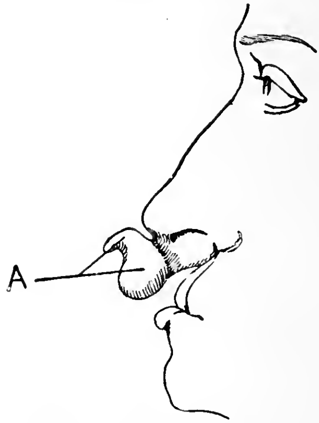


FIG. 8.—HARELIP WITH (*A*) ADVANCED INTERMAXILLARY PORTION.

broad and flat, the wing of the affected side being carried outward away from the mid-line. The deformity may be bilateral. In this case the intermaxillary bone is displaced forward. Occasionally the entire middle segment of the lip with the intermaxillary bone and vomer may be absent.

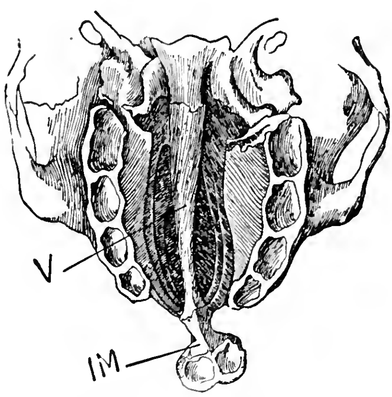


FIG. 9.—DOUBLE CLEFT PALATE WITH ADVANCED INTERMAXILLARY PORTION (*IM*) CARRYING THE SOCKETS OF TWO INCISOR TEETH. *V*, vomer (septum of the nose). (McGrath.)

Cleft of the Alveolar Process.—With harelip there may be present a cleft of the process which varies from the narrow fissure to a broad space; it may be unilateral or bilateral. If there is no cleft of the hard palate, the alveolar cleft stops at the anterior palatine foramen. If the cleft in the process is bilateral the intermaxillary bone which is attached to the vomer is pushed forward so that the median part of the lips projects in front of the nose. This advancement of the intermaxillary bone is due to the unrestricted growth of the vomer. If the cleft is unilateral, the intermaxillary bone becomes twisted and looks toward the normal side of the face.

Cleft Palate.—This is caused by a failure of union of the palatal processes in the median line.

Cleft of the Hard Palate.—This may be single or double; if one-sided the normal side is united with the vomer, while on the affected side the palate process is deficient, leaving an opening into the nasal cavity. At times we may find the palatal processes firmly united but the vomer fails to grow down and there is left a space below the lower border of the vomer through which the two sides of the nasal cavity communicate with each other. Cleft of the hard palate ends anteriorly either at the anterior palatine foramen, which marks the point of union between the intermaxillary bone and the palate processes of either side, or it may extend through the process. It may be combined with a single or double cleft of the alveolar process and harelip. Posteriorly there is usually a cleft of the soft palate.

Cleft of the Soft Palate.—The fissure extends from the tip of the uvula for a varying distance into the soft palate. It may be simply a bifurcation of the uvula, but, as a rule, it extends all the way through the soft palate as far as the posterior border of the hard palate or for some distance into the hard palate. It may be combined with a lateral or double cleft of the hard palate. As is the case with cleft of the hard palate, there is not only a simple lack of union between the two halves of the palate, but an actual deficiency of tissue which prevents the parts from meeting and coalescing in the middle line, and this fact is important in considering the operative treatment of this condition.

With the exaggerated forms of cleft palate there is frequently associated imperfect development of the mid-nasal process of the frontal plate or it may be entirely absent; the intermaxillary bone may be absent, with or without the absence of the vomer. If the intermaxillary bone, etc., are absent, we have a median cleft of the upper lip, or, better, a double harelip with absence of its middle segment. This state is usually associated with a broad cleft in the hard and the soft palate, and the nose may be soft and flattened, on account of the absence of the nasal septum, etc. The latter condition is apt to be accompanied by defective cerebral development.

Median Clefts and Notches of the Upper Lip.—These deformities depend upon exaggeration and persistence of the embryonal notch of the middle portion, the mid-nasal process, of the frontal plate and failure of the nostrils to approach each other. These defects are much less frequent than the preceding. There may be simply a notch or fissure in the middle of the upper lip reaching part way through, or this may be combined with a grooving or furrow upon the point and dorsum of the nose and a wide separation between the nostrils. This condition may be so pronounced that the nose appears to consist of two halves completely separated from each other and each containing one nostril. Instead of this extreme degree of deformity the nose may be simply flattened, the bridge depressed, the nostrils far apart and looking directly forward, "dog nose." The fissure in the upper lip, instead of simply notching the lip, may extend completely through the whole lip and into the intermaxillary bone. This variety of deformity may also be represented by a fistula of the tip of the dorsum of the nose.

Lateral Nasal Clefts.—These occur with or without harelip and cleft palate, the notch or fissure in this case involving the wing of the nose. If they extend upward for a considerable distance through the side of the nose, they terminate above, not in the inner canthus, but to the inner side of the inner corner of the eye; they represent the embryonal notch between the middle and lateral nasal processes of the frontal plate. Fissures of the side of the nose that resemble these, but terminate above in the inner canthus of the eye, are varieties of oblique clefts.

Oblique Facial Clefts.—Failure of normal union between the lateral process of the frontal plate and the superior maxillary process of the first visceral arch produces these deformities. They correspond to the embryonal orbitonasal line of coalescence. These deformities may be very extensive or slight, one-sided or double. They commence below at the edge of the upper lip, and, after splitting this at the usual harelip site, extend upward through the cheek and alongside of the wing of the nose, not into the nostril like a harelip, terminating above at the lower margin of the eye (lower lid) or inner canthus. They may extend beyond the orbit, from its outer corner, upward and outward into the frontotemporal region of the skull. They vary from a narrow fissure or incomplete notch to a wide gaping fissure, between the edges of which is the eyeball. This class of deformity is frequently represented in its simplest form by a notch or coloboma of the lower or upper eyelid. Instead of a fissure, this deformity may be represented by a cicatricial, nodulated seam, indicating the orbitonasal junction.

Fig. 10.—Incomplete Oblique Facial Cleft. The edge of the upper lip is notched and a cicatricial line extends across the cheek to the lower eyelid, which is everted. (McGrath.)

Deformities in which the First Visceral Arch is Involved

Transverse Facial Clefts.—These are due to a failure of the inferior maxillary process of the first visceral arch and its superior maxillary process to coalesce the normal extent. This deformity may be unilateral or double. The cleft extends from the corner of the mouth outward through the cheek and exposes the teeth (macrostoma). If the reverse of this process occurs, we may have a mouth so small as to require surgical interference (microstoma). (*See* Fig. 4.)

Fig. 11.—Transverse Facial Cleft. (McGrath.)

Median Clefts of the Lower Lip, Lower Jaw, and Tongue.—These conditions are very rare. They are due to failure of the two halves of the first visceral arch (mandibular process) to unite with each other in the middle line. They vary from a slight notching of the lower lip, in the middle line, to a complete separation through the lower lip, the lower jaw at the symphysis, and the tongue. The tongue, by itself, may be split or absent or bound down to the floor of the mouth or adherent to the side of the cheek, etc.

The lower jaw may be imperfectly developed, rudimentary, etc. It may be split in the middle line or there may be absence of the condyles, etc. As the formation of the face advances the jaw is gradually protruded forward, and, if arrested, we have, as a result, the receding chin, etc.

CRANIAL AND FACIAL BONES

The Skull

The term skull is used to describe the entire skeleton of the head. It comprises the cranium, that part surrounding the brain, and the bones which go to form the face.

Bones of the Cranium.	Bones of the Face.
1 Sphenoid	1 Vomer
1 Ethmoid	1 Inferior Maxilla
1 Frontal	2 Superior Maxillary bones
1 Occipital	2 Nasal
2 Parietals	2 Lacrimal
2 Temporals	2 Malar
	2 Inferior Turbinates
	2 Palate bones

The hyoid bone and the ossicles of the ear (malleus, incus and stapes) are usually described with the bones of the skull.

Frontal Bone

The frontal bone forms the front of the cranium and the roof of the orbits. It presents for examination an external, inferior, and an internal or cerebral surface. The external surface exhibits the following points for examination: Two convexities known as the frontal eminences, below which are the superciliary ridges. Between the superciliary ridges is a prominence called the glabella. The orbital arches or margins end externally and internally as the external and internal angular processes. Near the inner end is the supra-orbital notch. The temporal crest separates the frontal from the temporal part of the bone and is continuous with the temporal line of the temporal bone.

The inferior or orbital surfaces are triangular in shape and are separated by the nasal notch in front and the ethmoidal notch behind. From the nasal notch projects a sharp point of bone called the nasal spine. Between the orbital surfaces and the ethmoidal notch is a rough area of bone which forms the roof of the ethmoidal cells and presents two grooves, which complete, with the ethmoid bone, the posterior and anterior ethmoid cells. Far forward is an opening into the frontal sinus, a cavity in the bone. The smooth orbital surface presents externally the lacrimal fossa and internally a depression called the trochlear fossa.

The internal or cerebral surface is concave, except over the roofs of the orbits, where it is convex. It is marked by depressions in which are lodged the convolutions of the brain. In the median line, the frontal sulcus descends from the middle of the upper margin of the bone and terminates below as the frontal crest; this groove or sulcus lodges the superior longitudinal sinus. At the base of the frontal crest is the foramen cecum. On each side are several fine furrows which are occupied by the meningeal vessels which supply the meninges or coverings of the brain.

Parietal Bones

The parietal bones are quadrilateral in shape and present an external convex surface, an internal concave surface and four rough borders. They form a large part of the vault of the skull.

Externally are the parietal eminences, below which are the superior and inferior temporal lines; below the latter is the temporal surface which forms part of the temporal fossa. The internal surface is concave and, like the frontal bone, is marked by the convolutions of the brain, and here are seen several fine grooves which lodge the meningeal vessels. The largest of these begins at the anterior inferior angle, passes upward and backward and is occupied by the middle meningeal artery.

At the posterior inferior angle is a groove for the lateral sinus. Above, running along the superior border, is a groove for the superior longitudinal sinus.

Temporal Bones

The temporal bone is described in three parts: (*a*) the squamozygomatic, which is the expanded anterior portion; (*b*) the mastoid, which is the thickened posterior part; (*c*) the petrous portion, which intervenes between the two, presents externally the opening of the ear, from which point it projects inward and assists in the formation of the base of the skull.

The squamous portion projects upward and forward, being limited by a thin sharp border which forms about two-thirds of a circle. The inner surface is marked by cerebral depressions and by several meningeal grooves; at the lower part there is usually a fissure which marks the line of separation between the petrous and the squamous portions of the bone. The outer surface is slightly convex and forms a part of the temporal fossa. From the lower part of this surface projects the zygoma, which is at first directed outward and forward, terminating in a serrated edge for articulation with the malar bone. Posteriorly the zygoma springs from two roots, an anterior and a posterior, between which is a hollow called the glenoid fossa; this fossa is divided into two parts by the fissure of Glaser. The posterior portion formed by the tympanic plate is non-articular. The anterior part, covered with cartilage in the natural state, articulates with the condyle of the lower jaw. In front of the articular area is a triangular surface which forms a part of the zygomatic fossa.

The mastoid portion projects downward externally into the mastoid process; this process has on its inner surface a groove called the digastric groove, internal to which is the occipital groove for the occipital artery.

The internal or cerebral surface is marked by a depression which is a portion of the groove for the lateral sinus.

The petrous portion is pyramidal in shape and contains the organ of hearing. It presents a base, two internal or cerebral surfaces, an external or inferior surface and an apex. The base appears externally between the squamous and mastoid portions of the bone as the external auditory meatus which leads into the middle ear or tympanum. The meatus is bounded above by the posterior root of the zygoma, while all of the other boundaries are formed by the auditory process, the thickened edge of the tympanic plate. The tympanic plate forms the anterior and inferior wall of the external auditory meatus and the tympanum. The external surface looks toward the glenoid fossa, while its lower edge surrounds the styloid process. The styloid process is long and tapering and between this and the mastoid process is the stylomastoid foramen through which passes the facial nerve. Internal to the stylomastoid foramen is the jugular facet, which articulates with the occipital bone. In front of this is the jugular fossa which, with the jugular notch of the occipital bone, forms the jugular foramen. In front of the jugular fossa is the carotid foramen leading into the carotid canal, which passes upward and then inward to emerge at the apex of the petrous portion.

The posterior surface forms part of the posterior fossa of the skull. About the center of the surface is the internal auditory meatus, into which pass the facial and auditory nerves.

The superior surface forms part of the middle fossa of the skull. A depression near the apex marks the situation of the gasserian ganglion. The superior border is grooved for the superior petrosal sinus. The anterior border is short, and in the angle between it and the squamous portion is seen the opening of the eustachian canal, a part of the eustachian tube which leads from the middle ear to the pharynx. The posterior border articulates with the occipital bone and forms with it a groove for the inferior petrosal sinus.

Occipital Bone

The occipital bone is situated at the back part of the head and forms a portion of the base of the skull. It is irregularly quadrilateral in shape and is pierced in its anterior portion by the foramen magnum (through the foramen magnum pass the spinal cord, vertebral arteries and the spinal portion of the spinal accessory nerve). That portion of the bone in front of the foramen magnum is called the basilar portion; that behind, the tabular portion and on either side are the condylar portions. On the condylar portions are placed the condyles, or articular processes, by which the head is supported on the atlas. Two superior borders of the bone articulate with the parietal bones, the inferior borders with the temporal bone, while the basilar process is joined to the body of the sphenoid by cartilage. The tabular portion, externally, presents about its center a prominence, the external occipital protuberance. Extending laterally from this eminence are two ridges of bone called the superior curved lines. A little above these on each side is the less prominent linea suprema. Above this the bone is smooth, while below it is irregular and is divided into two lateral halves by a median ridge, called the external occipital crest. These lateral portions are divided into an upper and lower part by the inferior curved lines.

The internal surface is marked by two ridges which cross each other at right angles. One passes from the foramen magnum to the superior angle, the other laterally between the two lateral angles. The internal occipital protuberance is at the point of crossing. The internal surface is thus divided into four fossae; the superior and inferior occipital fossae. The superior parts of the vertical and the transverse ridges are grooved for the superior longitudinal and lateral sinuses respectively. The lower half of the vertical ridge is called the internal occipital crest.

The condylar portion externally supports the condyles which are the elliptical articulating surfaces (processes) by which the head is supported on the atlas. In front and external to the condyle is the anterior condyloid foramen which transmits the hypoglossal nerve. Posteriorly is the posterior condyloid foramen which transmits a small vein. External to the condyle is the jugular process which has the jugular notch in front. This notch with the corresponding one on the temporal bone forms the jugular foramen in the articulated skull. The internal surface of the jugular process is grooved for the lateral sinus.

The basilar process projects upward and forward and is joined to the body of the sphenoid. Externally it presents the pharyngeal tubercle. Internally is the basilar groove in the median line, and laterally near the margin on either side is a groove for the inferior petrosal sinus.

The Ethmoid

The ethmoid consists of a vertical plate and two lateral masses which are united at their superior borders by the horizontal cribriform plate. The vertical plate lies in the median line and forms the upper third of the nasal septum. In front it rises above the cribriform plate as the crista galli, a thick process of bone, to which is attached the falx cerebri. The anterior edge of crista galli is divided into two alae (wings) which articulate with the frontal bone. The two alae are separated by a groove which in the articulated skull forms the foramen cecum. Below the cribriform plate the vertical plate articulates anteriorly with the nasal spine of the frontal bone and with the nasal bones. Inferiorly it articulates with the triangular cartilage of the nose, posteriorly with the vomer and the crest of the sphenoid.

The lateral masses are composed of a number of cellular spaces which are lined with prolongations of nasal mucous membrane. The external wall is a smooth bony plate, the os planum, which closes in part of the cellular spaces and forms a portion of the inner wall of the orbit. In front of the os planum some of the cellular spaces known as the anterior ethmoidal cells are under cover of the lacrimal bone. From this portion extending downward and backward is the uncinate process. At the lower part of this aspect is a groove which in the articulated skull is the middle meatus of the nose. This is limited below by the edge of the inferior turbinated process.

Anteriorly this groove is continued upward into a canal, the infundibulum, which leads through the anterior ethmoidal cells into the frontal sinus. The internal aspect of each lateral mass forms a portion of the outer wall of the nose. Posteriorly it is divided by a groove, the superior meatus, which runs forward to about the middle of the inner surface. Above this groove is a small projecting shelf of bone, the superior turbinated bone (or process). Below this groove is another projecting plate called the middle turbinated bone (or process). The superior border of each lateral mass is covered by the orbital plate of the frontal bone, the anterior border by the nasal process of the upper jaw, and the posterior border by the body of the sphenoid. The lower border is formed by the free edge of the middle turbinated bone. The cribriform plate fits into the ethmoidal notch of the frontal bone. On either side of the crista galli are the olfactory grooves which lodge the olfactory lobes of the brain. The olfactory grooves are pierced by numerous foramina for the olfactory nerves; at the anterior end of the olfactory groove is a small slit on each side of the crista galli which transmits the nasal nerve.

Sphenoid

The sphenoid is so called because it is wedged into the base of the skull between the other bones. It resembles a bat with extended wings, so we can shape our description accordingly. It presents: (*a*) a body or central part; (*b*) two greater wings; (*c*) two lesser wings; (*d*) two pterygoid processes.

Body.—The superior surface comprises what is seen inside of the base of the skull. There is a deep depression in it, called the pituitary fossa or sella turcica, which lodges the pituitary body. In front of this is the olivary process, a rounded eminence, on which rests the optic commissure, which makes a transverse groove leading on either side to the optic foramen. In front of the olivary process is a smooth, slightly concave surface which supports the olfactory lobes and terminates anteriorly in the ethmoidal spine. Behind the sella turcica is the dorsum sellae, the posterior surface of which is continuous with the basilar process of the occipital bone. The angles of this process which project over the pituitary fossa are called the posterior clinoid processes. Laterally this surface shows a winding groove on either side for the carotid artery.

The posterior surface is united to the basilar process of the occipital bone.

The anterior surface is marked in the median line by the sphenoidal crest which articulates with the vertical plate of the ethmoid. The surface on each side of the crest is divided into a median portion which forms part of the roof of the nasal fossae, and a lateral part which articulates with the ethmoid and palate bones. The median portion presents near its upper part the opening of the sphenoidal sinus, which is a cavity in the body of the bone.

The inferior surface presents anteriorly the rostrum, a ridge of bone which is continuous with the sphenoidal crest of the anterior surface. Projecting horizontally inward from the pterygoid processes on each side are the two vaginal processes.

Greater and Lesser Wings.—The lateral surfaces form the attachment for the greater and lesser wings. Anteriorly below the root of the lesser wing is a small free surface which forms the inner boundary of the sphenoidal fissure and the posterior part of the inner wall of the orbit.

The lesser wing projects horizontally from the anterior part of the superior surface of the body. The upper surface of the lesser wing forms a portion of the anterior fossa of the skull. Externally this surface terminates in a pointed extremity which nearly touches the greater wing below. Inferiorly the sphenoidal fissure and the back part of the orbit are roofed over by this process. The anterior border articulates with the orbital plate of the frontal bone. The posterior border forms the anterior boundary of the middle fossa of the skull and ends internally as the anterior clinoid process. Between the anterior clinoid process and the olivary eminence is the carotid groove, and in front of this is the optic foramen.

The greater wings project upward and outward from the body; each wing also extends backward as a projection called the spine. They exhibit three surfaces for examination: 1, superior or cerebral surface; 2, inferior or temporozygomatic surface; 3, anterior or orbital surface.

The superior or cerebral surface is slightly concave. It is situated in a line passing forward and inward from the spine to the inner end of the sphenoidal fissure and several foramina. 1. Piercing it is the foramen spinosum which transmits the middle meningeal artery. 2. In front of this is the foramen ovale, through which passes the third division of the fifth nerve (inferior maxillary division of the fifth). 3. Internal and anterior to the foramen ovale is the foramen rotundum, through which passes the second division of the fifth nerve (superior maxillary division of the fifth).

The inferior or temporozygomatic surface is divided into two parts by the infratemporal crest. The upper surface forms part of the temporal fossa and the lower looks downward into the zygomatic fossa.

Internally this surface exhibits the external aspect of the foramen ovale and the foramen spinosum.

The anterior surface looks forward and forms part of the outer wall of the orbit; a small portion of this surface looks downward into the sphenomaxillary fossa and is perforated by the foramen rotundum.

The sphenoidal fissure (foramen lacerum anterius) intervenes between the greater and lesser wings and is widest at its lower end. The third, fourth, sixth, and the first division of the fifth (ophthalmic) nerves and the ophthalmic vein have their exit through this fissure.

Pterygoid Processes.—The pterygoid processes project downward from the body and the adjacent portion of the greater wings. Each consists of an external and internal plate, united at an angle so as to enclose between them the pterygoid fossa. The external plate is shorter than the internal, and its external surface forms a portion of the zygomatic fossa. The internal plate terminates below in a hook-like process called the hamular process. Superiorly the internal plate curves under the body and ends as a thin plate of bone called the vaginal process, which articulates with the vomer. A little external to this thin edge is a groove which contributes with the palate bone to form the pterygopalatine canal. Posteriorly is seen the pterygoid tubercle, which is to the inner side of and below the orifice of the vidian canal.

BONES OF THE FACE

The Superior Maxilla

The superior maxilla consists of a body and four processes. The body offers for examination an external or facial surface, an internal or nasal surface, and a superior or orbital surface. The processes are the nasal, projecting upward; the alveolar, which contains the teeth sockets; and the malar, which divides the external surface into an anterior or facial surface, and a posterior or zygomatic surface; finally, the palate process projects horizontally on the inner side of the body.

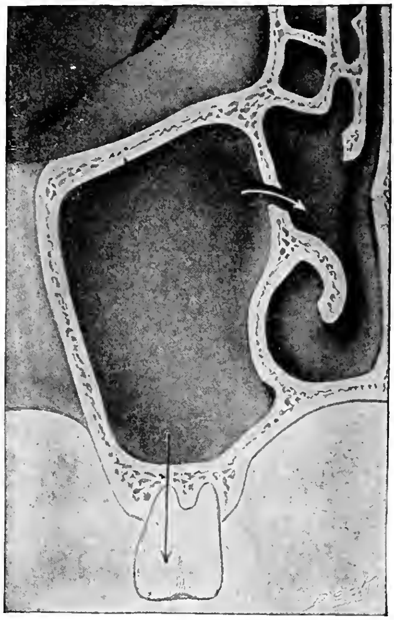


Fig. 12.—Antrum of Highmore. White arrow, natural drainage; black arrow, surgical drainage. (Campbell.)

Body.—The body is hollowed into a cavity called the antrum of Highmore which opens on the inner side into the nasal fossa. The facial surface is continuous below with the alveolar process, and is marked by ridges which correspond in position with the roots of the teeth; that of the canine tooth is very prominent and separates the incisive fossa from the canine fossa. Above the canine fossa is the infra-orbital foramen which transmits the infra-orbital vessels and nerve. The zygomatic surface is the posterior external surface lying behind the malar process. It shows the openings of the posterior dental canals which transmit the posterior dental nerves.

The nasal surface anteriorly presents the inferior turbinated crest which articulates with the inferior turbinated bone. Below this crest is the inferior meatus, and above it the middle meatus of the nose. Behind the nasal process lies the lacrimal groove, which is converted into a canal, the nasal duct (tear duct), by the lacrimal and inferior turbinated bones. Posterior to the lacrimal groove is the opening into the antrum of Highmore. Posterior to this opening is a rough surface for articulation with the palate bone. Crossing the lower part of this articular surface and passing downward and forward is a groove, completing with the palate bone the posterior palatine canal.

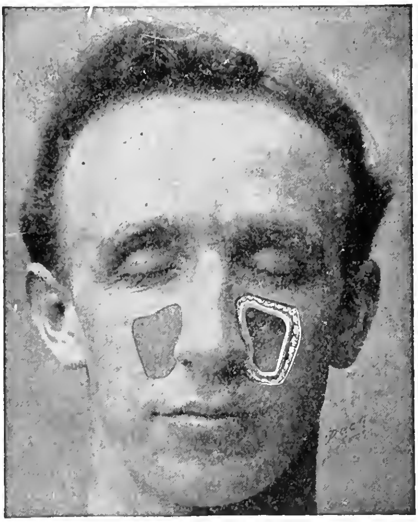


Fig. 13.—Antrum of Highmore and Surface Location. (Campbell.)

The orbital surface is triangular and smooth. The chief feature of this surface is the infra-orbital groove, which, passing from behind forward, into a canal of the same name, transmits the infra-orbital nerve and vessels. On the internal border of this surface, behind the nasal process, is the lacrimal notch for the lacrimal bone.

Processes.—The nasal process passes upward from the anterior part of the body. It requires no special description.

The alveolar process is thick and is hollowed out into sockets for the teeth.

The malar process is thick and triangular and divides the external surface into an anterior or facial surface, and a posterior or zygomatic surface. Its rough surface is for articulation with the malar bone.

The palate process forms about three-fourths of the hard palate, the remainder being formed by the palate process of the palate bone. The upper surface is smooth, and the lower, grooved and rough. The mesial border rises into a vertical ridge which with its fellow of the opposite side, forms the nasal crest for articulation with the vomer. Anteriorly this crest is more prominent than elsewhere. On the outer side of the incisor crest on the upper surface is a foramen, leading into a canal which opens on the lower surface into the anterior palatine fossa.

The antrum of Highmore is a cavity occupying the body of the maxilla. It is pyramidal in form, the base being toward the nasal surface and the apex toward the malar process. In the articulated skull the aperture opening on the nasal surface is nearly closed by the ethmoid, the palate and the inferior turbinated bone.

The Palate Bone

The palate bone (in two parts) forms part of the hard palate and lateral wall of the nose. It consists of a horizontal and a vertical plate, united at a right angle. In addition there are three processes: (*a*) tuberosity; (*b*) orbital; (*c*) sphenoidal.

Plates.—The horizontal plate forms the posterior portion of the hard palate and articulates anteriorly with the palate process of the upper jaw. Its upper surface contributes to the formation of the back part of the nasal fossa. The posterior border is free, concave, and gives attachment to the soft palate. The internal border articulates with the opposite bone, forming a continuation of the nasal crest of the upper jaw.

The vertical plate has an internal or nasal surface, and an external surface. The nasal surface is divided into an upper and lower portion by the inferior turbinated crest, which articulates with the inferior turbinated bone. These two surfaces are continuous with similar ones on the upper jaw, forming the inferior and middle meatus of the nose. At the upper end of the upper surface is another ridge, the superior turbinated crest, which articulates with the middle turbinated bone. The external surface presents a groove which forms with the superior maxilla, the posterior palatine canal for the large palatine vessels and nerve. The greater part of the surface articulates with the upper jaw.

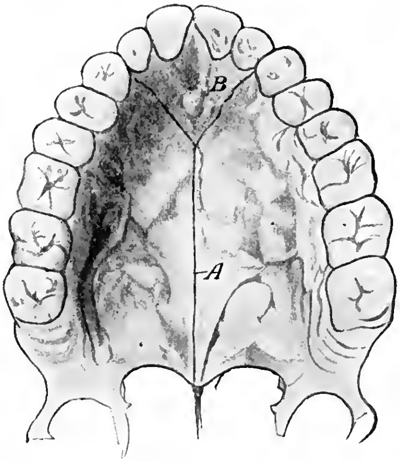


FIG. 14.—SHOWING THE INCOMPLETE FUSION OF THE PALATAL PLATES AND THE V-SHAPED INTERVAL FILLED BY THE INTERMAXILLARY BONE. *A*, median articulation; *B*, intermaxillary bone. (Campbell.)

Processes. — (*a*) The tuberosity fits into the notch between the pterygoid plates and completes the pterygoid fossa; (*b*) the orbital process lies at the anterior superior portion of the vertical plate and forms part of the floor of the orbit; (*c*) the sphenoidal process arises from the posterior superior part of the vertical plate. Its upper surface is in contact with the body of the sphenoid, its internal surface looks toward the nasal fossa, and its base looks into the sphenomaxillary fossa. The orbital and sphenoidal processes are separated by the sphenopalatine notch.

THE MALAR BONE

The malar bone is quadrangular in shape and forms the prominence of the cheek. The external surface is convex and the internal concave. The latter looks into the temporal and zygomatic fossae. The upper angle articulates with the external angular process of the frontal bone. The temporal border passes backward and downward to the temporal process which articulates with the zygomatic process of the temporal bone. The posterior inferior border is roughened for the attachment of the masseter muscle. The antero-inferior border is rough and serrated for articulation with the upper jaw. The orbital border is continuous with the orbital process which forms a portion of the outer wall of the orbit. The orbital process projects backward and inward and articulates with the greater wing of the sphenoid.

The Turbinates

The two upper turbinates are part of the ethmoid. The lower is a distinct bone and is the largest of the three. It is a thin plate of bone consisting of a body and three processes; the anterior part articulates with the inferior turbinated crest of the superior maxilla and the posterior part with a similar crest on the palate bone.

The maxillary process extends downward. It is the largest of the three processes and partly closes the orifice of the antrum of Highmore. The lacrimal articulates with the lower part of the lacrimal bone and forms part of the wall of the nasal duct. The ethmoidal process passes backward and upward, articulating with the uncinate process of the ethmoid.

The Lacrimal Bone

The lacrimal bone is irregularly quadrilateral in shape and is very thin. It is situated in the inner wall of the orbit between the nasal process of the superior maxilla and the lateral mass of the ethmoid. Below, it articulates with the inferior turbinated bone. It has an external or orbital surface and an internal or nasal surface. The anterior part of the external surface is grooved for the lacrimal sac, and this part prolonged downward forms part of the nasal duct. Superiorly the internal surface closes some of the anterior ethmoid cells; inferiorly it forms part of the outer wall of the nose.

The Nasal Bone

The nasal bones are two four-sided bones which meet in the median line forming the bridge of the nose. The upper border articulates with the frontal bone. The external border is the longest and articulates with the nasal process of the superior maxilla. The internal border meets its fellow of the opposite side; posteriorly the two bones form a crest which rests upon the nasal spine of the frontal bone, the vertical plate of the ethmoid, and the cartilaginous septum. The facial surface is concave from above downward at its upper part, and convex below. The nasal surface for the most part is concave except where it articulates with the nasal process of the frontal bone.

The Vomer

The vomer is a thin, flat plate of bone which forms the posterior inferior portion of the bony septum of the nose. Its upper part is spread out into two wings which articulate with the rostrum of the sphenoid. The rostrum passes between the two wings, while the vaginal processes of the sphenoid and the sphenoidal processes of the palate are applied to the margin. The anterior margin of the vomer articulates with the cartilaginous septum below, and above with the perpendicular plate of the ethmoid. The anterior edge fits into the incisor crest of the superior maxilla. The inferior edge articulates with the nasal crest of the maxillary and palate bones. The posterior border, thin, smooth and free, separates the posterior nares.

The Lower Jaw

The inferior maxillary bone or lower jaw consists of a body and two ascending branches or rami. The upper end of each ramus is composed of two processes, an anterior pointed coronoid process and a posterior, round, articular condyloid process.

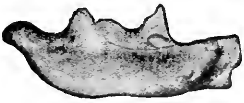


Fig. 15

Fig. 16

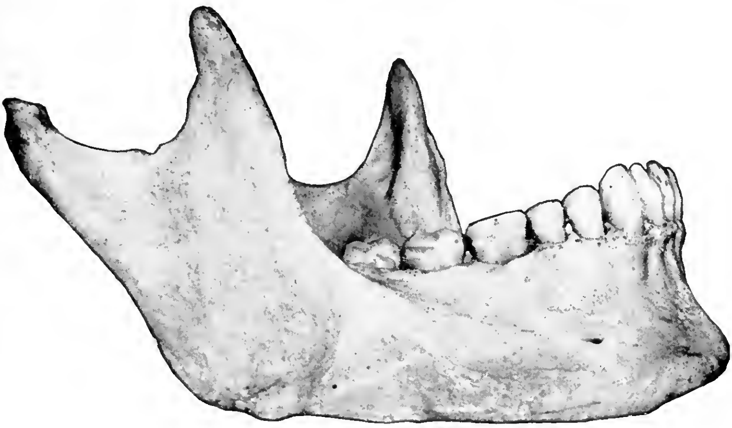


Fig. 17

Figs. 15, 16, 17.—Bones of the Lower Jaw. (Cryer.)

The body is U-shape, and from the extremities of the U the rami pass upwards. The inferior margin is called the base, the superior the alveolar process. The latter contains the alveoli for the lower teeth. Anteriorly the middle of the body exhibits the mental protuberance, on either side of which is a tubercle called the mental tubercle. Above and to the outer side of the mental tubercle is situated the mental foramen. Passing downward and forward from the anterior margin of the ramus to the mental foramen is the external oblique line.

The Internal Surface.—On either side of the median line is the digastric fossa, so named because of the digastric muscle being inserted at this point. Above the digastric fossae are the mental tubercles or spines, usually paired, for the origin of the geniohyoid and geniohyoglossus muscles. Above and to the outer side of the mental spine on either side is the sublingual fossa, which lodges the sublingual gland. Between the digastric and sublingual fossae is the mylohyoid ridge which passes backward and upward and gives origin to the mylohyoid muscles.

Each ramus has an external surface, an internal surface, a condyle and a coronoid process. The external surface is flat and here is inserted the masseter muscle. About the middle of the internal surface is the inferior dental foramen, the opening of the inferior dental canal, which transmits the inferior vessels and nerves. A plate of bone, the lingula, overhangs the anterior margin of the foramen. The posterior border of the ramus meeting the inferior border of the body, forms the angle of the jaw. Above, the posterior border terminates in a condyle. The head of the condyle is separated from the base by a constriction called the neck. The articular surface is ellipsoidal with the long axis nearly transverse. On the anterior surface of the neck is the pterygoid depression for the insertion of the external pterygoid muscle. The anterior border of the ramus terminates above in the sharp coronoid process for the insertion of the temporal muscle. The condyle and the coronoid process are separated by a deep excavation, the sigmoid notch.

THE SKULL

The bones of the skull, with the exception of those of the lower jaw, are fitted together by uneven edges with a little fibrous tissue interposed; this uneven line of articulation is called a suture. There are two exceptions to this: at the base of the skull the basilar process of the occipital bone is united to the body of the sphenoid, and the jugular process of the occipital is united to the petrous portion of the temporal by a layer of cartilage. Sutures derive their names from the bones between which they lie; i.e., parieto-occipital, etc. Those about the parietal bones receive special names; that between the two parietal bones is called sagittal; that posteriorly between the parietal bones and the occipital is called the lambdoid; anteriorly between the parietals and the frontal is the coronal suture; inferiorly is the temporoparietal and at the anterior inferior angle is the sphenoparietal.

Interposed between the cranial bones we often find small isolated irregular bones called wormian bones. These are most frequently found in the lambdoid suture and should not be mistaken for fractures.

Outer Surface of the Skull

The outer surface of the skull is divided into: (*a*) an anterior; (*b*) superior; (*c*) lateral, and (*d*) an inferior or basal region.

(a) Anterior Region.—The anterior region presents the openings for the orbits between which is the bridge of the nose, formed largely by the nasal bones. Below the nasal bones are the anterior nasal apertures separated by the bony septum. Below on either side are the incisor fossae, external to which are the canine fossae. The inferior maxilla completes the facial skeleton. The foramina in this region are the supra-orbital, infra-orbital, mental and malar.

The orbits are pyramidal in shape with the base forward. The inner walls are parallel, while the outer walls diverge. Seven bones enter into the formation of each orbit, eleven into both, four bones being common to each. The sphenoidal fissure (foramen lacerum anterius) at its

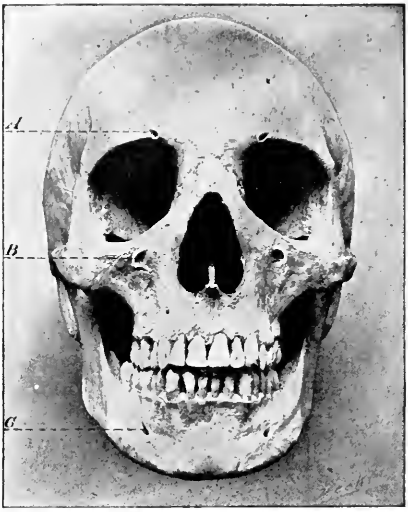


FIG. 18.—*A*. SUPRA-ORBITAL FORAMEN; *B*, INFRA-ORBITAL FORAMEN; *C*, MENTAL FORAMEN. (Campbell.)

inner end occupies the apex of the orbit, while the outer part lies between the external wall and the roof. The optic foramen is internal and above the sphenoidal fissure. Passing forward to the floor of the orbit is the infra-orbital canal, which terminates at the infra-orbital foramen. On the inner wall anteriorly is the lacrimal groove leading into the nasal duct or tear duct.

Further back on the inner wall are the anterior and posterior ethmoidal foramina. On the roof anteriorly is the supra-orbital notch or foramen.

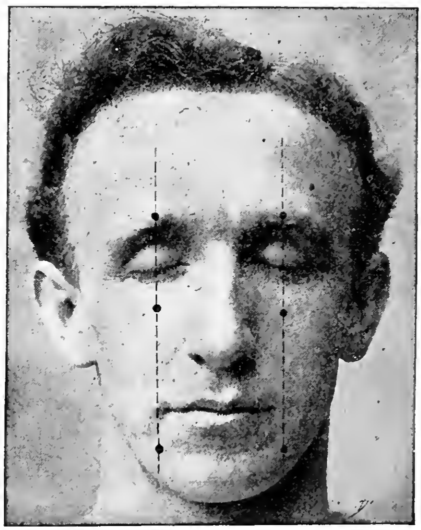


FIG. 19.—LINE OF SUPRA-ORBITAL, INFRA-ORBITAL, AND MENTAL FORAMINA. (Campbell.)

(b) Superior Region.—The superior region extends from the supra-orbital margin to the superior curved line of the occipital bone. It is limited laterally by the temporal line. It is smooth, convex and ovoid in shape, being broader in the parietal than in the frontal region.

(c) Lateral Region.—The lateral region exhibits from behind forward the mastoid process, external auditory meatus, glenoid fossa, with the condyle of the lower jaw, the zygoma; and, internal to the latter, the coronoid process of the lower jaw. Above the zygoma is the temporal fossa; below is the zygomatic fossa. The temporal fossa is occupied by the temporal muscle and is bounded above by the temporal crest of the frontal bone, and the lower temporal line of the parietal; the latter curves downward to join the supramastoid crest of the temporal bone, which is continued along the zygoma. Along the above line is attached the temporal fascia which covers the temporal muscle; the zygomatic fossa is partly covered by the ramus of the lower jaw, being separated from the temporal fossa by the infratemporal crest and the greater wing of the sphenoid. The foramina opening into this fossa are the foramen ovale, spinosum and posterior dental, together with the pterygomaxillary and sphenomaxillary fissures. The sphenomaxillary fossa is the space which lies in the angle between the pterygomaxillary and sphenomaxillary fissures. Five foramina open into this space: the foramen rotundum, vidian canal, pterygopalatine canal, sphenopalatine foramen, and the posterior palatine canal. Both the zygomatic and the sphenomaxillary fossae should be examined carefully on the skull, as any description is long and difficult to follow. (*See* Gray and Cunningham.)

(d) The Inferior or Basilar Region.—The lower jaw should be removed, and it will then be seen that this region is naturally divided into an anterior, middle, and posterior portion.

Anterior Division.—The anterior division consists of the hard palate and the alveolar arch. In front in the median line is the anterior palatine fossa opening into which are four foramina, the foramina of Scarpa and Stenson. Posteriorly on either side is the posterior palatine canal for the larger palatine vessels and nerve.

Middle Division.—The middle division extends from the edge of the hard palate to the foramen magnum. In the median line is the basilar process and the body of the sphenoid, on either side of which is the petrous portion of the temporal bone. Between the petrous and squamous portions is a part of the greater wing of the sphenoid. In the anterior part of this region are the openings of the posterior nares and external to these are the pterygoid fossae. In the angle between the petrous and squamous portions of the temporal bone is seen the opening of the eustachian tube. Between the apex of the petrous and the basilar process is the foramen lacerum medium. In a line extending outward and backward from this are seen the lower opening of the carotid canal, the vaginal and styloid processes and the stylomastoid foramen. Somewhat internal to these are the foramen lacerum posterius or jugular and the internal condylar foramen.

Posterior Division.—On each side of the foramen magnum are the condyles of the occipital bone, the under surface of the jugular process, digastric fossae, occipital groove and mastoid process.

The Interior of the Skull

The internal surface of the base of the skull is exposed by sawing horizontally through the cranium and removing the vault or calvarium. Three fossae may then be recognized: (*a*) anterior; (*b*) middle; (*c*) posterior.

(a) Anterior Fossa.—The anterior fossa is convex laterally and in the median portion presents a depression. It is made up by the orbital plates of the frontal bone, the cribriform plate of the ethmoid and the lesser wings with part of the body of the sphenoid. Anteriorly in the median line is the crista galli with the foramen cecum immediately in front of it. This latter sometimes conveys a small vein from the nose to the superior longitudinal sinus. On either side of the crista galli are the openings of the cribriform plate which are occupied by filaments of the olfactory nerve, and here also is the aperture for the nasal nerve.

(b) Middle Fossa.—The middle fossa consists of a central and two lateral portions. The central part is formed by the olivary eminence and the sella turcica. The latter portions are made up by the greater wings of the sphenoid, the squamous and the anterior surface of the petrous portion of the temporal. The foramina seen in this fossa are the optic, through which passes the ophthalmic artery and the optic nerve; the sphenoidal fissure which transmits the third, fourth, ophthalmic division of the fifth, the sixth nerve and the ophthalmic vein; the foramen rotundum, which gives passage to the second division of the fifth; the foramen ovale, which gives exit to the third division of the fifth; while through the foramen spinosum the middle meningeal artery enters the skull. There is also an irregular aperture, the foramen lacerum medium, between the apex of the petrous and the body of the sphenoid. In life this is closed by fibrous tissue. On its external aspect the opening of the carotid canal for the carotid artery is seen. Anteriorly is the vidian canal, through which the large superficial petrosal nerve leaves the skull.

(c) Posterior Fossa.—The posterior fossa lodges the cerebellum, medulla and pons. It extends from the superior border of the petrous to the internal occipital protuberance. The lateral boundaries are the grooves for the lateral sinuses. The occipital, the petrous and mastoid portions of the temporal, the posterior part of the parietal and the body of the sphenoid take part in its formation. The foramina in this fossa are the foramen magnum, anterior and posterior condylar foramina, the internal auditory meatus, the jugular and mastoid foramina. All these foramina are paired except the foramen magnum. The foramen magnum is occupied by the medulla oblongata, the vertebral arteries, and the spinal portion of the spinal accessory nerve. The facial and auditory nerves leave the skull through the internal auditory meatus. The posterior condylar and mastoid foramina are occupied by emissary veins. Through the jugular foramen (foramen lacerum posterius) pass the lateral and inferior petrosal sinuses, the glossopharyngeal, spinal accessory, and the pneumogastric nerves.

The Calvaria.—The upper part of the cranial cavity or calvaria is a vaulted dome formed by the frontal, parietal and occipital bones; the median part of the internal surface is grooved for the superior longitudinal sinus. It also presents shallow cerebral impressions, small grooves for meningeal vessels and depressions for the pacchionian bodies.

The internal surface of the skull is marked by grooves for blood vessels. The most important of these are the grooves for the middle meningeal arteries, the internal carotid arteries, the superior longitudinal sinus, the lateral sinuses, and the superior and inferior petrosal sinuses.

The Nasal Fossae

The nasal cavity is divided into two nasal fossae by the nasal septum, and nine of the bones of the skull take part in its formation. Each fossa has a floor, a roof, an internal and an external wall. The floor is formed by the hard palate: the median wall is the bony septum of the nose, which consists of the perpendicular plate of the ethmoid and the vomer. The roof is made up of the nasal bones, the nasal portions of the frontal bone, the cribriform plate of the ethmoid and the body of the sphenoid. The external wall exhibits the three turbinated bones. The superior and middle turbinates are processes of the ethmoid, but the inferior is an independent bone. These three turbinated bones divide the external wall into three canals; the superior meatus between the superior and middle turbinates; the middle meatus between the middle and inferior turbinates; the inferior meatus between the inferior turbinate and the floor of the nose. The external wall is formed by the following bones: the ethmoid; the nasal surface of the nasal process of the maxilla, and the nasal surface of the body of the same bone; the vertical plate of the palate; the inferior turbinate and the inner surface of the lacrimal bone.

There are numerous openings leading into each nasal cavity: (*a*) the foramina of the cribriform plate; (*b*) the superior orifice of the incisive canal; (*c*) the inferior orifice of the nasal duct which opens into the inferior meatus under the inferior turbinate; (*d*) the hiatus semilunaris, the opening of the antrum of Highmore; (*e*) the openings of the ethmoidal cells; (*f*) the orifice of the sphenoidal sinus and the sphenopalatine foramen; (*g*) the opening of the infundibulum, which leads into the anterior ethmoidal cells and the frontal sinus.

The following air sinuses communicate with the nasal fossae: (*a*) the antrum of Highmore; (*b*) the frontal sinus; (*c*) the sphenoidal sinus; (*d*) the ethmoidal sinuses. These sinuses are hollows within the superior maxilla, the frontal, the sphenoid, and the ethmoid bones respectively.

The Temporomaxillary Articulation

This articulation is the joint between the condyle of the lower jaw and the glenoid fossa of the temporal bone. It is divided into an upper and a lower portion by an articular cartilage which is adherent to the capsular ligament. The external lateral ligament is a means of reenforcing the capsular ligament. It is attached above to the zygoma, and below to the neck of the condyle. The internal lateral ligament extends from the spinous process of the temporal bone to the angle of the jaw and the posterior border of the ramus.

MUSCLES OF THE HEAD

The muscles of the head are divisible into the superficial muscles, the muscles of the orbit, and the muscles of mastication.

Superficial Muscles

The superficial group comprises the muscles of the scalp, face and the platysma myoides of the neck.

Platysma Myoides.—The platysma myoides arises from the deep fascia over the pectoralis major muscle and is inserted into the lower border of the inferior maxilla, into the skin of the lower part of the face, blending with the muscles about the angle and lower part of the mouth.

Muscles of Scalp.—The muscles of the scalp include the muscles of the external ear and the occipitofrontalis. The ear muscles are rudimentary and unimportant. The occipitofrontalis muscle consists of two muscular slips separated by a thin intervening aponeurosis. The posterior belly arises from the outer two-thirds of the superior curved line of the occipital bone. This portion is called the occipitalis. The anterior belly has no attachments to bone. It arises from the epicranial aponeurosis about the level of the coronal suture. Over the supraorbital arch its fibers blend with the corrugator supercilii and the orbicularis palpebrarum. The aponeurosis covers the vertex of the skull, being continuous with the aponeurosis of the opposite muscle across the median line. This muscle is supplied by the facial nerve.

Muscles of Face.—The muscles of the face are divided into the muscles of the eye, nose and mouth. For the most part these muscles are small and difficult to demonstrate except in a very favorable subject. Only the most important of these muscles will be considered.

Muscles of the Eyelids.—The muscles of the eyelids include the orbicularis palpebrarum, the tensor tarsi, the corrugator supercilii and the levator palpebrae superioris. The latter muscle is described under the orbital muscles.

The orbicularis palpebrarum is a sphincter muscle surrounding the eyelids; it is divided into an external and an internal portion. At the inner canthus of the eye it is attached to the tarsal ligament. Externally this muscle has no bony attachments. The other muscles are unimportant.

Muscles of the Nose.—The muscles of the nose are small, feeble and unimportant.

Muscles of the Mouth.—The muscles of the mouth are the levator labii superioris alaequae nasi, levator labii superioris, levator anguli oris, zygomaticus major and minor, the risorius, orbicularis oris, depressor anguli oris, the depressor labii inferioris, levator menti and the buccinator.

The orbicularis oris is the sphincter muscle of the mouth and lies between the skin and the mucous membrane of the mouth. It is attached above to the septum of the nose and the incisor fossa; below it is attached to the lower jaw on each side of the symphysis. From these points of attachment the fibers pass outward to join the rest of the muscle, which is formed by the fibers coming from the levator, depressors, and the buccinators.

The buccinator muscle arises from the alveolar arches of the upper and lower jaw and from the pterygomaxillary ligament. The fibers pass forward to the angle of the mouth where they join the levators and depressors. At the angle of the mouth the central fibers decussate, those from below being continuous with the upper portion of the orbicularis oris and those from above with the inferior portion. The highest and lowest fibers pass into the orbicularis oris without decussation.

The zygomaticus major arises from the malar portion of the zygoma. The fibers pass downward to be inserted into the skin and the orbicularis oris.

The zygomaticus minor arises from the malar bone and is inserted into the orbicularis oris.

The remaining muscles of this group are small and unimportant.

Muscles of the Orbit

The muscles of the orbit are seven in number. One of these, the levator palpebrae superioris, belongs to the upper eyelid, while the remaining six are muscles of the eyeball.

The levator palpebrae superioris arises from the margin of the optic foramen above the origin of the superior rectus. It is inserted into the upper border of the tarsal cartilage and slightly into the orbicularis palpebrarum.

The recti muscles are four in number: superior, inferior, internal and external. They arise from a membranous ring surrounding the optic foramen which is separated into two parts; the superior tendon gives origin to the superior and internal recti, and the upper head of the external rectus; the inferior common tendon gives origin to the lower head of the external rectus together with the internal and inferior recti. These four muscles end in tendons which are inserted into the sclerotic coat of the eye.

The superior oblique arises from the margin of the optic foramen between the superior and internal recti. It passes forward to the anterior margin of the orbit where its tendon passes through a fibrous pulley which is attached to the roof of the orbit. The tendon then passes outward and is inserted into the sclerotic coat between the superior and external recti.

The inferior oblique arises from the floor of the orbit external to the nasolacrimal groove. Its tendon passes outward to be inserted into the sclerotic coat between the superior and external recti.

The fourth nerve (trochlearis) supplies the superior oblique; the sixth (abducens) supplies the external rectus; the third nerve (motor oculi) supplies the others,—the levator palpebrae superioris, the superior, inferior, and internal recti, and the inferior oblique.

Muscles of Mastication

The muscles of mastication are the masseter, temporal, external and internal pterygoids and the buccinator. The buccinator has been described.

The masseter arises from the lower border of the zygoma in its anterior two-thirds; the deep part of the

Fig. 20.—Masseter Muscle. (Campbell.)

muscle arises from the inner surface of the whole length of the zygoma. It is inserted into the outer surface of the coronoid process, ramus, and angle of the lower jaw.

The temporal muscle arises from the temporal fossa and the temporal fascia which covers the muscle. It is inserted into the apex and inner surface of the coronoid process of the lower jaw.

The external pterygoid muscle arises by two heads. The upper head is attached to the under surface of the greater wing of the sphenoid; the lower head arises from the outer surface of the external pterygoid plate. It is inserted into the front of the neck of the lower jaw.

The internal pterygoid muscle arises by two heads. One head arises from the inner surface of the external

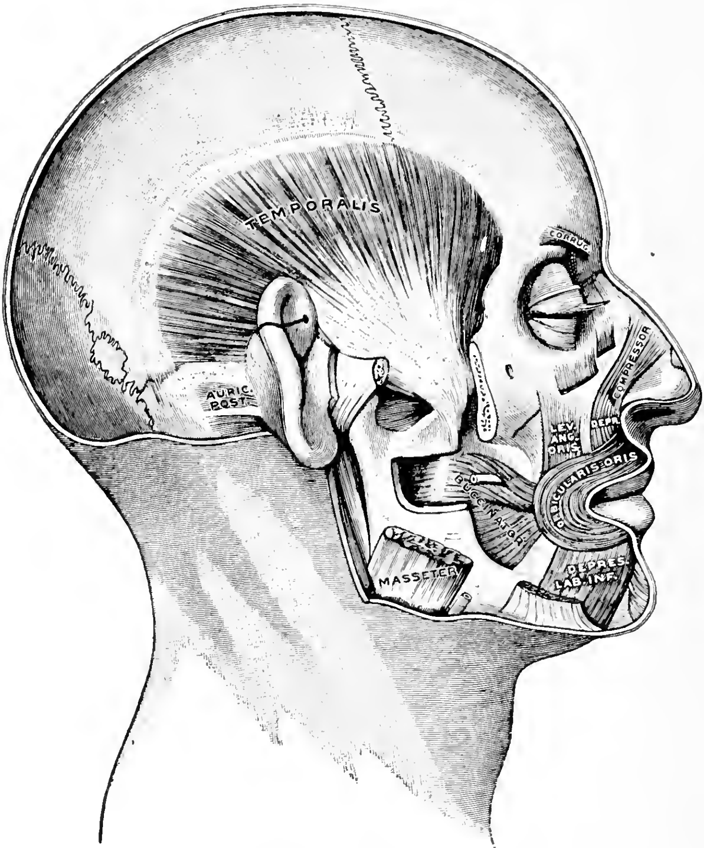


Fig. 21.—Temporal Muscle. (Gerrish.)

pterygoid plate and the tuberosity of the palate bone; the other head is attached to the tuberosity of the upper jaw. It is inserted into the lower part of the inner surface of the ramus and angle of the lower jaw.

The buccinator is supplied by the facial nerve. The

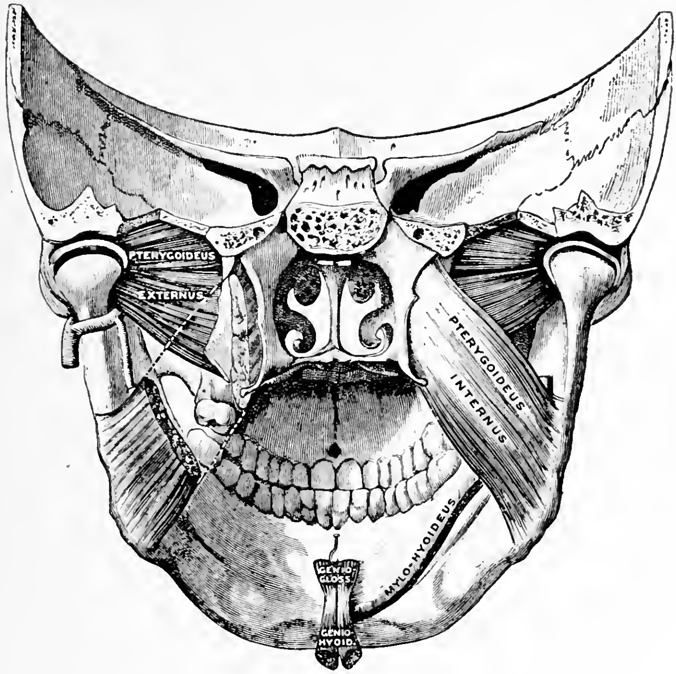


FIG. 22.—PTERYGOID MUSCLES. (Gerrish.)

remaining muscles are supplied by the inferior maxillary division of the fifth nerve.

MUSCLES OF THE NECK

The muscles of the neck are the following: (*a*) sternocleidomastoid; (*b*) the muscles of the hyoid bone; (*c*) the muscles of the tongue; (*d*) the muscles of the pharynx and soft palate; (*e*) the prevertebral muscles.

Sternocleidomastoid.—The sternocleidomastoid muscle arises from the anterior surface of the manubrium and the inner third of the upper surface of the clavicle. The muscle is inserted into the outer surface of the mastoid process of the temporal bone, and into the superior curved line of the occipital bone.

Muscles of the Hyoid Bone

The infrahyoid muscles connect the hyoid bone to the scapula, thorax, and thyroid cartilage. They are the omohyoid, sternohyoid, sternothyroid, and thyrohyoid.

The omohyoid consists of two fleshy bellies united by a central tendon. The posterior belly arises from the upper border of the scapula and from the transverse ligament which bridges over the suprascapular notch. It passes upward and forward to the central tendon. From this tendon the anterior belly proceeds upward to be inserted into the lower border of the hyoid bone.

The sternohyoid muscle arises from the clavicle, the first costal cartilage, and from the posterior surface of the manubrium. It is inserted into the lower border of the body of the hyoid bone.

The sternothyroid muscle arises from the first costal cartilage and the posterior surface of the manubrium. It passes upward in front of the trachea beneath the preceding muscle, to be inserted into the oblique line of the thyroid cartilage.

The thyrohyoid muscle lies in the same plane with the preceding muscle. It arises from the oblique line of the thyroid cartilage, and passing over the thyrohyoid membrane, is inserted into the body and greater cornu of the hyoid bone.

The suprahyoid muscles connect the hyoid bone to the lower jaw, cranium and tongue. They comprise the digastric, stylohyoid, mylohyoid and geniohyoid muscles.

The digastric muscles consist of two fleshy bellies united by a central tendon. The posterior belly arises from the digastric groove on the inner side of the mastoid. It passes downward and forward to the central tendon which is attached to the hyoid bone by a pulley-like band of fascia. The anterior belly of the muscle passes upward from the central tendon, to be inserted into a depression on the lower border of the jaw near the symphysis.

The stylohyoid muscle arises from the styloid process of the temporal bone, and is inserted into the body of the hyoid bone. This muscle is usually pierced by the tendon of the digastric muscle.

The mylohyoid muscle arises from the lower three-fourths of the mylohyoid ridge of the lower jaw. It is inserted into the upper border of the body of the hyoid bone and into a median raphe which extends from the hyoid bone to the chin. This muscle forms the floor of the mouth. The geniohyoid muscle arises from the inferior genial tubercle on the inner side of the symphysis of the lower jaw, and is inserted into the body of the hyoid bone. This muscle is concealed by the mylohyoid muscle.

Muscles of the Tongue

The muscular substance of the tongue consists of two series of muscles on either side of a median raphe. It is composed of extrinsic and intrinsic muscles.

The extrinsic muscles are the geniohyoglossus, hyoglossus, styloglossus and palatoglossus.

The geniohyoglossus muscle arises from the upper genial tubercle behind the symphysis of the lower jaw. The muscle is fanshaped; the lowest fibers are inserted into the body of the hyoid; the highest fibers are attached to the tip of the tongue; and the intermediate fibers pass into the substance of the tongue.

The hyoglossus muscle arises from the body and the greater cornu of the hyoid bone and is inserted into the side of the tongue.

The styloglossus muscle arises from the styloid process of the temporal bone and is inserted into the side and under surface of the tongue.

The palatoglossus muscle arises from the under surface of the soft palate, where it is continuous with the fibers of the opposite muscle. It is inserted into the side of the tongue, blending with the styloglossus.

The intrinsic muscles, which lie wholly within the substance of the tongue, are four in number on either side.

The superior lingualis extends from the base to the tip of the tongue on the dorsum.

The inferior lingualis occupies the under surface of the tongue between the geniohyoglossus and the hyoglossus muscles. The transverse fibers radiate outward to the dorsum and sides of the tongue, blending with the extrinsic muscles. The vertical fibers arise from the dorsum of the tongue and pass downward and outward to the sides of the tongue, blending with the transverse fibers.

The sternocleidomastoid is supplied by the spinal accessory nerve and by branches of the cervical plexus. The omohyoid, sternohyoid and sternothyroid are supplied by the loop of communication between the descendens and communicans hypoglossi (non). The thyrohyoid, geniohyoid, geniohyoglossus, styloglossus and the intrinsic muscles of the tongue are supplied by the hypoglossal nerve. The mylohyoid muscle is supplied by the mylohyoid branch of the inferior dental nerve. The anterior branch (belly) of the digastric is supplied by the mylohyoid branch of the inferior dental, and the posterior belly is supplied by the facial nerve. The facial nerve also supplies the stylohyoid muscles.

Muscles of the Pharynx

The muscles of the pharynx are the stylopharyngeus, palatopharyngeus and the three constrictor muscles.

The superior constrictor arises from the lower half of the posterior border of the internal pterygoid plate, the pterygomaxillary ligament and from the mylohyoid ridge of the lower jaw. The fibers pass backward and are inserted into the median raphe. The highest fibers are attached to the pharyngeal spine of the occipital bone.

The middle constrictor muscle arises from the stylohyoid ligament and from the cornua of the hyoid bone. The muscle is inserted into the median raphe.

The inferior constrictor muscle arises from the oblique line of the thyroid and from the side of the cricoid cartilage. Its fibers are inserted into the median raphe on the back of the pharynx. The lower fibers blend with muscular fibers of the esophagus.

The stylopharyngeus arises from the styloid process of the temporal bone and enters the wall of the pharynx between the superior and middle constrictors of the pharynx. It is inserted into the superior and posterior borders of the thyroid cartilage.

The palatopharyngeus muscle arises from the soft palate by two bands. The posterior fasciculus joins with the opposite muscle in the median line; the anterior fasciculus lies in the soft palate and joins in the median line the muscle of the opposite side. The muscle passes downward behind the tonsil and is inserted with the stylopharyngeus into the posterior border of the thyroid cartilage.

Muscles of the Soft Palate

The soft palate is composed of five pairs of muscles covered by mucous membrane. These muscles are the palatopharyngeus, azygos uvulae, levator palati, tensor palati and the palatoglossus.

The palatopharyngeus and the palatoglossus muscles have been described.

The azygos uvulae muscle consists of two bundles of fibers lying between the layers of the palatopharyngeus. They arise from the posterior nasal spine and unite as they pass downward to end in the uvula.

The levator palati has two origins. One portion arises from the apex of the petrous portion of the temporal bone; the other portion arises from the cartilaginous eustachian tube. It enters the soft palate between the two parts of the palatopharyngeus and is inserted into the aponeurosis of the soft palate.

The tensor palati arises from the scaphoid fossa and from the cartilaginous eustachian tube. The muscle passes downward and ends in a tendon which hooks around the hamular process and is inserted into the aponeurosis of the soft palate and posterior border of the hard palate.

The constrictors of the pharynx, palatoglossus, palatopharyngeus, levator palati and azygos uvulae are innervated by the pharyngeal plexus. The tensor palati is supplied by the otic ganglion. The glossopharyngeal nerve supplies the stylopharyngeal muscle, while the inferior constrictor receives an additional supply through the external and inferior laryngeal nerves.

Deep Lateral and Prevertebral Muscles of the Neck

These muscles are divided into three groups: (*a*) vertebrocostal; (*b*) vertebrocranial; (*c*) vertebral.

The vertebrocostal muscles are the scalenus anticus, scalenus medius and the scalenus posticus.

The scalenus anticus arises from the anterior tubercles of the transverse processes of the third, fourth, fifth, and sixth cervical vertebrae. It is inserted into the scalene tubercle on the first rib.

The scalenus medius arises from the posterior tubercles of the transverse processes of the cervical vertebrae, from the second to the sixth inclusive. It is inserted into a rough area on the first rib behind the groove for the subclavian artery.

The principal muscle of the vertebral group is the longus colli. These muscles are of no practical importance.

The vertebrocranial group is composed of the rectus capitis anticus major, minor, and lateralis muscles.

THE NERVOUS SYSTEM

The nervous system consists of the cerebrospinal and the sympathetic systems.

The sympathetic system is composed of a series of ganglia, bound together by intervening cords, placed on each side of the spinal column. It also includes various plexuses of nerves and several scattered ganglia. It is intimately connected with the cerebrospinal system.

The cerebrospinal system consists of the brain, spinal cord and peripheral nerves. There are thirty-one pairs of spinai nerves, which are attached to the spinal cord by an anterior and a posterior root. There are twelve pairs of cranial nerves, which are given off from the brain.

The Cerebrospinal Nervous System

The brain and spinal cord are composed of two substances: gray substance, which is composed of nerve cells, and white substance, which is composed of nerve fibers. The neuroglia, which is a connective tissue in function, forms the bed in which the nerve cells lie. It is present in both gray and white matter.

THE SPINAL CORD

The spinal cord is that part of the cerebrospinal system which occupies the upper two-thirds of the spinal canal. It extends from the foramen magnum to the level of the upper border of the second lumbar vertebra. It is about forty-five centimeters in length. At the foramen magnum the spinal cord becomes continuous with the medulla oblongata, while below it terminates in a pointed extremity called the conus medullaris. From the end of the latter a slender band is prolonged downward which is called the filum terminale.

The cord is protected by three membranes, the pia mater, the arachnoid and the dura mater. The pia mater is a fibrous membrane containing numerous blood vessels. It is closely applied to the cord, and septa project from the pia into the substance of the cord.

The arachnoid is a very delicate transparent membrane immediately external to the pia. For practical purposes it may be regarded as a part of the pia mater. External to the arachnoid, the dura mater forms a sheath which is continuous above with the dura mater of the cranial cavity. The spinal cord is suspended in this sheath by two lateral ligaments called the ligamenta denticulata.

In the dorsal region the cord is of uniform size and circular in outline. In the cervical and lumbar regions it increases in diameter. The cervical enlargement begins at the upper end of the cord and subsides opposite the second dorsal vertebra. The lumbar enlargement begins at the tenth dorsal and tapers away into the conus medullaris.

The cord is divided into lateral portions by an anterior and posterior fissure. They are known respectively as the anterior and posterior median fissures. The anterior is wider but shallower than the posterior. Where they come into relation near the center of the cord, between their internal extremities, there is a septum known as the commissure.

The spinal cord is composed of a central core of gray matter surrounded by white matter. The gray matter of the cord presents the appearance of the letter "H." The transverse part of the "H" is called the gray commissure. The parts above the horizontal line are called the anterior horns, and the parts below are the posterior horns.

The shape and disposition of the gray matter divide the white matter into an anterior, posterior and two lateral masses known as columns.

The posterior column is wedge-shaped and lies between the posterior fissure and the posterior horn of gray matter. The lateral column occupies the space between the anterior and posterior horns. The anterior includes the white matter between the anterior fissure and the anterior horn of gray matter. These columns are subdivided in the different regions of the cord.

A description of the different fiber tracts is not possible without illustrations.

The central canal of the spinal cord is a minute tunnel found in the gray commissure. Above, it passes into the medulla oblongata, and below, it ends blindly in the filum terminale.

THE BRAIN

The brain is the upper part of the cerebrospinal system. It occupies the cavity of the cranium and is surrounded by the meninges, the dura, pia and arachnoid.

Dura Mater.—The dura mater is a dense fibrous membrane lining the interior of the skull. It is the internal periosteum of the skull, and is one of the coverings of the brain. It is adherent to the inner surface of the skull especially opposite the sutures. Four processes of dura mater are sent inward into the cavity of the skull. These are the falx cerebri, tentorium cerebelli, falx cerebelli and the diaphragma sellae.

The falx cerebri is an arched process of the dura descending in the longitudinal fissures between the cerebral hemispheres. In front it is attached to the crista galli and behind to the upper surface of the tentorium. Superiorly it contains the superior longitudinal sinus and is attached to the skull. The lower margin is free.

The tentorium cerebelli covers the surface of the cerebellum and supports the posterior lobes of the brain. It is attached to the inner surface of the occipital bone, enclosing on each side the lateral sinus. In front it is attached to the upper margin of the petrous portion of the temporal bone, enclosing the superior petrosal sinus.

The falx cerebelli is placed between the lateral lobes of the cerebellum. It is attached superiorly to the tentorium and posteriorly to the internal occipital crest.

The diaphragma sellae forms a circular fold which makes a roof for the sella turcica.

Arachnoid.—The arachnoid is a delicate transparent membrane which, for practical purposes, may be considered a part of the pia mater.

Pia.—The pia mater is a vascular membrane consisting of plexuses of blood vessels held together by connective tissue. It covers the surface of the brain and is prolonged into the interior as the velum interpositum and the choroid plexuses.

Divisions of Brain

The brain may be divided into the *cerebrum, cerebellum, pons Varolii* and the *medulla oblongata.* The average weight of the male brain is 50 ounces and of the female 45 ounces.

Viewed from above the brain is oval, with the greatest transverse diameter slightly posterior to the center. From this point of view the two hemispheres only are visible, separated from each other by the longitudinal fissure. The inferior part of the brain is called the base, and is adapted to the base of the skull. Posteriorly is seen the medulla, which is continuous with the spinal cord. Above and behind the medulla is seen the cerebellum, or small brain. Above and anterior to the medulla is a white elevation called the pons Varolii.

In front of the pons is a hollow which is bounded laterally by the crura cerebri, which disappear by passing into the cerebrum. Passing around each crus on either side is the optic tract. The two tracts join together anteriorly to form the optic chiasm. Passing forward from the optic chiasm is the optic nerve of each side.

The crura cerebri, the optic tracts and the optic chiasm enclose the interpeduncular space. Within this area are seen the tuber cinereum, the posterior perforated space and the corpora mammillares.

The pons, medulla and cerebellum occupy the posterior fossa of the skull, being separated from the cerebrum by the tentorium cerebelli. They surround a cavity called the fourth ventricle.

The cerebrum forms the larger part of the brain, occupies the anterior and middle fossae of the skull and is separated from the cerebellum by the tentorium cerebelli. The two cerebral hemispheres are separated from each other by the longitudinal fissure. The hemispheres are connected with one another by the corpus callosum, a broad transverse band seen at the bottom of the longitudinal fissure. Each hemisphere has a cavity in its center called the lateral ventricle of the brain. Below the cerebral hemispheres is the interbrain, which is composed largely of gray matter arranged in a mass on either side, called the optic thalamus. Between the optic thalami is a narrow cavity called the third ventricle. The third ventricle is connected to the lateral ventricles by two small apertures called the foramina of Munro.

The cerebrum is connected with the pons, medulla and cerebellum by a stalk called the midbrain. This is composed of the crura cerebri, the corpora quadrigemina and the superior peduncles of the cerebellum. The midbrain is channeled by a narrow canal called the aqueduct of Sylvius, which extends between the third and fourth ventricles.

The Medulla Oblongata

The medulla oblongata, or bulb, is continuous with the spinal cord. It is about an inch in length and ends at the lower border of the pons Varolii. Its anterior surface lies behind the basilar process of the occipital bone, and its posterior surface lies in the vallecula of the cerebellum.

The Fourth Ventricle

The fourth ventricle is a cavity in the pons and medulla oblongata, being anterior to the cerebellum. Below, it is continuous with the central canal of the cord, and above, it is connected to the third ventricle by the aqueduct of Sylvius. Its floor is formed by the dorsal surfaces of the medulla and pons. The lateral boundaries are formed by the peduncles of the cerebellum. The roof of the fourth ventricle is formed from above downward by the superior peduncles of the cerebellum, the superior medullary velum, the inferior medullary velum, the tela choroidea inferior, the obex and the lingula. The cavity of the fourth ventricle communicates with the subdural space by three foramina which are lodged in the roof. The median foramen is called the foramen of Magendi and the lateral foramina, placed on either side, are known as the foramina of Key and Retzius. In the floor of the fourth ventricle are found the nuclei of origin of the cranial nerves from the fifth to the twelfth inclusive. In the floor of the aqueduct of Sylvius are the nuclei of the third and fourth nerves.

The Pons Varolii

The pons Varolii consists of an anterior and a posterior portion. The anterior part contains three layers of fibers, superficial, transverse, and longitudinal fibers, with a large amount of gray matter, the nucleus pontis, placed between the intersecting fibers.

The longitudinal fibers are the continuation of the pyramidal tracts of the medulla. These fibers pass into the crura cerebri.

The transverse fibers pass from side to side and constitute the middle peduncles of the cerebellum.

The dorsal part of the pons is continuous with the reticular formation of the medulla below and superiorly it is continuous with the tegmentum of the crura cerebri. The pons contains the nuclei of the fifth, sixth, seventh and eighth nerves and the superior olivary nucleus.

The Cerebellum

The cerebellum lies behind the pons and medulla and below the posterior portion of the cerebral hemispheres. It consists of gray matter on the surface and white matter interiorly. Its surface is traversed by fissures called sulci, which give it a foliated or laminated appearance. The cerebellum is divided into a median portion called the vermis, and two lateral parts called the lateral hemispheres. The hemispheres are separated behind by the posterior notch and in front by the anterior notch.

The largest and deepest fissure is the great horizontal fissure, which begins in front of the pons and passes around the free margin of the hemisphere to the middle line behind. It divides the cerebellum into an upper and lower portion. There are numerous secondary fissures dividing the cerebellum into lobes.

The cerebellum is connected to the cerebrum, pons and medulla by three pairs of peduncles called respectively the superior, middle and inferior peduncles.

The gray matter of the cerebellum occupies the surface, and there are also masses of it in the interior.

The white matter of the cerebellum is called the medullary body.

The Cerebral Hemispheres

Lobes of the Brain.—Each hemisphere is subdivided into seven lobes.

The frontal lobe is bounded by the longitudinal fissure internally, the fissure of Sylvius below, and behind, by the fissure of Rolando.

The parietal lobe is bounded above by the longitudinal fissure, below by the fissure of Sylvius, in front by the fissure of Rolando, and behind by the parieto-occipital fissure.

The occipital lobe lies behind the parieto-occipital fissure.

The temporal lobe lies below the fissure of Sylvius.

The island of Reil lies in the fissure of Sylvius on a deeper plane than the general surface of the hemisphere.

The limbic lobe is seen on the median surface of the hemisphere in the form of a ringlike convolution.

The olfactory lobe is placed on the under surface of the frontal lobe. It consists of the olfactory bulb with its roots and the trigonum olfactorium.

The surfaces of the hemispheres are formed of convolutions with intervening fissures, which arrangement enables it to present a large area of surface.

Fissures of the Brain.—The principal fissures of the hemispheres are the following: the great longitudinal fissure separates the hemispheres from each other, extending from the front of the cerebrum to the back. The floor of this fissure is formed by the corpus callosum, a commissural band, which connects the two hemispheres.

The fissure of Sylvius is the most conspicuous fissure on the surface of the hemisphere. It is composed of a short stem from the outer extremity of which three branches radiate. It lodges the middle cerebral artery.

The fissure of Rolando passes obliquely across the outer surface of the hemisphere, intervening between the frontal and parietal convolutions.

The parieto-occipital fissure is situated partly on the outer surface and partly on the internal surface of the hemisphere. The outer portion is about half an inch long and is limited by an arching convolution which winds around its extremity. The internal portion passes downward on the internal surface and terminates behind the corpus callosum in the calcarine fissure.

The callosomarginal fissure is situated on the median surface of the hemisphere. It divides the front part of the median surface into an upper marginal and a lower callosal convolution.

The calcarine fissure is placed on the median surface of the hemisphere. It begins close to the posterior extremity of the hemisphere, passes forward and is joined by the internal parieto-occipital fissure. It ends behind the posterior extremity of the corpus callosum.

The collateral fissure, also placed on the median surface, runs forward from the posterior extremity of the brain below and external to the calcarine fissure.

The hippocampal fissure, or dentate fissure, begins behind the splenium of the corpus callosum and passes forward between the gyrus dentatus and the hippocampal convolution.

The transverse fissure extends from the foramen of Munro of each side to the termination of the descending horns of the lateral ventricles.

Ventricles of the Brain.—The ventricles of the brain are five in number. Two lateral ventricles lie within the substance of the hemispheres and are connected to the third ventricle through the foramen of Munro. The third ventricle is placed between the optic thalami and the interbrain. It communicates with the lateral ventricles through the foramen of Munro, and with the fourth ventricle by the aqueduct of Sylvius. The fourth ventricle has been described under the medulla oblongata. The fifth ventricle is situated in the septum lucidum, between the lateral ventricles.

Ganglia.—The gray matter of the brain is disposed in two groups, that of the cortex and that of the basal ganglia.

The gray cortex is spread over the entire surface of the hemispheres, but is not equally thick in all localities.

The basal ganglia are a series of gray masses in the base of each hemisphere, and are named as follows: the corpus striatum, the claustrum, the nucleus amygdalae and the optic thalamus. The latter is part of the interbrain.

The white matter of the brain is arranged in three groups: the peduncular fibers connect the hemispheres with the medulla and cord; the commissural fibers connect the two hemispheres; the association fibers connect different structures in the same hemisphere.

The Interbrain

The interbrain is the region of the third ventricle. It is connected superiorly with the hemispheres and inferiorly with the midbrain. Its inferior surface corresponds with the interpeduncular space. Superiorly it is covered by the fornix.

The third ventricle has been described above.

The optic thalami are two masses of gray matter placed on each side of the third ventricle.

The Midbrain

The midbrain connects the pons Varolii with the interbrain. It is composed of the crura cerebri, the corpora quadrigemina and the corpora geniculata.

The crura cerebri consist of fibers connecting the medulla with the hemispheres. Each crus consists of an anterior part, or crusta, and a posterior portion, or tegmentum.

The corpora quadrigemina are four eminences on the dorsal surface of the midbrain. Between the anterior corpora quadrigemina is a small conical body known as the pineal gland.

The corpora geniculata are two small masses behind the optic thalamus of either side.

The aqueduct of Sylvius is a narrow canal in the midbrain between the corpora quadrigemina and the tegmentum. It connects the third with the fourth ventricle.

THE CRANIAL NERVES

There are twelve pairs of cranial nerves. The third and fourth nerves arise from the floor of the aqueduct of Sylvius; the fifth to the twelfth nerves, inclusive, arise from the floor of the fourth ventricle. These nerves leave

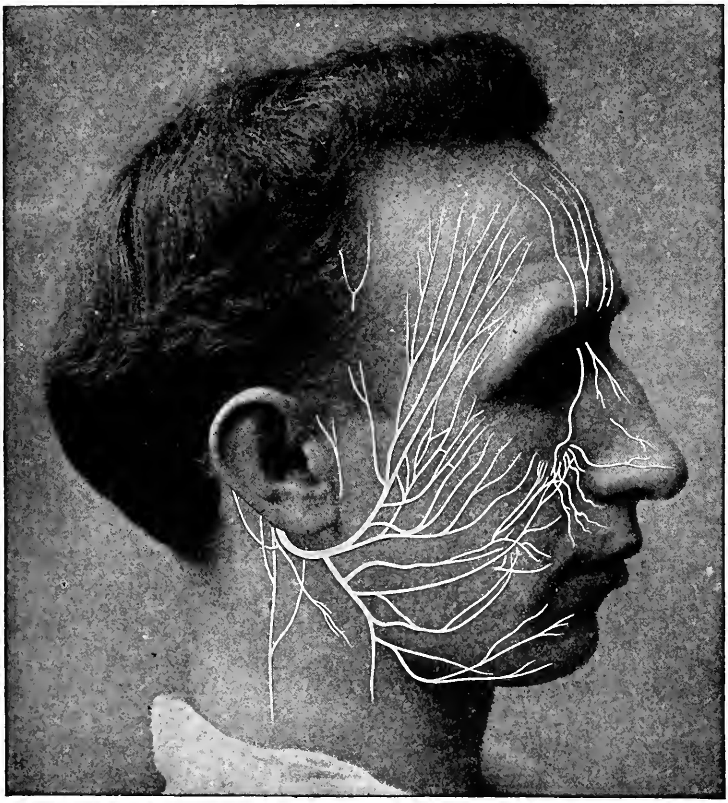


FIG. 23.—BRANCHES OF THE FACIAL NERVE SPREAD OVER THE FACE LIKE A FAN. (Campbell.)

the skull through the various foramina situated at the base of the skull.

The *first* nerve, the olfactory, is the nerve of smell. The fibers arise from the olfactory bulb, pass through the cribriform plate, and are distributed to the upper third of the nasal septum and the superior turbinated bone.

The *second*, or optic nerve, arises from the optic commissure, leaves the skull by the optic foramen and is distributed to the retina of the eye.

The *third* nerve, or motor oculi, leaves the skull by the sphenoidal fissure, and is distributed to all the muscles of the orbit except the superior oblique and the external rectus. It also sends branches to the ciliary muscle and the sphincter muscle of the iris.

The *fourth* nerve, trochlear or patheticus, leaves the skull by the sphenoidal fissure and supplies the superior-oblique muscle of the eye.

The *fifth* nerve, trifacial, or trigeminus, is both a sensory and motor nerve. It arises by two roots, a motor and a sensory. The gasserian ganglion is situated on its sensory root. A short distance from this ganglion the nerve divides into three branches: the ophthalmic, the superior maxillary and the inferior maxillary.

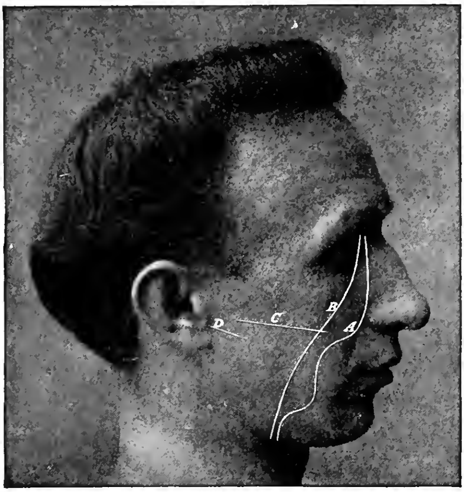


FIG. 24.—SURFACE MARKINGS OF THE FACE. *A*, facial artery; *B*, facial vein; *C*, Stenson's duct; *D*, facial nerve. (Campbell.)

The ophthalmic branch is a sensory nerve which leaves the skull by the sphenoidal fissure. It is distributed to the eyeball, lacrimal gland, mucous membrane of the eye and nose, and the skin of the forehead, eyebrow and nose. Its branches are the lacrimal frontal and nasal.

The superior maxillary branch of the fifth is a sensory nerve, which leaves the skull through the foramen rotundum. It is distributed to the temple, cheek, lower eyelid, nose, lip, upper teeth and the sphenopalatine ganglion. Its branches are the meningeal, orbital, posterior superior dental, middle superior dental, anterior superior dental, palpebral, nasal, labial and sphenopalatine.

The inferior maxillary division is both a motor and sensory nerve. It leaves the skull by the foramen ovale. Its motor fibers supply the muscles of mastication; its sensory fibers supply the teeth and gums of the lower jaw and the mucous membrane of the anterior two-thirds of the tongue. It also supplies the skin of the temple, external ear, the lower part of the face and lower lip. Its branches are recurrent, internal, pterygoid, masseteric, deep temporobuccal and external pterygoid. It also gives off the auriculotemporal, lingual and inferior dental. The otic ganglion receives a branch of the lingual nerve.

The *sixth* nerve leaves the skull through the sphenoidal fissure and supplies the external rectus muscle of the eye.

The *seventh* nerve, or facial, leaves the skull by the internal auditory meatus, passes through the aqueductus Fallopii and appears on the surface at the stylomastoid foramen.

The nerve is divided into branches of communication and branches of distribution.

The branches of communication are the following: (*a*) with the auditory nerve, (*b*) with Meckel's ganglion by the large superficial petrosal nerve, (*c*) with the optic ganglion by the small superficial petrosal nerve, (*d*) with the sympathetic by the external superficial petrosal nerve, (*e*) with the pneumogastric, (*f*) with the glossopharyngeal, (*g*) with the auriculotemporal and finally (*h*) with the auricularis magnus. All the above branches are given off in the aqueductus Fallopii. Branches under (*b*), (*c*) and (*d*) are given off from the geniculate ganglion. After its exit from the stylomastoid foramen, the facial nerve communicates with the three divisions of the fifth nerve and the cervical plexus.

The branches of distribution are as follows: Within the aqueduct it gives off the chorda tympani and the branch to the stapedius muscle. After leaving the stylomastoid foramen it gives off a posterior auricular, the stylohyoid and the digastric branches. On the face it is divided into a temporofacial and a cervicofacial branch.

The chorda tympani enters the cavity of the tympanum, passes through it and emerges from that cavity through the canal of Huguier. It joins the lingual nerve and is distributed to the mucous membrane of the anterior two-thirds of the tongue. The digastric and stylohyoid branches supply muscles of the same name. The terminal branches are distributed to the muscles of the face.

The *eighth* nerve, or auditory, is the nerve of hearing. It leaves the skull through the internal auditory meatus, and is distributed to the internal ear.

The *ninth* nerve, or glossopharyngeal, is the nerve of taste. It makes its exit from the skull by the jugular foramen. It communicates with the facial, pneumogastric and sympathetic nerves. Its branches of distribution are the tympanic, muscular (to the stylopharyngeus muscle), pharyngeal, tonsillar (to the soft palate and fauces) and two lingual branches.

The lingual branches are the most important, being distributed to the base and posterior half of the tongue.

The *tenth* nerve, vagus, or pneumogastric, has a more extensive distribution than any of the other cranial nerves. It is both motor and sensory. It is distributed to the organs of voice and respiration, the pharynx, stomach, esophagus and heart. It leaves the skull through the jugular foramen, and in this situation it exhibits an enlargement called the superior ganglion. After its exit from the foramen, the vagus is joined by the accessory portion of the spinal accessory nerve, and at the point of union is a second enlargement called the inferior ganglion.

Numerous branches are given off from this nerve and its ganglia. The most important branches are the superior and recurrent laryngeal nerves and the cervical and thoracic cardiac branches.

The superior laryngeal divides into the external and internal laryngeal. The external laryngeal supplies the cricothyroid muscle. The internal laryngeal is distributed to the mucous membrane of the larynx.

The recurrent laryngeal on the right side curves around the subclavian artery, and ascends to the larynx. On the left side it curves around the arch of the aorta and passes upward in a groove between the trachea and the esophagus to the larynx. The nerves supply all the muscles of the larynx except the cricothyroid muscle.

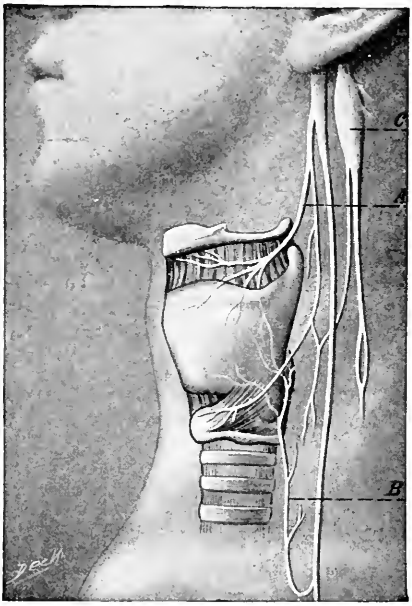


FIG. 25.—THE LARYNGEAL NERVES. *A*, superior laryngeal nerve; *B*, recurrent laryngeal nerve; *C*, superior cervical sympathetic ganglion. (Campbell.)

The *eleventh* nerve, or spinal accessory, consists of two parts, the accessory portion and the spinal portion. The accessory portion arises from the floor of the fourth ventricle. The spinal portion arises from the spinal cord as low as the sixth cervical nerve. This nerve leaves the skull through the jugular foramen. The accessory portion of the nerve is distributed to the pharyngeal and superior laryngeal branches of the pneumogastric. The spinal portion supplies the sternomastoid and the trapezius muscles.

The *twelfth,* or hypoglossal nerve, is the motor nerve of the tongue. It leaves the skull by the anterior condyloid foramen. It communicates with the pneumogastric, sympathetic, the lingual and the first and second cervical nerves. Its branches of distribution are the meningeal, descendens hypoglossi, thyrohyoid and muscular branches.

The descendens hypoglossi joins the communicating branches from the second and third cervical nerves to form a loop called the ansa hypoglossi. From this loop branches are given off which supply the sternohyoid and the omohyoid.

The thyrohyoid branch supplies the thyrohyoid muscle.

The muscular branches supply the styloglossus, hyoglossus, geniohyoid, and the geniohyoglossus muscles. The intrinsic muscles of the tongue are also supplied by these branches.

The Spinal Nerves

The spinal nerves are arranged in pairs, of which there are usually thirty-two. Each nerve arises by roots from the spinal cord and emerges from the spinal canal through the intervertebral foramen. Each nerve appears below the corresponding vertebra, except the first cervical, which passes out of the spinal canal between the skull and atlas. There are eight cervical nerves, twelve thoracic, five lumbar, five sacral and one coccygeal. The last nerve is occasionally absent.

After emerging from the intervertebral foramen, each nerve divides into an anterior and a posterior division after giving off a small recurrent branch.

The posterior divisions are distributed to the skin of the back of the trunk, back of the head, shoulder, buttock, and to the muscles of the back, but not to the muscles of the limbs.

The anterior divisions, with the exception of the first two cervical nerves, are much larger than the posterior divisions. They supply the neck, front and sides of the trunk and the extremities, uniting in various regions to form plexuses from which important nerves originate. Each is connected by a filament with the sympathetic.

THE DIGESTIVE SYSTEM

Under this head will be described the alimentary canal, digestive glands and accessory parts.

The alimentary canal consists of the mouth, pharynx, esophagus, stomach and the small and large intestines.

The digestive glands include the liver, pancreas and the salivary glands.

The salivary glands, of which there are three pairs,—parotid, submaxillary, and sublingual,—are placed about the face and secrete saliva which passes into the mouth through the ducts of these glands. The liver, placed in the abdominal cavity, secretes the bile which is conveyed into the duodenum by the bile duct. The pancreas secretes the pancreatic juice which flows through the pancreatic duct into the duodenum.

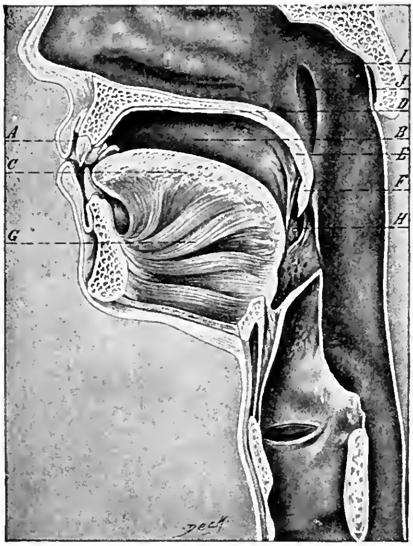


Fig. 26.—Vertical Section of Mouth and Pharynx. (After Deaver.) *A*, vestibule; *B*, cavity of mouth proper; *C*, tongue; *D*, hard palate; *E*, soft palate; *F*, uvula; *G*, geniohyoglossus muscle; *H*, tonsil; *I*, nasopharynx; *J*, orifice of Eustachian tube. (Campbell.)

The accessory parts include the teeth, tongue, gums and palate.

The Mouth

The mouth is the upper expanded part of the alimentary canal. The following parts of the mouth may be distinguished: the aperture, placed between the lips; the vestibule, which is the space between the teeth internally and the lips externally; the cavity of the mouth, which is bounded by the teeth externally and in front, and which opens behind into the pharynx.

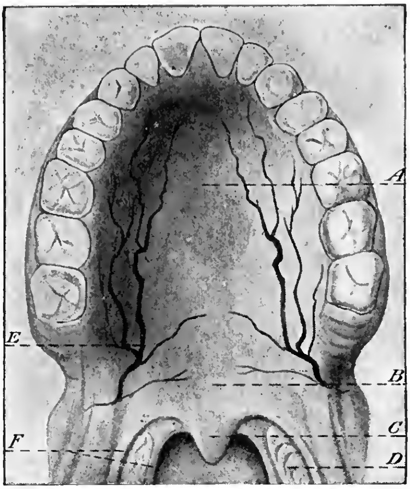


Fig. 27.—Palate and Alveolar Arch. *A*, hard palate; *B*, soft palate; *C*, uvula; *D*, tonsils; *E*, posterior palatine artery; *F*, anterior and posterior pillars of fauces. (Campbell.)

The cavity of the mouth is placed within the dental arches. Its roof is formed by the hard and soft palate, while the floor is occupied by the tongue. By raising the tongue, the sublingual region is exposed, and in the middle line under the tongue is a fold called the frenum. On either side of the frenum may be seen the opening of Wharton's duct of the submaxillary gland.

On the other side of the wall of the vestibule, opposite the second upper molar tooth, is seen the opening of Stenson's duct, which conveys the saliva from the parotid gland.

The Palate

The palate is the arched structure which forms the roof of the mouth. Its anterior portion is formed of bone and separates the nose from the mouth. The posterior part, the soft palate, is composed of two layers of mucous membrane between which are the palatine muscles, vessels and nerves. The soft palate separates the nasal pharynx above, from the mouth and oral pharynx below. The posterior margin is free and terminates in a projection, the uvula. On each side of this there extends outward a pair of ridges, the anterior and posterior pillars of the fauces. Between these pillars is placed the tonsil.

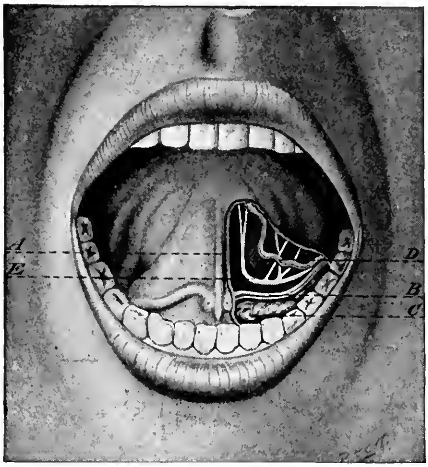


FIG. 28.—THE UNDER SURFACE OF THE TONGUE. *A*, frenum; *B*, Wharton's duct; *C*, sublingual gland; *D*, ranine vein; *E*, lingual nerve. (Campbell.)

The Tongue

The tongue is the organ of taste. It is composed of muscle, is covered with mucous membrane and is supplied with blood vessels, lymphatics and nerves. Its base is attached to the hyoid bone and to the epiglottis by the three glosso-epiglottic folds of mucous membrane. Its tip is free and rests against the lower incisor teeth. Its under surface is connected with the lower jaw by the geniohyoglossal muscles.

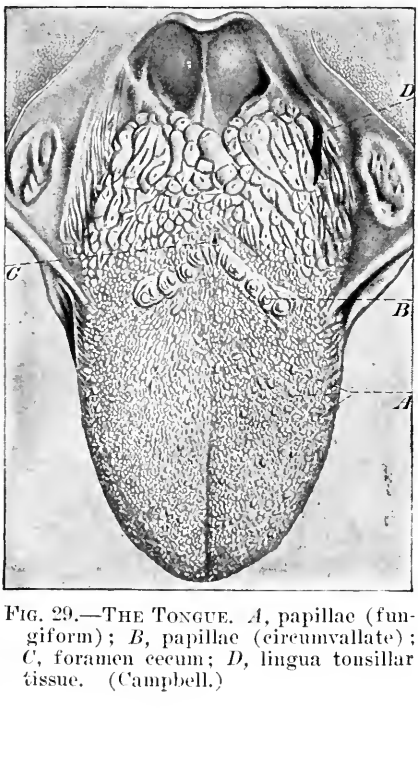


FIG. 29.—THE TONGUE. *A*, papillae (fungiform); *B*, papillae (circumvallate); *C*, foramen cecum; *D*, lingua tonsillar tissue. (Campbell.)

The tongue is divided into two halves by a median septum which terminates posteriorly in a depression, the foramen cecum, a short distance from the base of the tongue.

The mucous membrane on the dorsum of the tongue is covered with elevations called papillae. They are of three varieties: (*a*) filiform papillae are the smallest and are distributed over the anterior two-thirds of the tongue; (*b*) fungiform papillae are larger and less numerous than the filiform and are found near the tip and margins of the tongue; (*c*) the circumvallate are the largest of all the papillae and are arranged in the form of a "V" on the posterior part of the dorsum of the tongue.

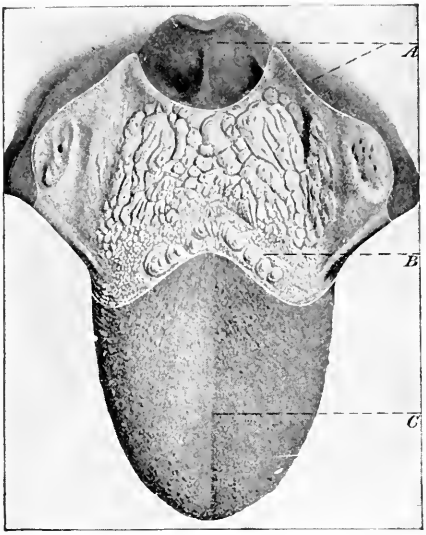


Fig. 30.—Areas of Nerve Distribution on the Surface of the Tongue. *A*, areas supplied by the internal laryngeal nerve; *B*, area supplied by the glossopharyngeal nerve; *C*, area supplied by the lingual nerve. (Campbell.)

The chief artery of the tongue is the lingual. The dorsalis linguae is distributed to the pharyngeal surface of the tongue together with the tonsillar branch of the facial.

The nerves of the tongue are: (*a*) the hypoglossal, which is the motor nerve of the tongue; (*b*) the lingual nerve, which, with the chorda tympani branch of the facial, supplies common sensation to the anterior two-thirds of the tongue; (*c*) the glossopharyngeal nerve, which sends its branches to the circumvallate papillae and the mucous membrane behind these papillae. This is the nerve of taste; (*d*) the internal laryngeal nerve, which also sends a few fibers to the posterior part of the base of the tongue.

The Salivary Glands

The salivary glands include the parotid, submaxillary and sublingual glands.

The parotid gland extends from the zygoma to the angle of the jaw and backward to the sternomastoid muscle. Internally it lies on the styloid process and anteriorly it is continued over the surface of the masseter muscle. The parotid, or Stenson's duct, leaves the facial process of the gland, crosses the masseter muscle and pierces the buccinator muscle. It opens into the mouth by a small orifice opposite the second molar tooth.

The arteries which supply the glands are branches from the external carotid. Traversing the substance of the gland are found: (*a*) temporomaxillary vein; (*b*) the branches of the facial nerve; (*c*) the external carotid artery which divides into its two terminal branches in the gland substance.

The submaxillary gland is placed in the submaxillary triangle partly under cover of the lower jaw. The deep surface lies on the myohyoid muscle, and behind this on the hyoglossus muscle. From the deep surface of the gland, a deep process passes forward beneath the myohyoid muscle with the duct. The submaxillary, or Wharton's duct, runs forward beneath the floor of the mouth. It opens on the floor of the mouth at the side of the frenum of the tongue.

The sublingual gland is placed in the floor of the mouth between the lower jaw externally and the geniohyoglossus muscle internally, and the myohyoid muscle below. Its ducts are called the ducts of Rivinius. They leave the upper part of the gland and open on a series of papillae which are placed along the summit of the plica sublingualis. This gland is supplied by branches of the lingual and facial arteries.

The Teeth

The teeth which begin to appear in the infant at about the sixth month, are called the temporary teeth, while those which succeed them in the adult are the permanent teeth.

The temporary teeth are twenty in number. In each jaw, beginning at the median line, there are two incisors, one canine and two molars.

The permanent teeth are thirty-two in number. In each jaw, beginning at the median line, there are two incisors, one canine, two bicuspids and three molars.

The Pharynx

The pharynx is placed behind the mouth, larynx and the nasal cavities. It extends from the base of the skull to the sixth cervical vertebra, where it passes into the esophagus. It is about five and a half inches in length.

In front of the pharynx are the nasal cavities, the mouth, the base of the tongue and the larynx. Behind the pharynx are the six upper cervical vertebrae covered by the vertebral muscles and fascia. Laterally are placed the carotid sheaths. Superiorly the pharynx is attached to the basilar process and below it joins the esophagus.

The pharynx presents seven openings through which it communicates with the neighboring cavities. On the anterior wall are the two posterior nares, the opening into the mouth, and the orifice of the larynx. On the sides of the nasopharynx are the pharyngeal orifices of the eustachian tubes. Behind each eustachian tube is a recess, the fossa of Rosenmuller. Below, the pharynx opens into the esophagus.

The Esophagus

The esophagus intervenes between the pharynx and the stomach. It extends from the lower border of the cricoid cartilage opposite the sixth cervical vertebra, to the cardiac opening of the stomach opposite the eleventh dorsal vertebra. It first lies in the neck, traverses the thorax, and, piercing the diaphragm, joins the stomach. It is about ten inches in length and about three-quarters of an inch in diameter. It presents two constrictions, one at the beginning, the other where it is crossed by the left bronchus.

In the neck it lies behind the trachea and in front of the vertebrae. Laterally are placed the carotid sheaths and the lateral lobes of the thyroid gland. In the thorax the esophagus passes through the superior and posterior mediastinal spaces.

HISTOLOGY

The digestive apparatus consists of a muscular tube that passes through the body, the function of which is to receive food materials and fit them for use in the body economy. In this process it is aided by certain glandular elements, which secrete the fluid solvents by which the disintegration of the food is accomplished, and certain absorbent elements by which the nutrient materials, products of the transformed food, are taken up by the circulation and appropriated by various parts of the body.

This tube opens at each end of the body: at the upper part on the oral cavity, and at the lower extremity in the anus. At certain points in its course it is in communication with special accessory glands, which act by pouring into the tube some element to aid in the digestive process, or by receiving or further elaborating the products of digestion, as for example, the liver, pancreas, and lymphatic system.

Oral Cavity

The digestive tract begins with the oral cavity. This cavity contains the teeth and tongue. The teeth are for the purpose of dividing the food into smaller fragments, while the tongue serves as a mixer of food and an organ of taste and tactile sensation.

Besides these, the submucous tissue of the mouth contains glands that supply the fluid which, mixed with the food, softens it and renders it susceptible to the action of the digestive fluids. These glands are known as salivary glands. There are three pairs,—the parotid, submaxillary, and sublingual. In addition there are numerous minute glands in the tissue of the tongue and mucous surface of the cheeks and lips, which also contribute their products to the salivary fluid of the mouth.

Mucous Membrane of the Oral Cavity.—The mouth is lined by a mucous membrane consisting of two layers. The surface layer consists of stratified pavement epithelium, already described, and beneath the epithelial surface lies the stratum proprium, or tunica propriae, which is composed of fibrous connective tissue in which the various glands are situated. This structure is the submucous connective tissue. This whole structure very closely resembles the skin. The pavement epithelium is stratified in the same way, the difference being in the absence of the stratum granulosum and lucidum, and the fact that the upper layers are not hornified and have not lost their nuclei. The similarity is still further observed in the formation into papillae of the stratum proprium, which represents the dermis of the skin. These papillae project into the epithelial surface and are larger or smaller according to situation. On the red margin of the lips the papillae are very high, while on the rest of the mucous membrane of the lips and cheeks they are low and broad.

The Salivary Glands

These glands of the mouth belong to the saccular, or racémose variety of glands, and furnish two kinds of secretion to the saliva: a serous, or albuminoid, and a mucous secretion. The serous secretion is a thin fluid having in its composition certain ferments which are specific products of the gland cells. The parotid glands furnish only a serous secretion; the sublingual and submaxillary are mixed glands and furnish both serous and mucous fluids to the saliva.

Salivary Cells.—The cells of the two kinds of glands differ in structure and appearance. The mucous cells when filled with secretion are clear and relatively larger. Their clearness is due to large quantities of clear globules of mucin contained in their substance. When the cells are full of secretion the nuclei are crowded back to the base of the cell. In the submaxillary and sublingual glands are found two kinds of cells: the clear cell, and a smaller, granular cell. The clear cell is the mucous, and the granular one is the serous cell. There are also at the outside of the alveoli numerous crescent-shaped cells known as the semilunes or crescents of Oianuzzi.

Secretion.—When the mucous cell has discharged its load of mucus, it becomes smaller and very much more granular. In the serous cells the protoplasm is, at one state of its activity, so crowded with granules that the nucleus is obscured, but after the discharge of the secretion, the cytoplasm is comparatively clear. The granules represent the material in the protoplasm which becomes the specific product of the gland cell. The ducts of the glands are lined by columnar epithelium and these cells have at their bases stripes, which pass from the base of the cell to its center, while the balance of the cytoplasm toward the lumen is granular. These ducts furnish a secretion to the product of the gland, and it may be that the stripes are broken into granules, and these, in turn, discharged from the cell to form a part, at least, of the secretory product.

It will be remembered that the pancreatic cell has somewhat the same structure, and the suggestion was made that these structural elements contribute in this way to the formation of the gland secretion.

The duct of the parotid gland is known as Stenson's duct; that of the submaxillary is called the duct of Wharton; while that of the sublingual is called the duct of Bartholin. The parotid opens into the oral cavity, opposite the superior molar tooth; while the ducts of the two latter glands, the submaxillary and sublingual, unite in a single opening under the tongue, directly posterior to the lower incisors.

The Tongue

This organ is composed of voluntary muscle, the fibers of which pass in various directions through its substance. Between the bundles of muscular fibers is found a greater or less quantity of areolar connective tissue, which serves as a supporting medium for numerous racemose glands, blood vessels and nerves. The surface of the organ is covered by stratified pavement epithelium which rests upon a layer of areolar connective tissue, forming the submucous areolar tissue corresponding to the dermis of the skin. In this submucous layer are found most of the blood vessels, lymphatics, and many of the nerve trunks, together with some lymphoid tissue.

Papillae.—The surface of the tongue is elevated into a series of papillae. The projections are sharp and pointed, or low and broad, according to situation. Some, attached at the base of the tongue, are surrounded by a deep depression and are called circumvallate papillae. On the sides of these latter structures are certain groups of specialized epithelial cells known as taste-buds. They belong to the so-called neuro-epithelium. Collections of lymph cells, resembling the solitary follicles, are found in the submucous connective tissue of the tongue papillae.

The Teeth

These organs of mastication are situated on the ridges of the superior and inferior maxillae. The larger portion of these organs, the root, is embedded in the alveolus of the jaw, while the upper third stands above the mucous tissue, known as the gum, and is called the crown.

Structurally the tooth consists of four parts, three of which are hard, bone-like materials, while the fourth is composed mostly of connective tissue. The hard parts of the tooth are the enamel, which covers the crown, the dentin, which makes up the bulk of the root, and the cementum, which covers the external surface of the root and comes in contact with the tissues of the jaw in which the tooth is embedded. The center of the tooth is occupied by the pulp, which is contained within the central cavity, known as the pulp-chamber.

The Enamel.—It consists of a series of rods or prisms, pointed at both ends and thickened in the center, which are laid together, their tapering ends overlapping. These prisms are put together in such a way that their long diameter is directed toward the surface, and are marked by a series of transverse striations. The enamel is the hardest substance in the body, and consists of inorganic or mineral substances, mostly phosphate, the prism being held together by a very small amount of organic substance called cement, so small indeed that it can hardly be demonstrated.

The Dentin.—This constituent of the tooth, which is known as ivory, is made up of a series of minute tubes embedded in a matrix of bone-like material. These tubes, known as the dentinal tubuli, pass through the substance of the dentin to the enamel of the crown, and to the cementum on the root. They are larger and farther apart at the pulp-chamber and very much branched as they pass toward the periphery. At the outer surface, or periphery of the dentin, they open into a series of irregular spaces known as the interglobular spaces.

The Cementum.—This substance, which is a true bone, forms a thin layer which covers the root of the tooth from the point where the enamel joins the dentin. It has lacunae and canaliculi as true bone, and like it is covered by a membrane which serves in the double capacity of a lining to the process in the jaw in which the tooth stands, the alveolar process, and a periosteal covering to the cementum. This membrane, the peridental membrane of the old histologists, is known as the alveolodental periosteum.

The Pulp.—The dental pulp occupies the pulp-chamber and sends an extension through a canal, which extends throughout the length of the root of the tooth and is known as the root canal. It is composed of a matrix of connective tissue in which are embedded an artery, vein and nerve. At the periphery is situated a membrane composed of large, oval cells with conspicuous nuclei. These cells are known as odontoplastic cells. They send processes through the dentinal tubuli, known as the dentinal fibrils, which pass through the tubuli and fill the interglobular spaces with their protoplasm. It is said by some authorities that there are no lymphatic vessels in the tooth-pulp. It seems to the writer that this statement grows out of an inadequate knowledge of the structure and function of connective tissue.

The lymphatic system, as stated elsewhere, has its origin in the connective tissue, or lymph spaces. These spaces are filled with lymph from the blood which must be disposed of somewhere. The question of lymphatics in the connective tissue of the pulp has not been investigated by anyone whose authority is of such standing that it can be accepted without question, and we must wait for further knowledge before deciding the question. Meanwhile we shall speak of lymphatics in the pulp as we do of like tissue elsewhere. Although there may be no true lymphatic vessels demonstrable in the pulp, it is conceivable that the lymph spaces in the connective tissue may function as such, just as they do in the voluntary muscle where a like condition exists.

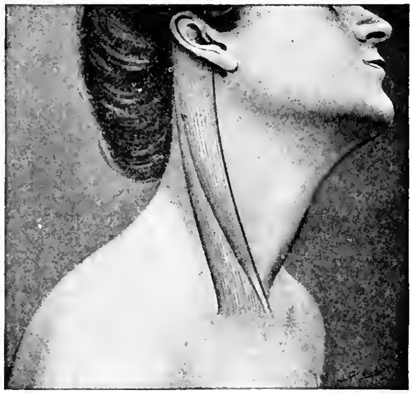


FIG. 31.—THE PRIMARY CERVICAL TRIANGLES FORMED BY THE STERNOMASTOID MUSCLE. (Campbell.)

THE REGION OF THE NECK

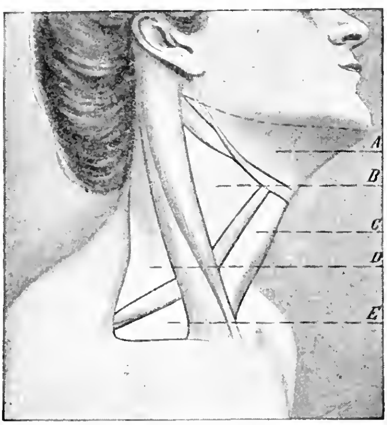


FIG. 32.—TRIANGLES OF THE NECK. *A*, submaxillary triangle; *B*, superior carotid triangle; *C*, inferior carotid triangle; *D*, occipital triangle; *E*, supraclavicular triangle. (Campbell.)

The arrangement of the muscles on the side of the neck is such that they are divided into a series of triangles. For descriptive purposes the lateral aspect of the neck may be regarded as a quadrilateral space, the upper boundary being the lower border of the jaw and a line extending from the angle of the jaw to the tip of the mastoid. The lower boundary is formed by the clavicle, the sides of the median line of the neck in front, and the trapezius muscle behind. This space is divided into two by the sternomastoid muscle, which runs diagonally from the mastoid to the sterno-clavicular joint. In this way the two primary triangles are formed. The anterior triangle is crossed obliquely

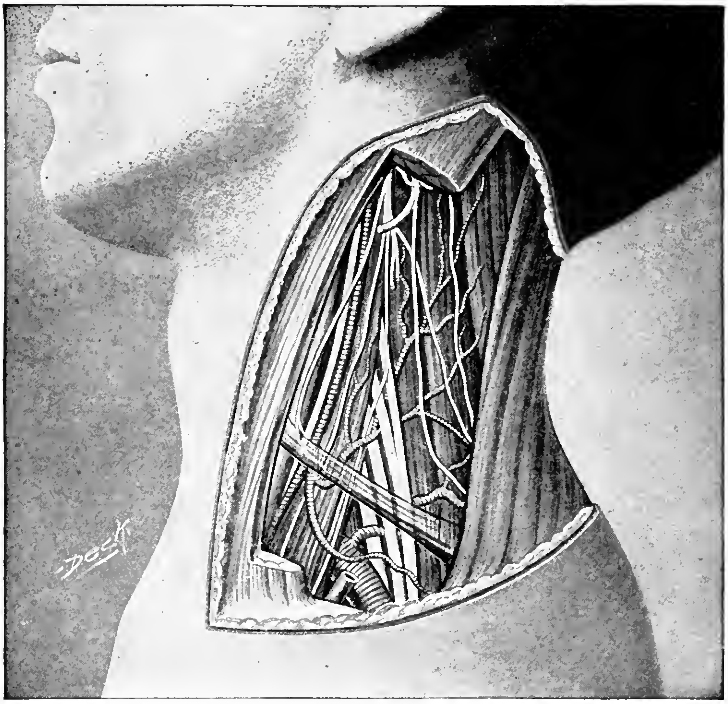


FIG. 33.—THE OUTER REGION OF THE NECK, SHOWING THE OCCIPITAL AND SUPRACLAVICULAR TRIANGLE. The omohyoid is indicated semitransparently. (Campbell.)

by the digastric muscle above, and by the anterior belly of the omohyoid below, and is thus divided into three triangles; the submaxillary, and the superior and inferior carotid triangles. The posterior triangle is divided by the posterior belly of the omohyoid into an occipital and subclavian triangle. In addition to the regions covered by these triangles there is the median visceral region extending from the hyoid bone to the sternal notch.

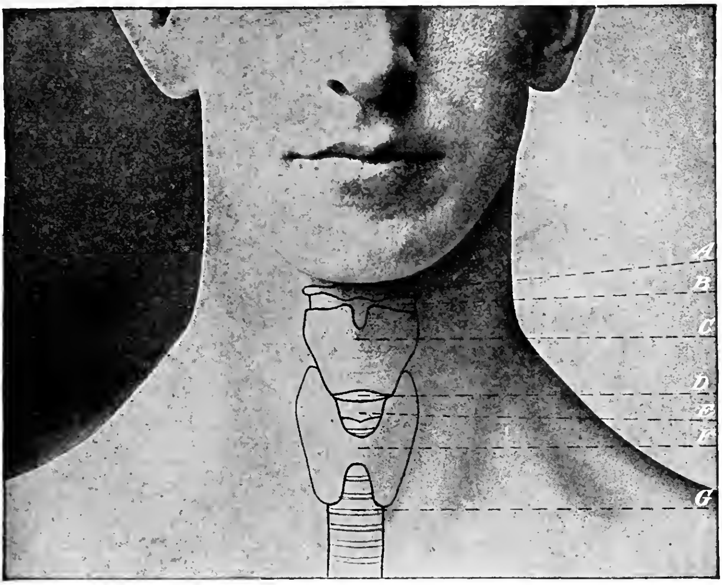


FIG. 34.—SURFACE MARKINGS OF THE ANTERIOR PART OF THE NECK. *A*, hyoid bone; *B*, thyrohyoid membrane; *C*, thyroid cartilage; *D*, cricothyroid membrane; *E*, cricoid cartilage; *F*, thyroid isthmus; *G*, trachea. (Campbell.)

THE VESSELS OF THE NECK

The common carotid artery takes its origin from the innominate artery on the right and from the arch of the aorta on the left. In the neck the course of the artery is indicated by a line drawn from the sternoclavicular joint to a point just in front of the mastoid process. It extends from the sternoclavicular articulation to the upper border of the thyroid cartilage, where it divides into the external and internal carotid. The common carotid gives off no branches in the neck and is always in an intimate relation with the sternomastoid muscle. It is contained in a sheath together with the internal jugular vein and pneumogastric nerve.

The internal and external carotid arteries are the terminal branches of the common carotid which divides opposite the upper border of the thyroid cartilage. At their origin they lie side by side in close relation to the jugular vein. The internal carotid gives off no branches in the neck but is distributed to the brain and the eye. The external carotid is the smaller of the two terminal branches supplying the face and the soft parts covering

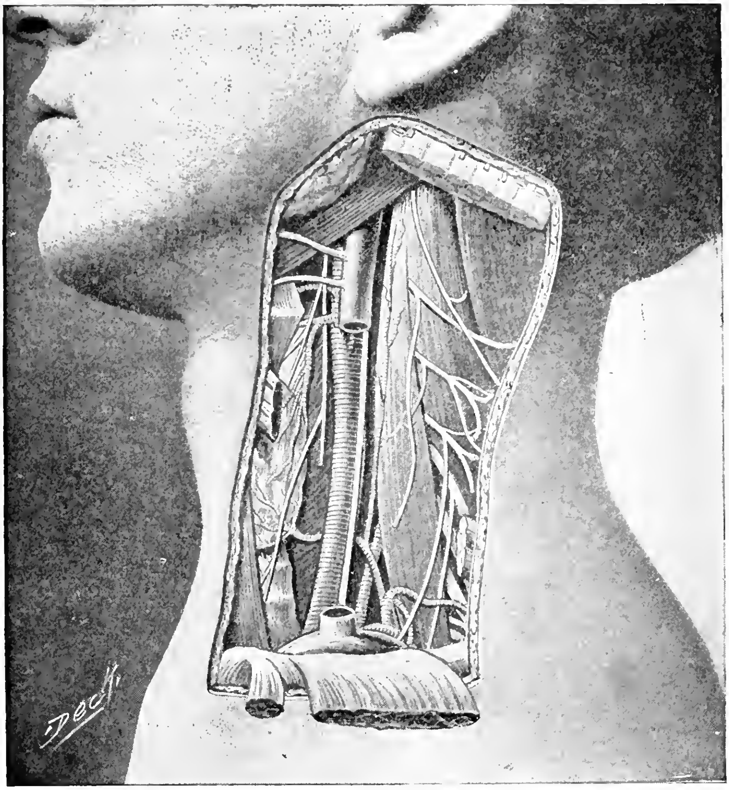


FIG. 35.—THE CAROTID REGION AND THE CHIEF STRUCTURES. Note the relation of the internal jugular vein, the common carotid artery and the pneumogastric nerve. (Campbell.)

the vault of the cranium. Its branches are the superior thyroid, lingual and facial arteries which supply the thyroid gland, tongue and face respectively. Posteriorly it gives off the occipital and posterior auricular arteries. Superiorly it gives off the internal maxillary and super-

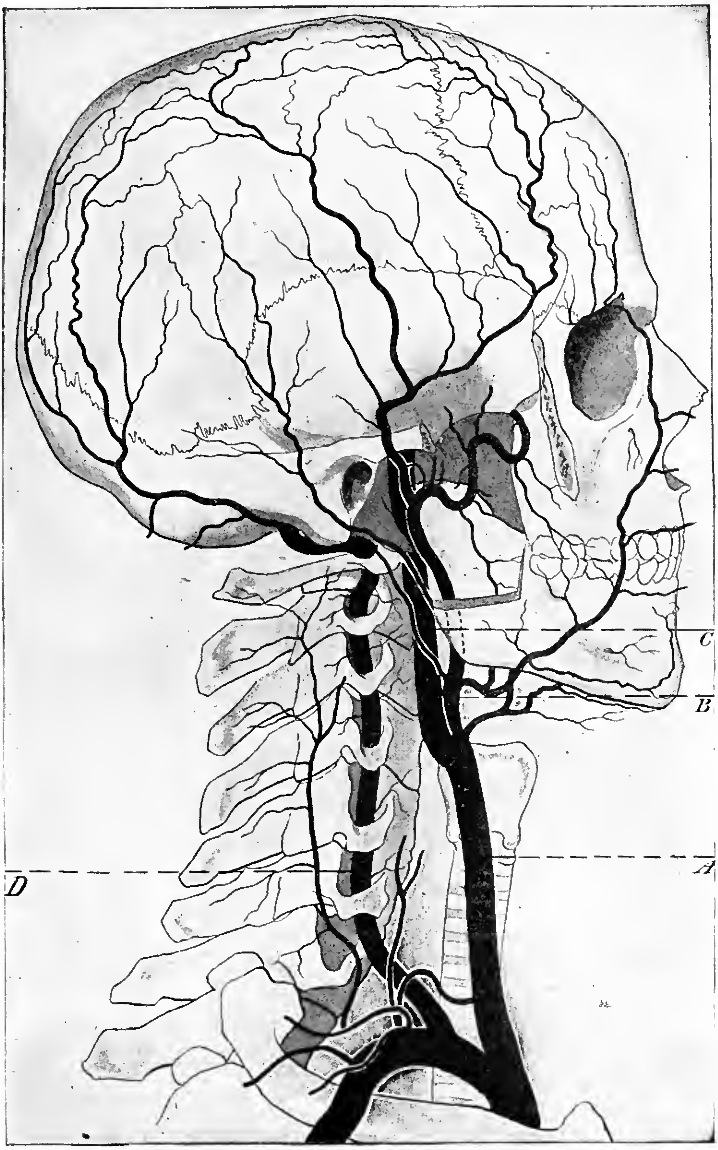


FIG. 36.—THE CHIEF ARTERIES OF THE NECK. (Deaver, modified.) *A*, common carotid; *B*, external carotid; *C*, internal carotid; *D*, vertebral. (Campbell.)

ficial temporal arteries. There is also a small trunk known as the ascending pharyngeal artery.

The internal jugular vein takes its origin at the base of the cranium, where it receives practically all the blood from the cranial cavity. It is always in close relation with the carotid arteries and pneumogastric nerve. Surgically it is of very great importance, as its large size and thin walls render it especially liable to injury.

CHAPTER II

RECENT ADVANCES IN PHYSIOLOGY

George Van Ness Dearborn, A. B., M. D., Ph. D.

INTERNAL SECRETION

Scope of Chapter.—The object of this chapter is to set forth the recent physiological advances that have been made. Their order has no significance. Of course every one knows that general physiology includes everything from the soles of the feet to the top of the head, but by far the most important studies made in physiology in the past ten years have related to the internal secretions. There has perhaps been more research of importance along this line of the internal secretions than in any other one. The term *ductless gland* might perhaps better be used.

Ductless Glands.—The very fact that these glands are ductless implies that their products are absorbed into the circulation instead of passing out into some body cavity. More physiological researches have been conducted upon these glands than with regard to any other organ, because they have been found to have far more to do with the conduct of the body than was formerly supposed. To have to treat of the subject of the ductless glands in a superficial way is very unsatisfactory because so many researches have been made, under the most complex conditions, that oftentimes the present apparent results are highly contradictory. It is perfectly possible to encounter ten or fifteen didactic statements, of great interest, made by reliable workers about the functions of the ductless glands, only to find these statements contradicted by equally eminent authority. That is happening all the time, and there is scarcely anything in regard to the physiology of the ductless glands that could be said didactically of which the reader cannot find a contradiction made by some good research authority. Consequently, although of immense interest in some ways to military dentists, it is difficult to make definite statements regarding the hormones, save in a few minor particulars, with which the reader is already more or less familiar.

Hormones and Koliones

Some of these internal secretions, or hormones and koliones, will now be briefly considered, the hormones being actuating products and the koliones (or "chalones") inhibitory in their effects.

Adrenalin.—In the first place *adrenalin* will be mentioned. There are four or five substitutes or synonyms for that word. It is the product of the cortex of the adrenal gland, which most physiologists used to call the suprarenal capsule. There is here the same substance producing contradictory effects,—a very small amount producing contraction and a still smaller dose relaxation of the smooth or vegetative muscle. This is a good example illustrative of the difficulty of dealing even with the most certain and longest known of the internal secretions. A certain amount of adrenalin constricts, and a smaller amount relaxes, the smaller arteries.

Adrenalin in Fatigue.—Professor Cannon, who is at present engaged in research work in France on an internal secretion in relation to shock, pointed out that this substance does away very largely with signs of fatigue.

He showed by actual experiment that adrenalin injected into the veins of a fatigued animal would rest that animal in five minutes as much as two hours of natural rest.

Just how this resting effect is brought about remains to be shown. Very likely it has something to do with the nutrition of the nerve cells. That is very important, but still vague.

Effect on Blood Composition.—Another thing with which adrenalin has to do is the coagulation of the blood. Moreover, it brings about in some way an increase of dextrose in the blood. In general, these various functions of the adrenal glands are all related to the *dynamic aspects* of the animal and to the amount of energy which it can expend. Adrenalin, then, is the index of emotional bodily power. The coagulation of the blood is a necessary thing for an animal about to go into combat, for in a good old-fashioned cat-fight blood flows freely. Under these clamorous conditions it is necessary for the blood to coagulate promptly, the more surely to save the animal from bleeding to death. All these results mentioned are means of increasing the possible energy-expenditure on the part of the animal. That on the whole is one of the most important contributions to physiology in the last few years. The cortex of the suprarenal capsules has much to do with the fitting of the blood for unusual muscular exertion.

Thyroid.—The secretion of the *thyroid* ("colloid") is probably familiar to all. The older work has been corroborated. There are one or two new things, one being the possible relation of colloid to tooth-anabolism. The nervous conditions known as Graves' disease, and myxedema, are known of old and need merely to be mentioned here.

Parathyroids.—The *parathyroids* have recently been studied with some effect. These are four glands no bigger than the end of the thumb, situated on each side of the thyroid in the neck, and so closely adherent to the thyroid that it was not realized at first that they were not part of it. The parathyroids seem to be concerned with the metabolism of the bone in some way, but just in detail what that relationship is remains to be seen. When the parathyroids are diseased the bones and the teeth become soft, and thus lack the normal characteristics of ordinary bone.

Hypophyseal or Pituitary Body.—The same is true of the *hypophysis* or *pituitary body.* The pituitary is concerned in some important way with the metabolism of lime (calcium), so that the bone is affected when the pituitary is deranged. Dr. Harvey Cushing, the director of the Peter Bent Brigham Hospital here in Boston, at the present time is a research authority on the structure and functions of the pituitary; but here again there are doubts.

Epiphyseal or Pineal Body.—The *pineal* gland, or *epiphysis,* has recently been studied, and is now known to be a depressor of the blood pressure, for one thing, and acts by lowering arterial tension. The blood pressure and the trophic processes are deranged when the pineal gland is thrown out of working order. This gland is famous as the minute structure in which the French philosopher Descartes, of the early 17th Century, located the human soul!—an illustration of the absurdity to which man sometimes will go in the hope of systematizing things under the compulsion of "authority."

Secretions of Ovary and Testis.—The *ovary* and the *testis* have internal secretions. It is now known that these secretions have to do with muscular vigor, to a considerable extent, both directly and indirectly. They are concerned in muscular development, too. A boy, for example, ten years of age cannot be trained in a physical sense at all. His muscles are incapable of the growth and hardness which are seen when a man's muscles are properly trained. The reason is that the organism at that early age lacks the internal secretions of the testis which they will have later. The same is true of the ovaries of the female. The *corpus luteum vera* of the ovary is now to be had in tablet form and is of very great importance in some nervous conditions of the menopause, and in some other conditions of deranged reproductive function.

Secretion of Pancreas.—The *pancreas* also has an internal secretion. There is no one "mix-up" which is more complicated than the exact relations of the pancreas to the thyroid, etc., in the metabolism of sugar. It is in some way related to diabetes, and to the presence of sugar in the urine, but just what that relationship is, is not accurately known as yet.

Secretion of Thymus.—The *thymus*, which is at its height in the child at the age of two years, has an important secretion. One of the most suggestive of recent discoveries is that the thymus is an inhibitor of the development of the sexual apparatus. Occasionally one finds one of these extremely sad cases of a child becoming a woman at the age of five, with perfectly developed reproductive mechanism. In these cases one always finds that the thymus gland is more or less diseased. The thymus therefore seems to be an inhibitor of the development of the reproductive apparatus; and it also apparently has to do with adenoid tissue. It is related in its action somehow especially to the epiphysis.

Other Probable Secretions.—The *carotid glands*, back of the carotid arteries, have an internal secretion. The *spleen* perhaps has an internal secretion. The *prostate* has an erotic internal secretion. The *kidney* has a vasomotor internal secretion, perhaps. Thus it may be seen what a large number of these internal secretions there are. A number of them are interrelated, and Cannon and his colleagues in the Harvard Physiological Laboratory are engaged in working out their relationships.

Professor Cannon, it is rumored, has made an important discovery in regard to the abolition of shock. It is said that he has discovered how an internal secretion may abolish "surgical" shock, and if it be true, of course it is one of the most important discoveries of recent decades.

METABOLISM

Advances in Dietetics.—Another important advance that has been made in physiology relates we will say to *dietetics,* although these matters should not strictly be spoken of as discoveries at all. But there has been a recent cohering and intercorrelation of practical dietetic facts and principles. The best the writer can do here is to give his opinion at random of some of the more important conclusions that have come out of recent research and its application. There is general feeling, for one thing, that perhaps the best rule in regard to the use of protein is to eat meat only once a day. That is an easy rule for everyone to learn, for anyone can remember a simple rule like "meat once a day." Under meat are included eggs and fish, for, as the reader knows, fish-meat is much like flesh-meat, except that it contains somewhat more water and less fat. This is the modern opinion as to the use of protein in the human diet.

Vitamines.—"Vitamines" recently have excited a good deal of popular attention; in fact, they have been made a fad of when, physiologically speaking, there is no reason for it. The vitamine "problem" is of no practical importance to the majority of ordinary people, for those who have money enough to buy even a reasonable all-round diet have a simple means of acquiring all the vitamines they need, as vitamines are found in all ordinary foods in abundance. This question, then, like many others, is a purely academic problem, except in very exceptional cases. Chinamen who are so poor, and some of the poorer "white trash" in the South who are so trashy that they have not been able to get anything except rice to eat, have sometimes suffered from a fatal disease called beriberi; and this has apparently been traced to the absence of certain substances found in the coverings of the grain. Victims of beriberi lived on polished rice with *all* the coverings removed, made so "good" and so "pure" that it was too angelic for normal human use. The problem, then, of vitamines is not one of any practical account for ordinary dietetics. The vitamines appear to be complex lipoidal substances, partly fat and partly protein, the lack of even minute quantities of which gives rise to certain severe derangements of the nervous system. Vitamines are found in all grains, in most vegetables, in all kinds of meat, so that a person living on a mixed diet, however inexpensive, is sure to have an abundance of vitamines. The word has become a fad. The subject of vitamines has become so familiar in the medical profession that it has long since ceased to excite comment.

Obesity.—Obesity has attracted a good deal of attention recently. The importance of not becoming obese has been emphasized in some quarters. It is perfectly obvious to physiology at the present time that to be obese is to put a mortgage at high interest both on happiness and on life-expectation; and there is no need of it. Modern physiology knows how to suggest a diet combined with exercise which will keep anyone from becoming overweight as long as his internal arrangements, hormones and koliones especially, are in good working order.

Villi of Small Intestine.—In relation to the diet, a word would not be amiss here in regard to the movements of the *villi* of the small intestine. In the small intestine of the human animal there are about 4,000,000 villi and these are now known to have actual muscular pumping movements of their own. It has become obvious that there may well be some sort of arrangement between this action of the villi and the adapted nutrition of the nerve cells.

CENTRAL NERVOUS SYSTEM

Unmedullated Nerve Fibers.—Another thing in relation to the nervous system, the fourth point in this fragmentary summary, was demonstrated recently by Professor S. W. Ransom of the Northwestern University Medical School. He has shown that for the most part the unmedullated fibers of the nervous system, part of the sympathetic nervous system, are undoubtedly protopathic sensory nerves. They represent the sensations, painful and otherwise, caused by the compression and distentions of the viscera. When a person eats eight green apples against urgent advice, in the course of four or five hours he will have a "pain in his stomach"—where it really ought to be! That pain is caused by the undue irritation of these unmedullated fibers of the autonomic nerves. The writer's chief interest in this matter is psychological, for it is clear that these fibers are in part the channels of supply of the subconscious aspect of the mind. For some years it has seemed that the subconscious mind is activated by subsensory impulses, those which are not felt. This physiologist at the Northwestern University, without any probable interest in this matter at all, has proven that these unmedullated fibers are afferent or sensory nerves.

Cortex of Brain.—The cortex of the brain undoubtedly is a unit in its action. It appears not to be divided into contiguous horizontal areas as was thought, as a remnant of Goll's phrenology; on the other hand the cortex of the brain probably acts as a unit in some sense. At least ten thousand million neurons compose its network of connecting pathways, but it appears more and more certain that they always act more or less in some kind of interdependent unison.

Brain Cortex as an Inhibitory Organ.—The cortex of the brain has a chief function as an inhibitory organ. One thinks more and more of the human cortex as an inhibitory or restraining fabric whose office it is to keep under control and to adapt the urgent impulses of the remainder of the nervous system. The result in actual social life whenever the cortex is seriously injured so that its inhibitory control is shut off, as in intoxication, is to make an animal of even a cultured human being. The controlling impulses come then from the spinal cord, and the human being degenerates for the time into what is practically a brute animal. This line of argument makes one believe that the cortex of the brain properly is an inhibitory nervous organ.

Mechanism of Central Nervous System Described by Dercum.—Some years ago Dercum, the neurologist, suggested a simile which is of very great interest and value in connection with the basal functions of the nervous system.

He said that one could compare the action of the body and its control by the nervous system to the working of one of the big modern steamships. In such a great machine there are two essential parts. There is in the first place the engine-hold. Here are the fuel arrangements and the engines, and intelligent men, the stokers and engineers, who have charge of those *motor* arrangements. Now the engineers and stokers down in the hold of the steamship, whose business it is to understand the working of the machinery which makes the vessel go, have no knowledge necessarily of where the vessel is going. It is their sole business to make the vessel go precisely as directed from the bridge of the ship; it is their business to keep it going or at rest as directed. If the engineer gets the order, "full speed astern" or "ahead," it is none of his immediate business whether the ship goes on the rocks or not. That part of the ship corresponds to the spinal cord, and to those parts of the nervous system that are concerned with the immediate control of the fabric of muscles and the glands. It is now pretty generally admitted that the brain knows nothing of the precise work of the actual muscles. Now, on the other hand, the commanding officers of this ship, the navigators, may know nothing of the engines at all. The only communication between the dominant bridge of the steamship and the engineers is held by means of simple signals mostly made on bells. These signals back and forth correspond to the impulses between the cortex of the brain and the spinal column. The officers of the ship, corresponding to the cortex of the brain, know what they want done but know nothing at all about the engines down in the hold which mechanically do it. They know what they want the boat to do, whether they want it to go fast or slowly, and where they want it to go. The cortex of the brain acts in much the same way. In other words, more and more centers that correspond to particular *movements* of the body are found in the cortex of the brain; but the cortex, so far as we know, has nothing to do with the "separate" muscles. The cortex controls the body much as the officers on the bridge control the vessel. The cortical control of the body is by simple signals which it sends down into the spinal cord and autonomic system just as the officer of the bridge sends signals down to the hold of the ship. This is a highly illuminating simile, which is capable of being worked out very far.

THEORIES IN REGARD TO VENTILATION

The Skin.—Another direction in which some progress has been made recently is in regard to the *skin*. One thinks now of the skin as a very important organ. Just because it happens to be spread out in a layer over the surface of the body like the shell of the tortoise is no reason at all why it should lack its important functions. The skin is now seen to have much more to do with control of the body than was formerly supposed.

Ventilation of Lungs Aided by the Skin.—The physiologist Bohr, of Copenhagen, who died too early, made a very good attempt to prove that the skin was the seat of essential reflex mechanism concerned in respiration, and that the skin therefore has a good deal to do with the ventilation of the lungs. Recently a commission in New York State has been studying the relations of mental efficiency to the ventilation of the schoolroom, and has again shown that the amount of carbon dioxid has little to do with the mental efficiency of the pupil. Anderson, of Yale, working in a Harvard laboratory, stayed in a room where the atmosphere contained 8,000 per cent of carbon dioxid with no more inconvenience than headache and general malaise. The commission in New York has been working on temperature and humidity and has found no direct and certain relationship between these and mental efficiency, though with *children under usual conditions* it may prove differently.

Movement of Air Important.—It is the *movement of the air* that seems to be the important thing, and it is the *stagnation of the atmosphere* which does the damage. One might imagine that these remarks were instigated by manufacturers of electric fans because electric fans are so important if these "current researches" are fully corroborated. The most important feature of the atmosphere, so far as comfort and efficiency are concerned, now appears to be its stagnation or its relative motion. As long as the air is in movement over the skin the conditions *pro tanto* are ideal. One can have too much of many atmospheric constituents, but the important thing, so far as hygiene is concerned, seems to be the movement of the air over the skin. According to this discovery one must work out of doors, must have outdoor air indoors, or else must use electric fans; one must leave the windows far open if one wishes to have both comfort and high mental efficiency. Care must be taken that living rooms approach as nearly as possible out-of-doors conditions when there is a breeze. Recent reports from many Health Commissions emphasize the fact that movement of the air is an essential factor in maintaining hygienic conditions.

VASOMOTOR MECHANISM

Sleep.—Sleep has recently been studied by J. F. Shepard, a psychologist at the University of Michigan. He has recently studied the human brain in sleep through large skull openings, one a trephine opening and one accidental; and finds that the blood in the brain is increased during sleep. This is perhaps the best opportunity that anyone has ever had to study the volume of blood in the human brain during this state. He had two different men to work with, each with a large opening in the skull through which the brain could be studied, for a year or two, comfortably and at leisure, and he had ideal opportunities for good observation. Since Shepard's research it can be said that the blood is increased in the brain during sleep, although its pressure is reduced. Sleep used to be considered a condition induced by a lessening of the blood supply, and that statement is often found in medical literature, but it would now appear to be a condition in which there is an abundance of blood in the brain, perhaps for the purpose of more rapidly resting the neurons, but probably under very low pressure. These two things are very different. The *amount of blood* and *pressure* are sometimes opposed physiological conditions.

Vasomotor Nerves.—Another point that has been recently studied more or less is in connection with the *vasomotor mechanism*. We now have a fairly good idea of what its functions are. The nerves have been discovered throughout the brain and in every part of the body. The increases and decreases in caliber of the smaller arteries constitute one of the most important of physiological processes. Everyone knows that there are two sets of vasomotor nerves—the dilator and the constrictor nerves; in addition the conditions under which these important different sets of nerves function are now known.

DYNAMIC THEORIES

Muscular Function.—Another point of interest relates to the action of the *muscles.* The modes of action of the voluntary muscles and of the smooth muscles have been very vaguely understood. It is really surprising that organs so simple as the smooth muscles, simple fusiform cells united together into a fabric, should cause so much dispute in regard to their mode of action.

All-or-None Principle.—The reader, if he gropes deeply in his cortex, will remember the *all-or-none* principle. This is the fact that a heart is practically all of one muscle-fiber. The fibers of the heart are connected together in so intimate a way that when one fiber contracts, they all contract. This principle is known as the "all-or-none" principle. A physiologist by the name of Keith Lucas, in England, has shown that probably one ought to consider the voluntary muscles as working in a sense on the same principle; that is, Lucas suggests that the voluntary muscles work on the principle of all-or-none. He postulates that every voluntary muscle is divided up into as many functional groups of fibers as there are motor neurons in it; in other words, the muscle fibers under the control of one motor neuron act on the principle of all-or-none. Now this explains something that has long been a mystery in physiology, namely, why people under conditions of emotional excitement sometimes have such an enormous increase of available energy. A hysterical woman, for instance, will make others and herself believe for years that she is paralyzed, and will lie in bed in the house, or think she is scarcely able to walk across the room. Suddenly the house catches fire, and she seizes two or three children under one arm and perhaps in her haste something else that is heavy under the other, runs downstairs and into the street—and is well forever after! Thus it may be seen that under conditions of excitement, which we do not yet quite understand, the muscular apparatus is able to greatly multiply its energy. The supposition now is that under these conditions all these groups of fibers in a voluntary muscle are stimulated simultaneously in some mysterious way instead of being stimulated one by one, so that the energy of the muscle is greatly increased. That is an interesting point of a rather technical nature, a dynamogenic explanation.

STHENEUPHORIC INDEX.—Another thing that has been treated recently by certain writers is the relation between good humor and the expenditure of energy. It is technically called the *stheneuphoric index,* and it is obviously the ratio which exists directly between joy and pleasantness and the expenditure of energy. When a man expends a large amount of energy he is generally in a condition of enjoyment; and when a man is happy he can spend more energy than when he is unhappy and discontented. This relationship, though it can be but briefly considered here, is vastly important in all skilled work.

RESEARCH ON BLOOD PRESSURE

Other work that has been done in the last few years relates to *blood pressure* or arterial tension. It is becoming now a popular fad, as it has been for some years among the medical profession. New discoveries have been made and are being made daily in this connection. At present, however, the writer merely wishes to suggest that he has worked out a method of making relatively "continuous" records of blood pressure. In the course of his work on the subject a young woman doctor submitted herself to anesthesia under nitrous oxid and oxygen. The hemobarogram, the result of the experiment, is here shown. (The heavy line at 110 in the diagram represents the systolic pressure or 110 m. m. of mercury; the heavy line at the bottom is the diastolic pressure, or 80 m. m., so that the space between the two heavy lines is 30 m. m.) Under anesthesia the blood pressure was taken and found quickly to go up about 40 m. m. The

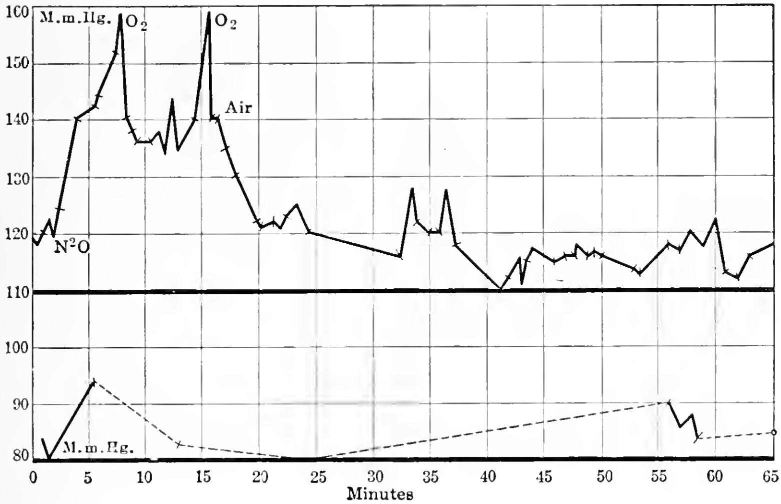


FIG. 37.—HEMOBAROGRAM A 22. Young woman, Forsyth Dental Infirmary for Children. The twenty millimeter systolic plateau for 12 minutes represents the effects of nitrous oxid given with a modern apparatus for mixing that gas with oxygen or air in any desired combination. The peaks are due to beginning asphyxia when using the laughing gas alone; the falls representing the instantaneous effect of applying oxygen. Some occipital and frontal headache on awaking. No lunch taken; no nausea. Heart rates 60, 96, 64, 60, 64, 58. The author extends his compliments to Dr. Goette of Cleveland for her kindness which allowed the making of this record.

sharp point, or drop, was made by the turning-in of oxygen. It can be seen that the turning in of oxygen instantly reduced the arterial tension. There is no danger of excessive blood pressure with nitrous oxid when it can be reduced so quickly by turning pure oxygen into the lungs. One level of lines shows the normal elevation; while those above the normal are due to the application of nitrous oxid.

An interesting curve, or hemobarogram, of the blood-pressure of a student in the Harvard Summer School shows beautifully how quick and strong is the arterial "response" to emotional conditions. At this point on the curve the experimenter suggested that the subject

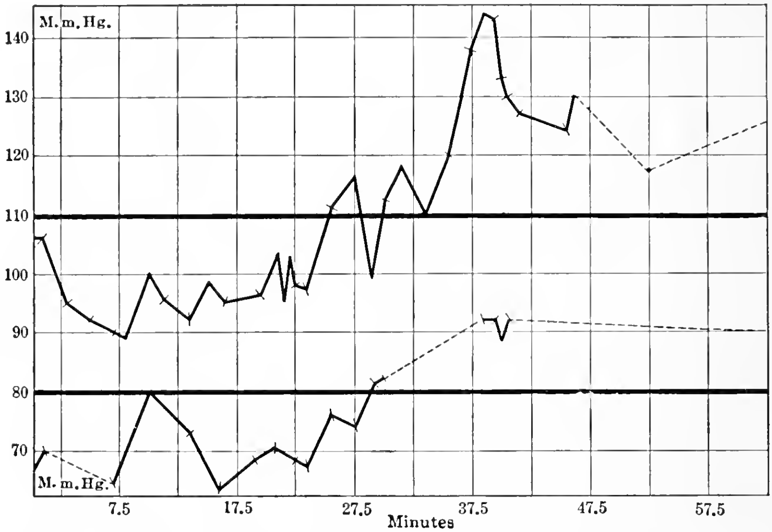


FIG. 38.—HEMOBAROGRAM B[1] 18. Woman, 28. During the twenty-fourth minute, accompanying an imaginary mental pain, the systolic rise from 97 to 111 (diastolic, 67-76) occurred. When the stimulus ceased, the systolic fell, but the diastolic (vasoconstriction) continued upward; the second systolic elevation (100 to 112) had *no conscious correlate whatever* (diastolic rise, one millimeter), but at its end the Korotkoff sounds at the third phase had wholly gone, the systolic sagged to 110, the young woman burst into tears, and there was, as is seen, a systolic tensional rise of 34 millimeters in five minutes (diastolic at 92) which subsided in a curve like that of exercise-rest in about eight minutes; but stayed 30 millimeters above the initial average for at least eighteen minutes (the diastolic 21 millimeters above). This was a true emotion (love-disappointment) and its long latency seems to corroborate the findings of Cannon and his colleagues that increased adrenin, and perhaps dextrose, is concerned in all true emotion. The heart rates ran 60, 74, 110 (estimated), 70.

think of the most unpleasant thing that had ever happened to her. The blood pressure went up about 15 m. m. and then promptly went down again. But whatever the thought, it obviously started a real emotion, and the blood pressure immediately rose again. It will be

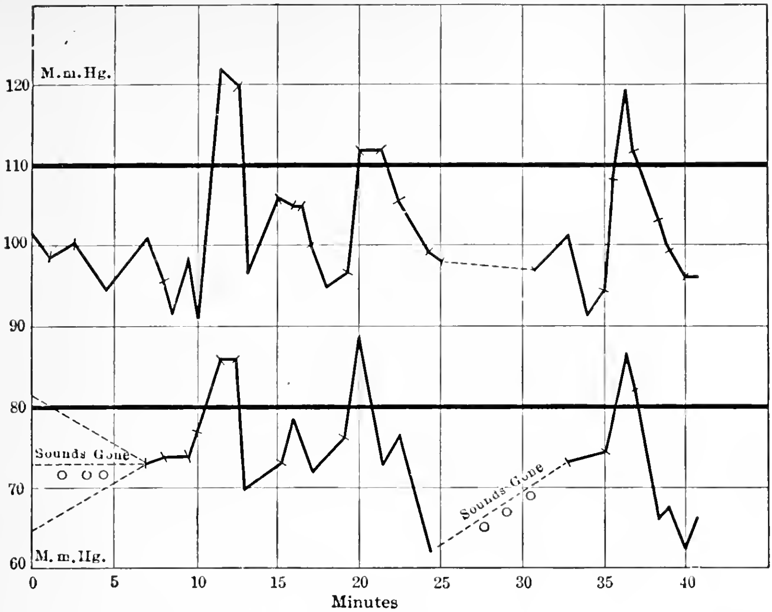


FIG. 39.—HEMOBAROGRAM A 14. Woman, 23. The systolic rise of nearly thirty millimeters in 90 seconds or less from multiplication effort is noteworthy; also the slower diastolic rise, typically less in extent, and the quicker diastolic downfall after unpleasantness, with a fall eleven millimeters below the previous mean. The heart was the typical irregular heart to be expected from playing basketball at 15 years. The heart rate varied between 92 and 96 at first and the observation stopped with it at 85.

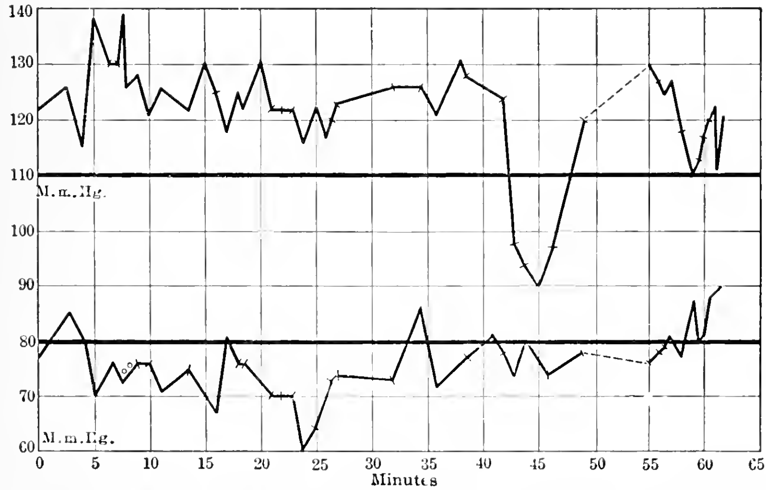


FIG. 40.—HEMOBAROGRAM D[2] 3. Woman, 23. Note the 40 millimeter fall in the systolic series at the beginning of the thirty-eighth minute; the stimulus (mental condition) being one of imaginary fatigue and relaxation following imaginary active exercise. The diastolic tension maintained its degree to an unusual extent. The heart rate varied from 80 to 73.

observed that the systolic and diastolic blood pressure stayed up this time for twenty or thirty minutes.

From these it will be observed how greatly and how quickly unpleasant emotions raise the blood pressure. On the other hand, pleasant states, so long as they be not allowed to shock in any way, and as long as they come on gradually, lower the blood pressure. Some of these charts represent three or four hours' work. One experiment, for example, took about an hour and a half, and another hour and a half to work out the curves.

The writer has enumerated the most important recent discoveries along physiological lines. Many of these are as yet merely theoretical, but earnest workers will watch and hope, for the future is still before them.

CHAPTER III

DENTAL PATHOLOGY AND BACTERIOLOGY, CHEMISTRY, PHYSICS AND METALLURGY

PERCY R. HOWE, A. B., D. D. S.

PYORRHEA

Organisms Found in Pyorrhea.—The subject of pyorrhea and of the dental abscess has of late attracted a great deal of attention, because the idea has been held by some that these pathological conditions are responsible for a great many systemic diseases. This view has been pretty thoroughly incorporated into the mind of the medical profession, even though recent experiments have tended to refute this theory to a certain degree. For this reason pyorrhea assumes an unusual importance, and its etiology should be understood. Various opinions have been advanced as to its cause. By some it is thought to be a bacterial disease. The streptococci, the staphylococci, the micrococci catarrhalis, the pneumococci, are various organisms that have been held responsible for this condition. The reason for believing that these microörganisms are a cause of pyorrhea has been based merely upon their presence in the affected part.

Noguchi has isolated and raised in pure culture two spirochaetae from pyorrhea, viz.: Treponema mucosum and Treponema microdentium. These are strict anaerobes, mucin formers, and produce the odor characteristic of the affection. Vincenti has shown the presence of Bacillus fusiformis in pyorrhea.

But no one has yet been able to produce pyorrhea by the injection of any of these microörganisms either in pure culture or in mixed.

On the other hand, the writer has produced in guinea pigs, by diet, a condition that resembles pyorrhea. The teeth became loose, the gums bled, and in some cases pus formed. This is a condition that others have produced in studies upon scurvy. The impacted cecum has apparently been the center from which the trouble here originated, for cathartics have removed the trouble, and the teeth have tightened.

The important point here is that the infection is secondary to an anomalous metabolic condition. Pyorrhea may be produced locally by irritation, by trauma, and by other causes. The tissue resistance must first be broken down, and then the infection follows.

The treatment is surgical and hygienic locally with attention to the correction of dietetic and metabolic irregularities.

Nature of Tartar.—Another thing of interest in this connection is tartar, its nature, and mode of formation. The writer has found by analysis that tartar consists of carbonate and phosphate of calcium. He has not, in about fifty analyses, found urates present, as many have claimed. Analyses show that the phosphate of calcium forms about 85 per cent of the tartar, while the carbonate of calcium is present in about 15 per cent. The principles of pathological calcification laid down by Dr. H. Gideon Wells in his Harvey Lecture are in the main applicable here in such calcific deposition as occurs in tartar. Calcium is held in the blood and in the saliva in from two to four times its water solubility. The CO_2 and the colloids accomplish this. Any alteration in the colloids, or the escape or decrease of CO_2 promotes tartar formation. An excess of calcium in the bodily fluids acts in the same way.

The stroma in which the inorganic constituents are laid down are the degenerate tissue of the peridental membrane, in the case of the so-called serumal tartar, and precipitated mucin in the salivary calculus.

Tartar formation is in the main a systemic affection.

Amebic Theory of Pyorrhea.—There is another theory which it is well to know something about, and that is the theory that amebae cause pyorrhea. Roughly speaking, there are three kinds of amebae that inhabit the human system: first, the Endamoeba buccalis which we consider harmless; second, the Amoeba coli, also harmless; and third, the Amoeba histolytica. This last is the cause of tropical dysentery, and it is because of this that the Amoeba buccalis has been considered parasitic by some. The Amoeba buccalis is a very interesting organism, and can be obtained from almost any mouth. An examination of the mouths of the young patients in the Dental Infirmary showed an abundance of amebae. The mouth of one of the athletes of Harvard, one of the finest specimens of men who had just broken a record, was examined, and plenty of amebae were found in it. The amebae do not feed on tissue. They feed upon the dead bacteria, and cleanse the mouth as if it were a pool of dirty water. There is no evidence that the amebae of the mouth have anything to do with pyorrhea, and this is very generally understood now.

Pyorrhea and the dental abscess have been considered foci of infection, and on the strength of this theory many useful teeth have been needlessly extracted. Teeth are very necessary to the army men. It is the opinion of the writer that the theory of the foci of infection, particularly with respect to the teeth, needs further study before it is made the basis of practice.

Universal Prevalence of Microörganisms. — Man breathes, eats and drinks microörganisms. There is no such thing as a sterile mouth, nor are even mammals sterile. Nature has not intended that they should be. Microörganisms enter the circulation from time to time through the nasal mucosa and through the intestinal wall.

Examinations of the internal organs of animals show that there is an internal microbic flora as well as an external. Therefore, "point of entrance" means but little. It is in the cellular activity of tissue and of the blood that the defense against microbic invasion lies, and it is manifest in a specific manner in the sera of animals. It is not so much the point of entrance as the question of resistance that concerns us.

Streptococcus Viridans Infection.—Why of all the microörganisms of abscess and pyorrhea the Streptococcus viridans should be fastened upon as the cause of many maladies attributed to these conditions the writer does not know. It is certainly one of the least virulent. Massive doses are injected to produce any effect, and an animal is tolerant of exceedingly large amounts. From one to twenty-five c.c. of viridans in suspension may be injected into an animal without serious consequences, while .000001 of a c.c. of a virulent streptococcus will produce septicemia and death. Therefore, from the standpoint of virulence, one need have no grave fear of the viridans. Neither pyorrhea nor dental abscess can be produced by the injection of these microörganisms. On the other hand, as the writer has stated above, by lowering the resistance of an animal by dietary means, the teeth loosen, and infection of the tissue follows. A tooth struck by a blow shows subsequent infection of the pulp, because the circulation is injured, the resistance of the tissue is lowered, and without any external communication the pulp becomes the seat of infection. So it is with the tonsil, which histologically is a lymph gland. When by stress of work upon it its tissue breaks down, it also becomes the seat of infection. Much other evidence might be brought forward to support the idea that this type of infection is secondary.

Importance of Resistance.—In such cases as pyorrhea and abscess, the first thing to understand is why and how the first infection occurs, before we can go on to intelligently explain any supplementary or coincident trouble. After clearing up certain extensive cases of pyorrhea, improvement is at times seen in a remote pathological condition. If this secondary trouble has proceeded or originated from the pyorrhea, it has now become an established thing. It has become an independent process. What then has the removal of the primary foci to do with it? There is but one explanation for the improvement that may follow. It is that a *load is taken off the resistance.* Resistance, general or local, is the keynote of such bacterial invasions.

Focal Infection.—What is there in the pathology of the blind abscess to indicate a tendency to bacterial diffusion? The bacteria selected as the basis of the theory are the most innocent. They are types such as Pasteur used in his early studies upon immunity. Examination of such a root end shows a hyaline condition, an obliteration of dentinal tubules, of organic matter. It is a protective effort on nature's part far superior to that effected by any mechanical procedure. Therefore, so minor and so small a thing as a dental abscess, with all its protective and walled-off structures, with all the forces of immunity between it and danger, cannot be the cause of all the ills that theorists attribute to it.

I am, of course, heartily in favor of cleaning up any oral infective condition. That is our daily business. That is the sum total of dental practice, but it is outside the topic of discussion.

The light and dark of the roentgenograms are not to be taken as deciding factors *per se;* they are valuable adjuncts, but clinical symptoms must first be considered before forging ahead too extensively in these matters. Much harm has already resulted from laying too much stress upon the principle of the dental primary foci; too many serviceable teeth have been removed on account of it. We need to take a broader view of this topic. We must not base practice upon the exception. It seems to me that the proofs offered as a basis for the exploitation of this theory are not sufficiently complete for us to adopt them as a basis of practice, nor for allowing them to make a scapegoat of dental affections for the many but too little understood bodily ills.

BACTERIOLOGY OF DENTAL CARIES

The literature upon the mycology of the mouth is voluminous, yet it contains no work upon the bacteriology of dental caries that meets modern biological requirements.

Miller's Work on Caries.—*Miller,* in 1880-90, carried out the work that is most familiar to dentists. He placed teeth in a fermenting mixture of bread and saliva, renewing this from time to time in order that it might not grow alkaline, and he succeeded "after three months in producing effects upon tooth sections which could not be told either microscopically or macroscopically from true caries." He then demonstrated by zinc crystallization that such a fermenting mixture produced lactic acid and upon this evidence he originated the lactic acid theory of caries.

Now, the bacteria that have the property of fermenting carbohydrates are legion. Miller had no thought of bacterial specificity in this action. He described a few oral bacteria such as Leptothrix innominata, B. buccalis maximus, Jodococcus vaginatus, Spirillum sputigenum, Spirochaeta dentium; but he himself says that "this bacteriological study upon caries has not been sufficiently extensive or conclusive" to warrant being incorporated into his book. His work was done 30 years ago, and, as has been said, he paid no attention to any specific microorganism. The idea he had in his mind all the time was simply the fermentation of food materials, sugars and starches, particularly starches.

He states that this theory is only a part of the carious process. The lactic acid of fermentation inaugurates the process. The work must be completed by proteolytic bacteria, these having the property of completing the destruction of the tooth substance after it has been decalcified. These proteolytic bacteria are unknown to him.

Work of Goadby.—There have been other workers upon this subject, the most important of whom is *Goadby*. His work is more modern and more in keeping with modern ideas as to the bacterial requirements. Goadby, in 1902-3, studied the microörganisms of the superficial and the deep layers of decay. He classifies these bacteria as acid formers and liquefiers; the acid formers being the ones that precede the active decay, and the liquefiers, having the property of liquefying gelatine, indicate that they had the property of dissolving the organic structure of the tooth. Goadby also found that in the deeper layers of decay a smaller variety of bacteria exists. The deeper he went, the fewer bacteria he found. In eighteen cases he constantly found Streptococcus brevis and B. necrodentalis (as he calls it) and nothing else. In another part of his work he adds to these staphylococci. In the superficial decay he finds other things:—B. mesentericus, B. furvus, B. plexiformis, both Staphylococcus aureus and albus, sarcinae and some other forms. He lays particular stress on the streptococci and staphylococci in this connection. There are other workers who agree with him in this latter finding.

It should be stated tnat a great many of the theories that have arisen, or descriptions of bacteria that have arisen in connection with dental decay, have been arrived at simply by taking a little of the bacterial mass off tooth surfaces, smearing it out and examining it. Pickerel, in his work of making some comparative tests among the native tribes in Australia, made his examination solely by smears, and arrived at his conclusions from his interpretation of them. One cannot get a very deep knowledge of bacteria by simply looking at microörganisms. They must be studied culturally in pure culture and subjected to biochemical and other tests.

Kligler's Work.—Recently *Kligler* studied the microorganisms of the mouth. His work was done in 1915. He collected material from tooth surfaces, and made a bacterial count of the microörganisms from the mouths of immunes and also from the mouths of those who had prolific decay. He arrived at the conclusion that the streptococci predominated in mouths free from decay, but that, as decay proceeded, this character of the oral flora was changed from a streptococcal to an acidic rod and a thread flora. Unfortunately the immunes were limited in number. From a few cases of immunes, and of adults at that, one cannot arrive at anything very conclusive, but it is probable that on the whole Kliggler was correct. The research department at the Forsyth Dental Infirmary has done the same kind of work upon an extensive scale, and the work taken as a whole agrees with his. From what has been said it can be seen that there is no agreement, nor has work of much account from the bacteriological standpoint been done upon caries. At the Forsyth Infirmary a careful study of caries has been made. In order to be sure that the proper flora were under investigation the research department selected children of nearly the same age, the same tooth or teeth, the sixth and the twelfth year molars, where decay was active, being chosen for study. It can be seen that examination of the decayed tooth in an adult might not always give proper results, because one does not know whether or not the caries is active. The decay may have stopped and a different flora may be growing in the cavity that may not have anything to do with decay. It may simply live there as an incidental invader. Before study was begun it was thought that the microörganisms in a decayed tooth would be very varied; therefore an attempt was made to get at this matter in three different ways.

Bacteriological Experiments.—First, inert fillings were inserted over the decay. These were allowed to stay in place three months, with the idea that the microörganisms that were most at home in the tooth and most active and responsible for decay would live, while those that were incidental invaders would die off. After three months these fillings were removed, and the carious material cultured.

In another series of cases, and with the same principle in view, cement fillings, with slight antiseptic properties, were put in. These were not left for so long a time, the idea being that the antiseptic would act upon the weaker and more incidental bacteria and would kill them, while the more hardy organisms and those which had the best hold upon life would in all probability survive the antiseptic properties.

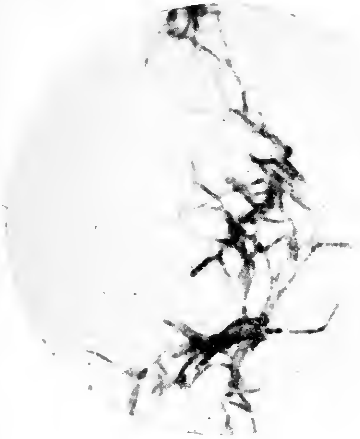
Again in the third condition the flora was examined from the open carious tooth.

Moro-Tissier Group of Organisms.—It was soon seen that comparatively few organisms were to be reckoned with. It was evident from observation that the constant and predominating flora of dental caries was the closely allied group of microörganisms described by Moro, Tissier and others. These were found in all the cases of decayed teeth examined and were the prevailing bacteria. In cases that had been under fillings for three months, and under fillings with slight antiseptic properties for a shorter time, no other microörganisms were found. In the flora from the open teeth it was found that in about 40 per cent of the cases there was nothing else present; that is, on the media used:—agar, glucose-agar, blood serum and bouillon. These microörganisms were cultured aerobically and anaerobically.

In the first class of cases, after taking out the amalgam, using aseptic precautions, the decay was removed in three layers. We took off a top layer, taking several little bits from this upper area and planting them on the various media just mentioned. Then from the middle layer the same thing was done. Next, a third or deep layer was removed, after which the deep dentine was studied. This small group of microörganisms, and nothing else, was found in every case. They, and nothing else, were found under the antiseptic fillings and cements. They, and nothing else, were found in 40 per cent, in round numbers, of the open tooth cavities.

In some of the open carious teeth other things were found; yeast for one thing, which is very common in the mouth but is not often mentioned. Micrococcus catarrhalis, staphylococci, streptococci, and other bacteria were found, but there was no regularity in their appearance. Some member of the Moro-Tissier species was always present. This group is a known group. It has been studied, fortunately, by some very able men, but it has never been found in the mouth before. The natural place in which it has been studied has been the intestine of a nursing infant; in fact, it forms the dominant flora of a nursing infant's intestinal content, which is very acid. There is the home of it, so far as is known, until solid food begins to be taken, when it gradually gives way to other bacteria. Our experiments found it in the mouth.

This group of organisms has been called the Moro-Tissier group. Kendall, Cahn, and a great many other workers have studied this species. This flora possesses two or three very important characteristics. One is that it is a very high acid producer,—the cultures producing about 14 per cent normal acid,—much higher than ordinary organisms. Not only that, but it is characterized as a highly pleomorphic group. One of these organisms has been treated by Noguchi in a most interesting manner, in an article in which he gives an account of his study upon B. bifidus. He says that he was "able to show B. bifidus to be an anaerobic phase of an aerobic sporagenous organism belonging to the subtiloid group and closely

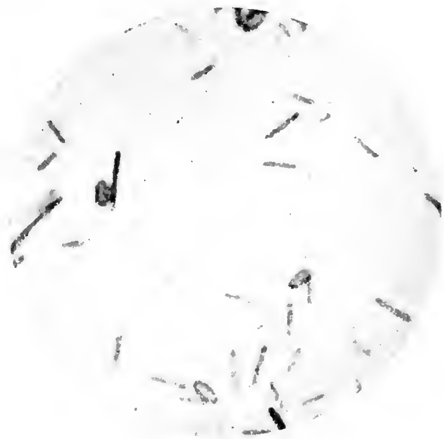


B. bifidus

B. [X]

B. bifidus. Staphylococcus form

B. bifidus. Streptococcal form



B. bifidus. Spore

FIG. 41.—MICROÖRGANISMS FROM DENTAL CARIES, B. BIFIDUS AND B. X.

resembling, especially morphologically and biologically, B. mesentericus fuscus."

Moro's acidophilus—in studying these organisms that term should be remembered—has been found in the mouth, but there is no previous record of B. bifidus having been found there. From the examination of about 25 specimens of deep dentine which are being studied now at the Infirmary B. bifidus was found in nearly every case. In some of the teeth the operator had excavated everything and no growth was obtainable. These microörganisms possess the property of inaugurating decay in a much greater degree than any other organism. They are the dominant flora,—the only flora of tooth decay that is constant. It cannot be stated that they are the cause of caries. There are many other factors that may enter into this, but their constant presence, their acid-forming and acid-tolerating properties are interesting.

A glance at the cuts and descriptions of the few microorganisms that *Dr. Miller's* work contains, shows that he had seen these microörganisms, but he did not study them morphologically and did not identify them. The same is true of *Goadby's* work. His B. plexiformis and micrococcus dentalis are undoubtedly organisms of this Moro-Tissier group that we have termed B. X. in our work, and so it is with others that he describes.

Summary.—It is the theory of Dr. Miller that is known and taught and therefore must be the basis for examination work. But while Miller has done astonishingly well for his time, still much remains to be worked out.

A brief account has been given of the studies upon the subject here. Eighty cases have been examined. Uniform conditions have been sought and a constant flora in caries has been found and identified; its sugar-fermenting properties, its high acid-forming and high acid-tolerating properties demonstrated, and that it overgrows other types in laboratory media is proven.

These are interesting facts for those who are dealing continually with the repair of the carious dental process. In this connection it would be well to speak of a few things that may be serviceable in practice.

Sterilization of Cavities.—Cavities, as they are prepared, are very rarely sterile. This is on account of the depth of action of caries. It is not practical to sterilize any cavity by the burr except the most superficial. Bacteria have been shown to be alive under fillings after six months, and it is believed that the attempt should be made to destroy them and that work should be carried on upon surgical principles.

A tooth cavity can be made sterile by drying it for 5 minutes with 70 per cent alcohol if the cavity has been well excavated. A very effective way of sterilizing the decay in posterior teeth is by using an ammoniacal solution of silver nitrate and reducing the metallic silver by a solution of formalin. This produces sterility and at the same time impregnates the pathological tissue with a metal. The formula is given below. Copper cements have slight antiseptic properties. From the bacteriology of caries alkaline washes are indicated. Physiological salt solution is recommended for ordinary use.

METALLIC SILVER IMPREGNATION OF CANALS

Some very interesting histological work is now being carried out in connection with six-year molars, many of which are abscessed teeth. In a badly abscessed root it will be seen that there are transparent areas. The abscessed condition affects the structure of the teeth. The first step in the treatment of abscessed teeth is complete sterilization of the tooth structure with a strong solution of silver nitrate and subsequent impregnation of the canals with it. The silver solution is simply pumped down into the roots. Two solutions are necessary for this treatment, viz.:

$$\text{I. 35 per cent nitrate of silver}\begin{cases}\tfrac{1}{2}\text{ water}\\ \tfrac{1}{2}\text{ ammonia (28\%)}\end{cases}$$

II. 25 per cent formalin

Method of Use.—This can be pumped through the end of the root, if necessary, but only in abscesses. In using these solutions the nitrate of silver is put in first, using care not to get it on the tissues, and the root of the tooth

FIG. 42.—EFFECT OF ABSCESSED CONDITION ON TOOTH STRUCTURE.

is pumped full, and then one drop of the formalin solution is injected. Actual sterility throughout the tooth follows this method. The illustrations show the tooth alterations that occur in abcessed conditions and the way in which they are impregnated by the silver. The black discoloration is just silver and nothing else. This treatment will be found to cure an abscess quicker than anything else. There is a preparation that will take that silver off the teeth, but it is very poisonous and must be handled with great care. It must be stated that this treatment is still in the experimental stage, but thus far it seems to be very effective. In employing the treatment just an ordinary broach is used. The preparation cannot be used on the front teeth, because it would discolor them, but perhaps by and by a way of doing that will be found. As has been stated this process is still in the experimental stage, but it is a very good method. X-rays have been taken of some of these teeth and they

FIG. 43.—TEETH AFTER TREATMENT WITH METALLIC SILVER IMPREGNATION.

show up very well. A good many practitioners are relying entirely on the X-ray. In conclusion it may be said that the X-ray is a valuable thing, but there are a number of things it cannot do. Clinical evidence must be considered first in studying these interpretations.

CHAPTER IV

PHARMACOLOGY

Frank G. Wheatley, M. D.

ACTION OF DRUGS

The relation between pharmacology and the general education of the physician and dentist is no doubt apparent. A study of the subject presupposes a knowledge of anatomy, a knowledge of physiology, a knowledge of chemistry, and a knowledge of pathology.

The importance of some knowledge of the subjects discussed in pharmacology will appeal to every one. It is obviously desirable to know something about some of the agents that are included in the lists of materials which we know as pharmaceutical agents or drugs. However, the tendency with modern medicine and modern dentistry is to steer away from the use of these agents for the treatment of pathological conditions and to depend upon surgical procedure, and the curing, healing power of nature, with the surrounding hygienic conditions, to effect our cures. So that one in talking about this subject is facing "therapeutical nihilism."

General Effects of Drugs.—But for all that drugs can never be wholly eliminated from medical practice, for they can do what neither surgery nor nature can accomplish. With a drug, perspiration can be produced; expectorations can be modified; the secretion of the respiratory tract can be affected,—if it is excessive it can be checked, if insufficient it can be increased; vomiting can be produced; the chemical character of the urine can be changed with drugs, an alkaline urine to acid, an acid to an alkaline urine by the proper drug administration; the circulation of the blood can be affected, the rate and force of the pulse increased or decreased, by the administration of drugs; catharsis, or free movement of the bowels, can be produced; the respiratory function can be affected,—making a man breathe more forcibly, or more rapidly, by the administration of drugs; a man's digestion can be affected,—the digestive function stimulated so that when food enters the stomach it is more promptly and efficiently acted upon or digested; the character of the blood can be changed, actually increasing the number of red blood corpuscles (and this can be demonstrated by actual count), by the administration of drugs; temperature can be lowered; pain can be relieved; anesthesia can be produced,—*general* anesthesia, or unconsciousness accompanied by insensibility, or *local* anesthesia, which does not affect the consciousness but only sensibility of the part involved. Those two functions, those two things, that can be done with drugs,—the control of neuralgia and the production of anesthesia,—are extremely important as bearing upon the special work of dentists. Then there are certain antitoxins with which the system can be so fortified that it will deal more directly and forcibly with the cause of disease.

Physical Therapeutics.—Besides drugs there are the so-called physical therapeutical agents, like heat, cold and massage; so that there are a good many things that can be done to the human body that it may be desired to do by the means of drugs or through therapeutic agents.

If drugs can do so much, then surely the dentist does not waste his time in acquiring a general knowledge of this subject. In fact, too many physicians, as well as dentists, are apt to be influenced by the many new anti-drug theories in vogue at the present time.

SCHOOLS OF THERAPY

Here a few words may be said about a subject which physicians do not like to talk about very well, and which does not bother the dentist very much, and that is the various schools of therapeutics. It would seem silly to talk about the kind of anatomy, physiology, chemistry, or surgery that a man is to study. But when one comes to therapeutics one finds that there have grown up, perhaps rather unfortunately, various schools of therapeutics. It has always been so, since the history of medicine began. Some particular sect has claimed that it has discovered the fundamental facts in regard to therapeutics and that if one should base all his therapeutics on those certain fundamental facts he would have a system of therapeutics that would be all to be desired. Now, the therapeutics here presented are not based on any particular system, dictum, or preconceived theory. What are they, then? This theory of therapeutics is based on the known action of agents on the course and cause of disease. It will be asked, "What is meant by the *known action?* Who *knows* the *action?*" By that is meant that one must have, under the present conditions, two kinds of therapeutics, first, an empirical system of therapeutics; and secondly, one which is strictly scientific, which depends for its action upon the known causes of disease and upon the action of the agent on that cause.

Empirical Therapeutics.—To illustrate: from the time when the Spaniards invaded Peru four or five centuries ago, to the present time, a more or less large percentage of the human race has taken quinine to cure malaria. That is a matter of common knowledge. One does not have to be a physician or a dentist to know that. Any layman can tell that quinine is a good thing for malaria, that is, if he is a sensible sort of layman (although once in a while one is met who says, "I can't take quinine because it does something to the blood or bone"); but the average, intelligent person knows that quinine, or cinchona, from which it comes, is an agent that cures malaria. Now, that fact has been taken advantage of for 400 years. Only a few years ago was it discovered that quinine acted upon the direct cause of malaria and therefore cured the disease. By that is meant that the specific cause of malaria, the so-called plasmodium malariae or specific causative germ, was discovered. It was further found that if a clump of these bacteria were placed in solution, in a glass tube, and poured into a sufficiently strong solution of quinine, they would die, and there is a very simple explanation of the fact that malaria can be cured by quinine.

So from a system of what we may call empirical therapeutics, a scientific, exact method of treating disease is evolved. Unfortunately, the causative agent of all diseases is not yet known, and until it is known it cannot be expected that a remedy will be produced that will cure every disease. The number of diseases that can be treated scientifically is all the time increasing. There is hope that some day there will be nothing but strictly scientific therapeutics; but today it must be said that there are scientific therapeutics, which have been described, and also empirical therapeutics. Now, when a man has malaria and takes quinine, the physician knows why he is giving it to him. Thus the system of empirical therapeutics is based on the observation of skilled and competent observers having extensive facilities for observation up to the present time, and on the mass of experience that has been accumulated in that way.

The men who are making studies on this subject are comparing notes and sifting the evidence all the time, and there is today, in almost any text-book of value on this subject, a collection of the results of these observations, and that is the basis of our therapeutics that is called empirical. It may be asked why a certain remedy is given for a certain disease. The answer is,—one which can be made in the case of quinine,—that it destroys the cause of the disease. If that cannot be said, the answer is that the observation of skilled observers up to the present time goes to show that that remedy is indicated in that disease. That is as far as one can go. That kind of therapeutics, however, is lessening all the time, and the scientific kind is widening all the time.

Various Therapeutic Systems

Special Therapies.—What about these special therapies like homeopathy, hydrotherapy, thermotherapy, and all those different kinds of therapy so prevalent today? They are built up, it would seem, on the basis of a preconceived idea. That is, a man assumes that certain things are true, then goes to work to build up a theory around them.

Homeopathy.—The homeopath says, "Like cures like." That means that a disease producing certain symptoms is cured by an agent that will produce those symptoms. For instance, a man having scarlet fever has a rash. Now, "like cures like" means, if it means anything, that when one is going to treat that disease one must give the patient something that will produce that same symptom; and to carry the illustration further, one knows that belladonna, given in a reasonable amount, will make a man's skin break out with a rash, resembling scarlet fever. Therefore, according to the principle of "like cures like," if a man has scarlet fever one should give him belladonna, because one gets the same symptoms from belladonna as from scarlet fever. Sensible men and women will agree that this seems a rather absurd theory.

On principles like the foregoing is built up the system of homeopathy. One does not want to misrepresent the homeopath. There are many practicing medicine as homeopaths. They have graduated from homeopathic schools, but it can be stated absolutely that there is not a graduate of the last 15 years, or 10 years, in this country who is practicing a strict homeopathy today. They give drugs, just as any other sensible man does. As for homeopathy, a cèrtain amount of good has resulted from its introduction. It has taught medical men to be a little more careful as to the forms of medicine they administer. The old-time doctor was a crude fellow who used to carry his pills and potions around in rather a loose way and administer them without much regard to their physical appearance or taste. The patient took them or left them as he pleased. The homeopathic physician came along with a little vial full of white globules that tasted good. A patient would rather take those, if they would do as much good, than take the vile-smelling tincture that the old doctor gave. The result was that the homeopath got a good deal of business from the class of patients who got along very well whether they took medicine or not. It is an open secret in disease that a certain percentage of cases will get well if one does not do anything to prevent it. In that class of cases the homeopath can get along beautifully, because the patient likes to take the medicine. So they built up a large business. It has been said by those who are inclined to ridicule homeopathy that the homeopath appeals to children and old women of both sexes!

For instance, in the case of a rather turbulent child to whom it is necessary to give some medicine, that child would take some sugar tablets much easier than a tablespoonful of sulphate of magnesium. That kind of case accounts to a certain extent for the popularity of the homeopath and also for the fact that the physician of the regular school,—as it is called,—the old-time physician, has become more careful in the form of drug he administers. Elegant pharmacy has been the result of homeopathy. Today the agents are presented to the patient in as attractive and palatable a form as possible.

Now what has been said about homeopathy applies in a greater or less degree to all of the special classes of medicine. It is as well not to be bound to any particular school, but to say,—"Here is a human body that I have studied about, know about. Here is an agent that will do certain things to this body, I believe, because I know the cause of the pathological condition. Therefore I will give it that agent." If that cannot be done, say, "Men have been investigating this subject for hundreds of years and the consensus of opinion is that this is the agent to use, and therefore I use it." That is a good reason, not because of "like cures like" or any other such fetish as that.

Christian Science.—In these days of mental suggestion Christian Science has become quite a profession. Many people think they are cured of disease by a process of mental healing or Christian Science. Many of them are excellent people, people of high character, quick sympathies, and remarkable intelligence in a good many ways, and there is something in the theory. Of course, anyone who is observant at all knows that the mental condition has a good deal to do with the physical condition. One knows that if he is happy in his mind and if he has made a thousand dollars in a stock speculation, he enjoys a good dinner, and it digests better than if he has lost a thousand. The mental condition is affected and the mental condition has to do with the well-being of the body. Now, if a person has a fancied ill, say, for instance, he thinks he has indigestion, or he thinks that he has oncoming locomotor ataxia, or that some other disease is hovering over him, his mental condition is a desperate one and one which reacts on his physical condition. He sees the symptoms of the disease which he thinks he has. Exactly similar is the case of the man who reads a patent medicine advertisement which says—"If you get plant juice and drink a full glass a day you will get rid of that backache, that headache, etc." After he has read this particular advertisement over three or four times, even if he felt in perfect health when he began, by the time he gets through with it he will be a pretty sick man.

That illustrates just what may happen by mental suggestion. And if a person can get out of his mind the idea that he is sick (if there is really no definite pathological condition present) a great deal has been done. Even if he is sick, to keep him in a pleasant, happy frame of mind will do more for him than despondency. So Christian Science has a field there, a field in improving the mental condition. If people who believe in mental suggestion would confine themselves to conditions that they can safely treat, they would do a lot of good, but if they attempt to treat broken legs or definite pathological conditions that they do not know anything about, they are liable to do harm.

Osteopathy.—A great many people say they get results from osteopathy. No doubt they do. Osteopathy is simply a scientific massage, and everyone knows what massage will do. Massage is a sort of passive exercise, —a lazy man's way of taking exercise. If properly applied it is of great value. Now, if the osteopath will admit that his manipulation of tissue is simply a refined and skillful massage, there is no ground for quarrel with him; but, if he claims, as some do, that the man who has a pain in the back of his neck, has dislocation of the cervical vertebra, and that he can, by manipulation, snap back one of those vertebrae into place, one would say that perhaps he is claiming more than he is justified in claiming. There was once an osteopath who had great success in relieving pain in the back of the neck. In every case he told his patients that the cervical vertebrae were displaced, that he could get them back by manipulation and they would be relieved. He had a trick of cracking one of his thumbs every little while and saying—"There, hear that bone slip back,—there it is!" And the cure resulted. Now these statements are not intended to ridicule osteopathy, because the man who practices osteopathy on proper lines does a great deal of good. There is no doubt but that proper manipulation of the pathological tissue is a great factor in the treatment of disease, and the medical student, and the dental student, should have instruction in that sort of thing.

Therapeutic Fallacies.—The fallacy of the whole thing, however, is the attempt to build up a system of therapeutics on one particular tenet, one particular system, a preconceived idea that a certain thing must happen, that one can cure all disease by water—that is, hydrotherapy; that one can cure all diseases by heat—that is, thermotherapy; that one can cure all diseases by massage—that is, osteopathy.

Nihilism in Therapeutics.—The tendency to therapeutic nihilism is pretty prevalent in Massachusetts, and it is generally though not always true that the more strongly a person becomes a therapeutic nihilist the poorer physician he is. This does not mean that one must dose every patient he meets, but it does mean that if the physician uses the agents at his control in an intelligent way he will do his patients more good, and incidentally himself more good.

PRESCRIPTION AND ADMINISTRATION OF DRUGS

Prescriptions.—In the administration of remedies it is necessary to write prescriptions. A formal prescription is a written direction from the attendant,—physician or dentist,—to the pharmacist, to dispense to the patient certain remedial agents, and should contain on its label certain directions for the patient as to how to take that remedy. Now, many times an oral prescription is given:

to tell a man to take some salt water and rinse out his mouth three times a day is an oral prescription. It is just as much the function of the dentist to prescribe as of the physician. When his degree is obtained, the dentist has the same right to prescribe as the M. D. has, and he is held under the same restrictions in prescribing.

Methods of Measuring.—In writing prescriptions there are two methods of measuring,—the old or *apothecaries'* system of weights and measures, and the *metric* or *decimal* system of weights and measures, about which more will be said later.

Materia Medica and Therapeutics.—Materia medica means, roughly speaking, the *materials* used in the treatment of disease; therapeutics, any means used for the treatment of a pathological condition. Anything done for the care of patients is therapeutics; thus, to tell them to raise the window shades, to get in fresh air, is part of therapeutics; a sponge bath is therapeutics. Technically, however, by therapeutics is meant the administration of drugs.

Administration of Drugs

Pharmacology; Pharmacodynamics; Pharmacy.—Pharmacology is a term used to embrace both materia medica and therapeutics, and means, literally, a discussion of drugs. Pharmacodynamics signifies the action of drugs on the human system. Pharmacy is the art of preparing and dispensing remedial agents, and is the province of the pharmacist.

Means of Introducing Drugs.—The administration of drugs and the ways in which they can be taken into the body are next to be considered, and in this respect the body can be treated as a whole. The human body is covered with skin and has cavities lined with mucous membrane. To get a drug into the system, then, there are two modes of entrance—either through the skin or through the mucous membrane. It is evident that one cannot get into the circulation otherwise. Of these two avenues, the skin will be first considered.

The Skin.—If an agent or a drug is placed on the skin there will be some result with some drugs, some absorption; and if it is rubbed in, there will be still more. By taking a needle and piercing the skin, and then injecting a fluid into the subcutaneous areolar tissue the maximum result will be obtained. The epidermis may be removed by blistering, and the agent put on the raw surface to be absorbed that way, but that is not usually done.

Mucous Membrane.—In considering the mucous membrane as an avenue for drugs there is, first, the digestive tract, beginning with the lips and ending with the anus. Here there is a surface that can be brought in contact with drugs to get results from them. That is, of course, by far the most common way. Most drugs are thus administered, taken into the mouth, carried into the stomach and absorbed. That is one of the routes by the mucous membrane. A drug can be injected into one of the cavities of the body—into the urethra, the vagina, or the rectum—and it will be absorbed. It can be dropped into the conjunctiva of the eye, or it can be inhaled and be thus absorbed through the respiratory mucous membrane.

Time for Administering Drugs.—The time at which to administer a drug is important, particularly with relation to meals. A drug taken before meals is more promptly active than if taken after meals. If it is taken on an empty stomach it strikes a fairly clear mucous membrane and is absorbed directly.

Dangers of Toleration.—If a drug is given for a long period of time a *toleration* will result. By toleration is meant the effect of a drug upon the system by which the normal or initial effect is lost. To illustrate this point, a great many men have learned to smoke. The first time they did not enjoy it. Occasionally one meets a person who says he enjoyed his first smoke, but most people do not. It is remembered with horror. However, after trying a few times with praiseworthy perseverance they succeed in "learning to smoke," as it is called. That is, a toleration for the drug is set up. What has happened is that the system has become accustomed to the action of that drug. One can obtain toleration of almost any drug by a continuance of its use. If morphin is taken to control pain, an eighth of a grain will give relief at first, but if this is kept up for six months, it would probably take a grain or two then to get the same result, and finally there would come a point where the most excessive doses would give no results. That is what is meant by toleration.

The sex of a patient has something to do with the effect of a drug. Women react to drugs more promptly and more powerfully than men, so that the dose has to be a little smaller.

Determination of Dosage by Age.—Many rules have been devised for the determination of the proper dose for different ages. The simplest one is this: The adult age can be considered as twenty. Anyone under twenty will take that fraction of the total dose that his age is of twenty. If the patient is five, he will take one-fourth of the dose; ten, he will take ten-twentieths; fifteen, fifteen-twentieths or three-fourths of the dose. That is accurate enough for practical purposes. Young's rule is to divide the age by the age plus twelve; but the more complex the rule, the more likely one is to get mixed.

Determination of Dosage by Weight.—Another way to determine the dose is by weight. The average person is supposed to weigh 150 pounds. A man weighing 200 pounds should thus take two hundred-one hundred and fiftieths of the dose (or one and one-third times the dose); a man weighing 50 pounds, one-third of the dose; 300 pounds, twice the dose. That is the most accurate of all the rules. It has no reference to age, but to the avoirdupois to be affected.

THE METRIC SYSTEM

Weights and Measures.—The subject of Weights and Measures now claims attention. A dentist is supposed to be a man who writes prescriptions and has a legal right to do so, so that the matter of prescription-writing and the matter of weights and measures become of considerable importance to him. Most dentists absorbed in their schooldays a knowledge of the apothecaries' table of weights and measures as a part of their mental pabulum. The matter of the metric system, however, seems to be a stumbling block to many students, and yet this system is ultimately much easier to use and by far the most scientific and accurate.

Metric System.—The metric system follows the decimal system of United States money, the basis of the system being the meter. The attempt was made to get an accurate and unchangeable standard of weights and measures, so the authors of the system took a quadrant of the earth, the distance from the equator to the pole, and called one ten-millionth of that distance, the meter, or 39.37 inches (a little over three feet). It can be thought of as a large yard. That meter is the basis of the whole system. From that one unit may be calculated all the units of measure, of weight, and of capacity. The divisions of that meter are indicated by using Latin prefixes. Thus a *decimeter* is a tenth of a meter, a *centimeter* a hundredth, and a *millimeter* a thousandth of a meter. In the ascending scale Greek prefixes are used: thus a *dekameter* is ten meters, a *hectometer* is one hundred meters, a *kilometer* is one thousand meters. A hollow cube measuring one centimeter each way is called a *cubic centimeter.* Now the amount of distilled water that can be put into such a cube is a cubic centimeter; and in measuring liquids in the United States that amount of liquid is spoken of either as a gram by weight or as a cubic centimeter, and is expressed by the letters *c.c.* Usually in prescribing in the United States the term c.c. is used rather than the gram, that is, measure rather than weight, although in its essence the system contemplates weighing everything. The term mil is also used to express the same unit. From that unit of weight, the gram, are derived the fractions of a gram and the multiples of a gram in the same way as with the meter. Thus one says, *decigram* for a tenth of a gram, *centigram* for a hundredth, and *milligram* for a thousandth of a gram; for ten grams the term *dekagram* is used; for a hundred grams, *hectogram;* and for a thousand grams, *kilogram.* Now, having learned that the unit of weight, the gram, is the amount which a cubic centimeter of water of 4° C. would weigh, one has a basis of weight and one can express any denomination required from that.

PRESCRIPTION WRITING

Prescription Blanks.—A prescription, as has been said, is a written direction, from the dentist to his patient, to be taken to the druggist or pharmacist to compound or dispense certain agents which the patient in turn is to take. An up-to-date dentist will take care to have proper blanks. A prescription written on brown wrapping paper, even in accurate terms, would not commend itself to the average discriminating patient. So that a proper blank, with certain data upon it, would of itself be of some value in establishing the standing of a dentist in the community. This blank at the top should be in a certain way the card of the dentist. Supposing that his name is *John Jones, D.M.D.*, and that he lives at *125 Beacon Street, Boston*, and that his telephone number is *101 Back Bay*, and that his hours are *9-12 A.M. and 2-4 P.M.*, that will add to the knowledge to be given to the patient.

There is, in fact, a professional card, and when a prescription is written if that is handed to the patient he receives valuable information, and he will be impressed with the fact that his dentist is a man who is careful of detail. The word "For" can be printed with a blank left for the name, *Thomas Smith,* with space for the address, if desired. At one corner can be added another blank for the date. Thus the form denotes something for *Mr. Thomas Smith* and that he is to take as a document to the pharmacist.

A prescription which might be used by the dental profession would go somewhat as follows:

Model for Writing Prescriptions.—"℞"—that stands for the Latin word *Recipe,* which means "take." The derivation is from the sign of the zodiac that represented Jupiter, the king of the gods, and in ancient times when a prescription was written or when some direction was given, the deity was invoked to aid in the action of the remedy. Written in that way it means "Take," and is a direction to the druggist. In this particular prescription, perhaps, *Acidi Benzoici* is to be taken. That is the proper form which is used to represent one ingredient of the prescription and is to be translated "of Benzoic Acid." Then follows the quantity, so many ounces or grams of this agent. It will be noticed that it is expressed in Latin. There are many good reasons for this. In the first place, Latin is a dead language and not subject to change. The English language is changing every year. Latin, however, is a fixed standard and means the same thing everywhere. It is a universal language among educated people and can be translated in Petrograd, Vienna, Paris, London or New York. Also, as a rule, it cannot be read by the patient. It expresses a thing in terms with which he is not acquainted. This is often most desirable. There are many good reasons why one ought not to let the patient know exactly what he is getting. If salt and water were ordered instead of sodium chlorid, the patient might think that the doctor did not know any more than he did about such things. That, then, is a reason for using the Latin language. However, a prescription written in good English is preferable to one in poor Latin. The tendency to employ English is increasing every day. Those not familiar enough with Latin terms to write a prescription in Latin had better write in English.

Take Benzoic Acid ʒi=4 00

Now, one can translate that into the terms of the metric system. As has been said, the unit of weight in the metric system is the gram, that is, about 15.5 grains. Now as a dram is 60 grains, a dram would be about four of those grams. In using the metric system it is customary to have the prescription blank divided by perpendicular lines, one side of the line representing grams, the other side fractions. The way to transpose a dram into grams is to multiply it by four.

Now to that can be added:

Tincture of Krameria ʒiv=16 00

That is simply a vegetable bitter with some astringent qualities, often used as a mouth wash.

Four drams of that equals a half ounce. This is a liquid, expressed in terms of fluid measure, 16 grams in weight or 16 c.c. by measure. The gram is the weight of a cubic centimeter of a liquid at a certain temperature, so that 4 drams will equal four times as many grams or cubic centimeters, which in America is the term generally in use in speaking of liquids. In the Continental system it is generally weighed; in America it is generally measured. Sixteen is either grams or cubic centimeters, as one pleases.

Oil of Peppermint Gtt. xx=1.25

Gtt. is an abbreviation for *Gutta,* the Latin for drop. Here there are 20 drops. Now, as a gram is equal to about 15 grains, or 15 drops, by a very simple arithmetical process one can conclude that 20 drops will equal about 1.25 c.c., which will be expressed in this way. Usually this is carried out to the milligram place. That means that oil of peppermint, 20 drops, or 1.25 grams is to be taken.

To that let there be added:

Alcohol *qs. ad* iv

enough to actually make up four ounces. *Qs.* means *quantum sufficit; ad* means *up to.*

4 x 30=120 grams, or 120 c.c.

Here, then, are the ingredients. To recapitulate: oil of peppermint 20 drops, or 1.25 c.c. (Remembering that a gram equals 15 grains in liquid measure, a cubic centimeter equals 15 minims or 15 drops, so that 20 drops will be a gram and a quarter.) Alcohol is then added in sufficient quantity to make four ounces. This covers the ingredients.

Next is written the sign M, which means to mix together; followed by *et Sig.*, meaning mix and mark. How is the pharmacist going to mark this? "One-half teaspoonful (and the word teaspoon is allowable in such prescriptions) in a glass of water for mouth wash." Of course the term *teaspoon* is inaccurate. It is not allowable if a powerful agent is used. In a not very powerful mouth wash one is perfectly justified in using *teaspoon* for a measure. One-half dram, or two cubic centimeters, might be substituted for *teaspoon,* and would be more accurate.

In regard to signing a prescription, the careful dentist will have a blank and write his name. He will not have his signature printed. If he did, anyone could take the blank and have it filled. So, if his name is *John Jones,* he will write it; and if he has D.M.D. at the top, it will not be necessary at the bottom. That, however, is really a matter of individual taste. Yet one reason why the title should be put there is that it makes the signature official and shows the patient that one is signing as a registered dentist, which on the whole it is as well to indicate. Then follows the complete prescription in its proper form:

JOHN JONES, D.M.D.

125 Beacon St., Boston. Tel. B.B. 101

For Thomas Smith.

℞

Acidi Benzoici	ʒi = 4 00
Tinct. Krameriae	ʒiv=16 00
Olei Pepperminti	Gtt. xx=1.25
Alcohol qs. ad	℥iv

M et Sig.: One-half teaspoonful in glass of water for mouth wash.

John Jones, D.M.D.

That is a form which will surely pass muster. If one can write a prescription according to that form, he will be able to satisfy the patient that he is up-to-date as far as prescription writing is concerned. There are plenty of text-books to which reference can be made in the matter of prescription writing, and it is essential that any up-to-date dentist should be able to write a passable prescription. It is, perhaps, a matter of advertising, but it is also a matter of showing to the public and to one's patients that one is up to modern requirements in these matters. Of course, the dentist does not have occasion to write prescriptions as often as does the medical man, because he does not use drugs so much.

Summary.—An attempt has been made here to show in a very brief way the general principles of prescription writing and the method of transposing from the metric system to apothecaries' weight, and vice versa. To recapitulate: there are certain things to be borne in mind, and first is to get the idea of what a *gram* is. That is the unit. Then comes the term *cubic centimeter,* and that is explained by recalling that a centimeter is a hundredth part of a meter; or, in other words, it is something like one-third of an inch. A *meter* is the ten-millionth part of the distance from the equator to the pole.

The Standard Meter.—The unit of the whole system is the meter. The distance has been pretty accurately determined, and most governments have a platinum rod that is exactly, as far as government authority can make it, a meter; and it is made of metal that does not shrink or expand very much with changes of temperature.

Apothecaries' Weight.—The standard of apothecaries' weight is very variable. It is based on the grain, and when man first began to measure things, the unit was a grain of wheat well dried, which of course is very variable. The one-meter metal rod referred to is kept in the Bureau of Weights and Measures as a standard. So the great advantage of the metric system is in having a stable unit. That old table, 60 grains make a dram; 8 drams make an ounce; and 12 ounces make a pound will probably be remembered. There is no relation between them. It is a matter of clear memory. On the other hand, 10 meters is a dekameter, 100 meters a hectometer, and 1000 meters a kilometer. There is something that is easily remembered and is so comparable to our American system of money that it makes it very much easier to remember; and, as has been said before, the metric system would probably be learned for the first time in half the time that one would learn the other.

One or two other things can be said in regard to the metric system. In measures of capacity the unit of liquids of large amounts is the liter, which is a kilogram by weight. A kilogram is 1000 grams and a liter weighs 1000 grams. One thousand grams of water at 4° C. is a liter. The term liter is not often used in prescribing, so that it is not specially important. Some of the essential things about the metric system of weights and measurements have now been reviewed and something has been learned in a general way about prescriptions: the ability to write them depends now upon careful reference to the text-book on the subject.

ANALGESICS

A word can be said here about specific drugs, some of the drugs that are particularly interesting to the dentist.

Opium.—One of these drugs is opium, because opium is a drug that dentists have occasion to use. It is the king of analgesics and one of the most powerful of these agents that there is. It is known that there exists in this country a certain law under the provisions of which one must prescribe certain drugs, and among them opium. Certain conditions are defined under which the drug must be prescribed. A fee of one dollar must be paid and registration made. There are also certain restrictions in regard to the way in which the drug can be bought. Dentists are subject to that law, but they have just as much right to prescribe opium as medical men have.

Opium is a vegetable known technically as *Papaver somniferum,* the sleep-producing poppy. The poppy tribe has various branches, but this particular kind is the sleep-producing poppy, so called because it makes a man sleep if he takes very much of it. Opium, as it is known in commerce, is the dried juice of the poppy plant. The juice exudes and collects in a sort of globule or ball, and is thus obtained in the form of crude opium. This is usually of a dark brown color. Opium yields its active principles to water fairly well, in the form of a tincture. It can be prescribed in its crude form. The tincture of opium, known as laudanum, is ten per cent in strength.

So that when a certain amount of laudanum is prescribed one is prescribing a certain percentage of opium. The most important alkaloid of opium is morphin.

Physiological Action of Opium.—The effect of opium upon the digestive tract is to check secretion and stop action. If opium is swallowed the juices of the stomach are dried up and the peristaltic action of the digestive tract is checked. The result is indigestion and constipation. The action of the drug is to check all the secretions of the body excepting those of the perspiratory glands.

Pain.—Opium relieves pain, and that is the main reason for its use. Everyone knows what pain is and everyone knows when he has a pain. In order to define pain one must consider what causes pain and thus arrive at the definition. Pain is caused by injuring a sensory nerve. Pain itself is the knowledge of the injury of the sensory nerve. One must ask, then, what does opium do and how does it relieve pain? It controls pain by destroying the conductivity of the nerve which conveys the sensation of pain to the receptive centers of the brain. The higher nerve centers are made up of certain areas, among which are the receptive centers. If when walking along the street one sees an automobile coming, he gets an idea of danger from his eyes; this is conveyed to the receptive centers which comprise his area of knowledge. This information tells one what to do. This is a direct physiological problem. The receptive center is the center that receives impressions and that records the impression of pain. Now opium inhibits the response by destroying the conductivity of those nerves which should convey the knowledge of the injury of a sensory nerve to the receptive center. No message has been carried to the brain and therefore no pain is felt. That is the reason why dentists are justified in prescribing opium, because their patients are suffering from pain about the jaw and other places, and it is justifiable to prescribe the drug to relieve this pain.

Objections to Use.—The main objections to the use of opium are that it destroys to a certain extent the digestive powers; the patient's mouth becomes furred; he is constipated and has no appetite. Another objection is the danger of habit-forming, therefore it should not be prescribed for continued use. A single dose only should be prescribed and the patient always cautioned as to the danger of repeating the dose without consulting his advisor. The prescription should contain the abbreviation "N.R." (*non repetatur*). The form under which opium will be prescribed will be, as morphin, furnished as a sulphate, a white powder like the alkaloid. It is soluble, and for the average adult the dose is about a quarter of a grain. Now a grain is, roughly speaking, 65 milligrams, so that a quarter of a grain would be about 15 milligrams. To the average adult it may be administered either subcutaneously or by the mouth; this would probably be the main way in which this drug would be used in practice.

Coal-tar Series of Drugs

Analgesics in Neuralgia.—There is also the coal-tar series of drugs, which include acetphenetidin and the salicylic acid series, including acetanilid and acetyl salicylic acid,—analgesics of no mean value. The distinction between the action of the coal-tar series and opium is that the coal-tar series are applicable only to a certain kind of pain. Ordinarily a man will get but little relief for pain inflammatory in its nature. In a case of a suppurating root little relief can be obtained by administering these coal-tar drugs, but if the pain is simply neuralgic a certain amount of relief from pain will be obtained.

Attention should be called here to acetanilid, acetyl salicylic acid and acetphenetidin. These three drugs are all agents of value in the treatment of pain which is of a neuralgic character and not due to inflammation. Any one of these drugs can be taken in dosage of about one-half a gram for the average adult dose.

ACETANILID.—Acetanilid exists as a white powder not easily soluble and can be given in tablet or powder form, in dosage of half a gram (7.5 grains), every three hours, for neuralgic pain. It is more or less depressant to the circulation, and those who take a great deal are apt to show bad results. It is an ingredient of most of the popular headache powders, and patients are seen who suffer from periodical headaches, with a livid color of the skin which suggests a breaking down of the blood, and that is just what does occur from continued use of this drug. It is a dangerous drug for self-administration.

PHENACETIN.—Phenacetin, or acetphenetidin, is also a white crystalline powder which has been brought to the attention of medical men and dental men as an improvement on acetanilid, on the ground that it is less depressant to the vital functions. There is perhaps some justice in that claim, although there is not nearly the difference which the literature on the subject would lead one to suppose. It is better to use acetphenetidin than acetanilid.

ASPIRIN.—Aspirin exists in the form of white crystalline needles, and should be always ordered under the name of acetyl salicylic acid and not "aspirin," as the latter is a trade-mark name and would subject the dentist or his patient to extra expense.

There are many other commercial drugs for the control of pain, but if one keeps clearly in mind these—*opium* or its derivatives, *acetanilid* or *a. salicylic*—one has practically all of value; and one need not be misled by circulars from manufacturing chemists stating that they have found new compounds of exceptional value. That sort of thing is continually met with and the dentist or medical practitioner who uses everything called to his attention is apt to be a very unscientific man.

Pope's lines

> "Be not the first by whom the new is tried
> Nor yet the last to lay the old aside"

constitute a very good rule to follow in the use of these new remedies. Let them be tried in the laboratories; let the physiological experimenter tell what these products will do before they are poured into the patient's system.

ASTRINGENTS

Next in the consideration of drugs are Astringents. These are particularly interesting to the dental profession, because they are used locally to a certain extent. They are drugs that condense or draw together tissue, making it more compact. When put inside of the mouth they first dry up all the natural fluids.

Astringents are of two classes, vegetable and mineral. The mineral are more powerful; they include salts of copper, particularly sulphate of copper, blue vitriol, which may be used at a strength of one-half to two per cent for an astringent wash.

Alum.—Alum is a very common agent which exists in the form of whitish crystals, not very soluble in water. Burnt alum, that is alum deprived of its water of crystallization, exists in the form of a coarse powder, and is an excellent mineral astringent.

Acetate of Lead.—Acetate of lead, or sugar of lead, may also be used in a weak solution as an astringent agent, but it is not commonly so used. The distinction between an astringent, an irritant and an escharotic is one of degree rather than of kind. A weak escharotic may be astringent; a more powerful astringent may be an irritant; a more powerful irritant an escharotic.

Tannic Acid.—Tannic acid is an important agent among vegetable astringents, and exists as a powder having a bitter taste, fairly soluble in water; a valuable astringent for the general purposes for which astringents are used. It may be used at any strength up to a saturated solution (as much as water will take up). Tannic acid is made from nut-galls.

Krameria.—Mention might be made here also of krameria, which was spoken of above in connection with correct prescription writing, and which many leaders of the dental profession value as an astringent more than almost any other.

Witch Hazel.—Then we have hamamelis, or witch hazel, —a household remedy to be found on the shelf of almost every kitchen in New England.

Oak Bark.—Quercus or oak bark, in the form of an infusion, is also a valuable astringent.

Caustics or Escharotics.—The agents used to destroy tissue are *caustics* or *escharotics,* and attention is called to trichloracetic acid, which exists in the form of crystals fairly soluble; it will tend to destroy neoplasms pretty effectually.

Lactic Acid.—Pure lactic acid is a powerful escharotic. Nitric acid is the caustic par excellence among mineral acids; applied to neoplasms it is pretty sure death, but it is somewhat painful in its action.

Silver Nitrate.—Silver nitrate is also a very important agent, and is classed here as an astringent because it is that, and also an escharotic to a certain extent. It is soluble in water, and in a strength of from one per cent to ten per cent silver nitrate is one of the most valuable astringents and escharotics which we have. It is not painful in its action ordinarily. It has been used largely in the dental profession for treating pulps. Literature on the subject tells a great deal about nitrate of silver in the practice of dentistry.

Arsenic.—Of course arsenic is one of the escharotics used for the devitalization of the pulp of a tooth; most dentists know about that.

DISINFECTANTS

Disinfectants, or antiseptics, are next to be considered. Strictly speaking there is a difference between the two. Anything that arrests bacterial action is an antiseptic. It may not be a germicide. A germicide destroys the power of the germ: while an antiseptic renders the field less fertile for the growth of microörganisms. The use of antiseptics is very extensive, probably more extensive than the facts of the case warrant; for if an agent sufficient to destroy the germs is used one may also destroy the tissue itself.

In the mouth the problem of asepsis is more difficult than on the surface, because the oral cavity is lined with mucous membrane which one cannot scrub, and it is more absorbent, more easily affected by septic material; and so the hope of getting an antiseptic mouth is pretty faint. Practically it cannot be done. What can be done, however, is to get a fairly clean mouth; and those who have worked over a variety of mouths know how desirable it is to approximate cleanliness in the oral cavity.

Phenol.—There are several agents to be used for cleanliness. One of the oldest and most popular is *phenol,*—carbolic acid it used to be called. Phenol exists as crystals, which liquefy at the average temperature in summertime, and is a powerful germicide and disinfectant; in sufficient strength it will destroy the germ of any known disease and it also destroys the tissue. Care must be taken not to have the solution too strong. A 3 per cent solution of phenol applied to the hand produced gangrene in one case. Of course in that case evaporation was prevented and the continued action of the drug maintained. Caution must be used in regard to the strength of phenol for continuous action,—one-half to one per cent is strong enough.

Hydrogen Peroxid.—Peroxid of hydrogen is H_2O_2,—

a watery solution of the gas which produces effervescence when brought in contact with albuminous tissue, liberating oxygen.

Bichlorid of Mercury.—Bichlorid of mercury is one of the most powerful disinfectants. It exists in the form of a powder,—in strength of 1 to 1000 to 1 to 5000.

Alcohol.—Alcohol is an antiseptic of some value,—not powerful, not destructive of all pathological germs, but it dissolves sebaceous matter and helps carry off secretions of the hand or flesh anywhere, making it fairly clean.

Iodin.—Iodin in the form of a tincture has come to be one of the most highly valued antiseptics which we have. A monograph by a surgeon on the treatment of incised wounds recently stated that instead of opening up the wound as surgeons formerly did they deeply probed with gauze soaked in tincture of iodin, wiped out the wound, and got as good results as if they had opened it up and drained it. Most surgeons use iodin in the tincture form to clean the field of operations.

Creosote.—Creosote is an antiseptic of some value, formerly used for its obtundent properties.

Boric Acid.—Boric acid used in a saturated solution is a valuable antiseptic.

DENTIFRICES

Cleansing Preparations.—In regard to the use of preparations for cleansing the mouth and the teeth there are three forms ordinarily in use,—the liquid form, the powder form and the paste form; each man has his favorite formulae for them. It seems that some caution should be exercised in the use of the commercial powders, many of which are dangerous for the teeth of the patient. Not long ago a series of articles on tooth powders showed that many of the commercial tooth powders contain chalk enough to wear off the enamel of the teeth, and it was demonstrated that one could take a live tooth and cut it off with that powder if one rubbed long enough. A powder which has been tried with excellent results consists of 95 parts calcium carbonate, about 3 parts Castile soap and about 1 to 1½ parts oil of birch or oil of peppermint.

A preparation for a liquid mouth wash consists of boric acid 5 parts, sodium boras 18 parts, resorcinal 18 parts, cologne water 200 parts and sterile water 500 parts. It would be a good thing for dentists to prescribe even toothpaste, etc., for their patients, as it would save the patients' money and increase their confidence in the dentist.

PHARMACOLOGY OF NOVOCAIN AND COCAIN

Local Anesthesia.—Local anesthesia is of somewhat modern origin, as far as practical results are concerned. It was the dream of the old surgeons that anesthesia might be attained, so that suffering from operations on the body might be abolished. The subject of general anesthesia has been handled by Dr. Freeman Allen very thoroughly and satisfactorily. Therefore this chapter will be confined to local anesthesia.

Previous to 1884 attempts to produce local anesthesia were somewhat unsatisfactory. Such methods were resorted to as the application of a freezing mixture and the cutting off of circulation, but none of them produced good results. Today there are agents which, injected into the tissue at any particular point, produce a degree of anesthesia sufficient for ordinary surgical purposes.

Ethyl Chlorid.—There are among the freezing mixtures the one known as *ethyl chlorid,* with which most dentists are familiar. This is made by the combined action of hydrochloric acid and alcohol and exists under ordinary temperatures as a gas, but is easily liquefied.

Under a pressure of about two atmospheres it becomes a clear, colorless liquid of a rather agreeable odor and sweetish taste. It is put up ready for use in tubes, from which the liquid can be released under suitable pressure, when it immediately vaporizes and produces an amount of local anesthesia which is satisfactory. If it is necessary to open an abscess or boil with the ordinary novocain and cocain solution, the skin must be pierced, which is painful. It therefore seems the perfection of technic to throw upon the skin a vapor like this, which renders it practically insensible, and then the needle can be introduced without pain.

Cocain.—Cocain was the pioneer agent in the matter of injected substances for producing local anesthesia and is an alkaloid of coca. The coca plant itself may be briefly considered here. When the Spaniards invaded Peru, they found that the leaves of the coca plant were used to a very large extent by the natives, who used them so that they could go without food much longer; and couriers who ran long distances to convey tidings carried coca leaves and chewed them on the way so as not to be obliged to stop to eat. Undoubtedly the effect was to produce a certain amount of numbing of the gustatory nerves so that the man did not sense the fact that he needed food, and therefore was able perhaps to get along with less craving for the natural food that he would ordinarily take. The plant temporarily stimulates respiration and circulation, so that under the influence of it a man would have a harder pulse and would breathe with more force. It produces a certain amount of exhilaration, not like that of alcohol, but a sense of well-being and general feeling of comfort. This is probably brought about by sending more blood to the brain. It also gives a sense of happiness. It tends to increase the amount of urine, but the amount of urea is lessened. It checks metabolic waste. Under large doses, there is a feeling of incoördination, and some delirium. By using cocain in its condensed form a local anesthesia is obtained. It is a cerebral and cardiac stimulant, and is used to dilate the pupil of the eye. In large doses it causes a feeble, intermittent pulse, a jerky, disturbed respiration and a mental condition of great depression and anxiety, and this is liable to come on very suddenly.

Danger in Administration.—The patient begins to act strangely; his pulse is quick, intermittent and jerky; he begins to get very anxious and may say "Doctor, I feel terribly. I think I am going to die." He becomes delirious and may get convulsions. The thing to do under such circumstances is first to get blood to the brain. This is best done by lowering the head and lifting the heels. Amyl nitrite, which tends to flush the superficial blood vessels, may be used. Another treatment of this condition is to use aromatic spirits of ammonia. This seems to act as a stimulant of the respiration or the cardiac functions pretty promptly. Strychnin used subcutaneously is also of value. The dose is one-thirtieth to one-sixtieth of a grain. If the patient stops breathing the only thing to be done is to use artificial respiration. That is the sheet-anchor in restoring these desperate cases. Any quick-acting stimulant is of value. Sulphate of strychnin and alcoholic stimulants act much in the same way as aromatic spirits of ammonia.

Effects of Cocain.—The effect of cocain is to produce local anesthesia. It is a protoplasmic poison. The production of local anesthesia depends to a certain extent upon the paralysis of the sensory nerve in the part affected, and this is ordinarily increased by preventing the return of the venous blood. If it is necessary to open a finger, it is better to put a rubber band around it and by so doing the solution is held in the point where it is wanted. The addition of some agent which will tend to constrict the blood vessels is the modern method of administration of a drug like cocain. The modus operandi of injecting cocain is like that of a surgical operation, and should be treated with all the precaution that modern aseptic surgery demands.

Aseptic Precautions.—When the drug was first used there were horrible cases of sepsis. Cases have occurred where the jaw bone has been nearly denuded through necrosis of the tissue because of the injection of cocain into the gum. This was not the result of cocain as a drug, but the result of a septic operation. The dentist did not understand the necessity of cleanliness, and introduced the drug into the gum with a dirty syringe without particular care as to whether the solution was sterile or not. The things to consider in this operation are, to get the field as sterile as possible, to cleanse it as thoroughly as may be, and to paint it lightly with tincture of iodin.

Validol.—There is an agent known as validol, one of those preparations apparently made up of menthol and valerianic acid which is alleged to be valuable in the treatment of cocain poison. However it seems less valuable than the agents just considered, and one is open to the criticism of furthering a commercial enterprise when prescribing it.

Disadvantages of Cocain.—There have been various attempts to improve upon cocain, for the reason that it produces such serious results in some cases, and also for the reason that it is not easy to get a sterile solution of cocain. It does not stand boiling well. Various attempts have been made to get agents similar to cocain.

Novocain.—The result of all this investigation has given us what we know as *novocain,* which appears to be today the best and most valuable substitute for cocain. It is a chemical synthetical compound which apparently does what cocain does and with less danger. It is claimed for novocain that it is five to seven times as safe as cocain. With common doses the chances for serious results are about one-sixth as large. In solution in water it can be sterilized by boiling, which is another point in its favor. It is usually administered with epinephrin and easily penetrates the mucous surface. Those are the advantages of hydrochlorid of novocain. The modus operandi of injecting cocain or novocain is first to get a sterile surface to operate on, then have a sterile syringe. The syringe must be boiled for from five to fifteen minutes, using a normal salt solution or plain sterile water. With these precautions the dangers of novocain are practically eliminated. For five years there has not been a single case with serious results from the injection of cocain or novocain. This is perhaps largely due to the fact that aseptic methods are used by those who attempt to do this sort of work. The strength of a novocain solution may vary from one to ten per cent. For application to the nose or throat a solution of from five to fifteen per cent is recommended. A formula is here given for making a solution for external use: one gram (or 15 grains) with 100 c.c. of sterile water; solution of one per cent strength. A tablet is furnished that combines epinephrin, about 0.005 of a grain or 0.3 of a milligram, with novocain, 0.33 of a grain. One of these tablets in a cubic centimeter of water gives a 2 per cent solution.

Aside from the uses of ethyl chlorid and novocain for local anesthesia, there are the aromatic oil series, the oil of cloves, etc., and the routine treatment ordinarily for toothache is the application of some of these mild local anesthetics, especially oil of cloves and creosote.

CHAPTER V

PRE-OPERATIVE AND POSTOPERATIVE MEDICAL CARE OF PATIENTS

William E. Preble, A. B., M. D.

Medical Care of Patient Essential.—The general condition and care of patients before operation and their care immediately after operation and through convalescence are factors of great importance in surgery. In many cases attention or lack of attention to what I may call the *medical* care of the surgical patient makes the difference between life and death, and in many more cases, between a short and a long convalescence. In the past few years much has been added to the store of knowledge in this field of medicine. The general principles of pre-operative and postoperative care are the same for soldiers as for civilians, though with soldiers in the field the best conditions can only be approximated, partly because much of the surgery is emergency work and partly because the best facilities for work are unattainable.

Pre-operative Factors.—Factors that should always be considered before any operation is undertaken are (*a*), the presence of systemic disease; (*b*), the general condition of the patient as regards fatigue, starvation, and mental condition; (*c*), the psychic factor as influenced by bodily comfort and surroundings; and (*d*), the immediate preparation for the operation, including diet, care of bowels, etc.

COMPLICATING SYSTEMIC DISEASES

Chronic Conditions.—A careful and complete physical examination should always be made before any operation is performed. The presence of acute infections, general or local, should be noted. Chronic infections such as tuberculosis and syphilis should be ruled out for obvious reasons. The condition of the heart should be noted, although heart lesions, unless badly decompensated, are not, as a rule, contra-indications for surgery. Kidney disease is more serious, not only as affecting the eliminative functions and introducing the danger of uremia, but also because many patients with chronic kidney disease have an accompanying acidosis which may menace the life of the surgical patient. A point to bear in mind in regard to nephritis, when choosing the anesthetic, is that nitrous oxid raises the blood pressure 30 to 50 mm. and may be very dangerous for patients with an already existing high blood pressure. Diabetes mellitus and Graves' disease should always be ruled out, as advanced cases would be subjects for surgery only in cases of grave necessity. A careful examination of the urine should always be made before operation.

GENERAL CONDITION OF PATIENT

Dangers of Acidosis and Acapnia.—The condition of the patient as regards exhaustion, starvation, insomnia and great emotion or excitement is particularly important in army surgery, as all of these conditions may be accompanied by an acidosis of sufficient severity to render the administration of an anesthetic very dangerous to the patient. Cotton [1] has shown that extreme excitement and hysteria may induce very rapid breathing and thereby cause the condition known as acapnia, due to a diminution of the normal percentage of carbondioxid in the blood. As carbondioxid is the normal stimulant of the respiratory center, inhalation anesthesia would be very dangerous to a patient in this condition, as respiratory depression, or even paralysis, might ensue. In lesser degrees of acapnia, there may be loss of venous tone, which may be an important factor in surgical shock, and loss of tone of the stomach and bowel musculature, predisposing to acute dilatation of the stomach and bowel,—the dreaded paralytic ileus. A few hours' sleep (giving an opiate if necessary) would restore the CO_2 balance to normal, and eliminate the dangers from acapnia.

ACIDOSIS AS A FACTOR IN SURGERY

The presence of an acidosis, or acidemia, may be of grave import to a surgical patient. Acidosis is an abnormal increase of the acid element of the blood. It is probably a much more common condition than is generally realized, and is undoubtedly responsible for many deaths in surgical practice. In the past few years much valuable work has been done on this subject. L. J. Henderson [2] in a wonderful series of articles has done much to explain this condition. The experimental work of Crile [3] on acidosis and anesthesia, of Peabody [4] on acidosis in cardiac and renal conditions and of Marriott and Howland [5] on phosphate retention and acidosis in nephritis should be given careful attention. Whitney [6] gives an excellent summary of the subject in a recent issue of the *Boston Medical and Surgical Journal.* A brief statement of the main factors in this condition may be of some value in explaining its importance in surgery.

Balance of Acids and Alkalies

Metabolism.—Normally, the balance of acids and alkalies of the blood is maintained at a very constant level. The chief constituents affecting the reaction of the blood are the alkaline radicals, Na, Ca, Mg, and K, and the phosphates, carbonates, and free CO_2. There are other factors, but they are relatively unimportant.

When, for any reason, there is an increase in the acid content of the blood, there is a general shifting of hydrogen ions. The phosphates are changed, some of the alkaline phosphate becoming acid phosphate; some of the carbonate becoming bicarbonate; and some of the bicarbonate loses its alkali, and free carbonic acid is released. The increase of carbonic acid in the blood stimulates respiration and the increased ventilation quickly reduces the CO_2 percentage in the blood to normal, provided the addition of acid to the blood is not too great. The kidneys are also an important factor in maintaining the acid content of the blood at a constant level, as they have the power of excreting either acid salts or alkaline salts as may be necessary to maintain the normal balance.

This mechanism is ordinarily very efficient, but, in extreme cases, the acid production may be so great that the lungs and kidneys are unable to keep the acid content of the blood below normal limits; the CO_2 first stimulates, then depresses, finally paralyzes the respiratory center, and death ensues from respiratory paralysis.

Acids are formed normally to some extent in the body metabolism. Among foods, meat and most cereals produce acids; and most fruits and vegetables produce alkalies.[7] The organic acids in oranges, lemons, grapefruit, tomatoes, etc., form alkaline carbonates when absorbed, and help neutralize the acids in the blood. Vigorous exercise, exhaustion, starvation and insomnia cause an abnormal acid production.

Incidence of Acidosis.—Acidosis may develop with decompensated hearts, in nephritis, diabetes mellitus, with certain infections (especially pneumonia), during inhalation anesthesia, and after surgical operations; hence the importance of the condition in surgery. The withholding of food immediately before and for many hours after operation, together with the anesthetic, may cause sufficient increase in acid production to cause respiratory paralysis and death. In other cases an acidosis may be the cause of persistent postoperative vomiting, and be conducive to shock. Patients with decompensated hearts, or with impaired renal function, should be the objects of especial care to avoid the dangers of acidosis.

Treatment of Acidosis

Alkalies.—If the kidney function is not impaired, alkalies may be administered freely, together with plenty of fluid, but if the kidneys are diseased and cannot excrete the salts, care must be taken not to give too much alkali, as too great a concentration of salts in the blood is dangerous. In any case, the administration of alkalies should cease when the normal balance is restored—i.e., when the urine is neutral or very slightly alkaline, as prolonged use of alkalies causes lassitude and general weakness.

Excess Alkali Diet.—Mild cases of acidosis should be treated by regulating the diet, if time and conditions will permit. Practically all of our ordinary vegetables and fruits (except prunes, plums, and cranberries) give an alkaline balance when ingested, the citrous fruits (oranges, lemons, grapefruit, etc.) being particularly valuable, as the juice can be given in pleasant drinks. Beans, peas, carrots, beets, potatoes, tomatoes and melons all give considerable excess alkali. Milk has very little excess alkali, but with limewater added makes an excellent food for these patients.

The meats all give an excess of acid, lean pork containing the least acid, and chicken the largest amount. The common cereals and breadstuffs all give an excess of acid, rice the lowest and oatmeal the highest. Eggs have a fairly high excess acid. The diet for patients with an acidosis should contain plenty of fruit (especially orange, lemon and grapefruit juice), cream or milk soups with vegetables, such as potatoes, carrots, peas, beans, spinach, lettuce, etc., and milk and cream with limewater or French Vichy added. It may be necessary to give some sugar in order to help restore to normal the fat—carbohydrate metabolism.

Gruels made of cereals, meat broths, and eggs, or egg drinks, are contra-indicated.

The diet should contain plenty of fluid, to assist the kidneys in eliminating the excess of acid salts, and the patient should, of course, have plenty of fresh air to enable the lungs to excrete the excess of carbonic acid.

THE PSYCHIC PREPARATION FOR SURGICAL OPERATIONS

To the ordinary person, a surgical operation has a peculiar horror. This feeling of fear may be so intense as to be a factor, not only in the comfort of the patient, but even in the result of the operation, as has been demonstrated by Crile. Much can be done in the way of reassurance if the nature of the operation is explained, and if the patient is told of the very low mortality accompanying anesthesia and most surgical operations. The patient should have a good sleep the night before the operation, even if an opiate is necessary. It is very desirable for the patient to go to the operating table with confidence in the surgeon and with nerves well under control.

THE PRE-OPERATIVE MEASURES

Diet.—Ordinarily, the usual full diet should be given up to the night before the operation. If the digestive tract is normal, it should be remembered that the stomach will empty itself in four to six hours or less, and the small bowel in about eight to twelve hours, so that if the patient does not take breakfast, the colon is really the only part of the gastro-intestinal tract that needs attention. An enema the night before and another in the morning before the operation is sufficient preparation.

Catharsis.—Of course if the intestinal tract is not acting normally, a cathartic may be required the day before the operation. It should be remembered, however, that a perfectly well-behaved bowel may have its functioning ability very much impaired by drastic catharsis. Even if the operation is to be a laparotomy, the attempt to turn the bowel inside out, with the accompanying irritation and congestion of the mucous membrane, can only do harm. Excessive irritation is conducive to later paralysis, and an absolutely empty bowel is apt to fill with gas.

Complicating Conditions

Diabetes—Nephritis.—If the patient has systemic disease, much more careful preparation may be necessary. Diabetics should not be operated until they are free from sugar and acidosis. Patients with chronic nephritis should be put on a low protein diet with plenty of fluid for several days before the operation, and it should be remembered that many nephritics have an acidosis which may not show in the urine. A safe procedure is to give the excess-alkali diet mentioned above. Three pints of milk will contain the necessary daily amount of protein, —about fifty grams.

Cardiac Conditions.—As has been mentioned before, compensated heart lesions do not as a rule contra-indicate operation. If the heart is decompensated and there is edema present, several days on the Karell diet will be beneficial. Karell[8] published his "cure" in 1866. It consists of 200 c. c. of milk at 8 A.M., 12 M., 4 P.M. and

8 P.M. The patient is, of course, kept flat in bed, and no other food or drink is given. Drugs may be used as indicated. Digitalis may be advisable to slow the pulse and opium may be necessary to quiet the patient and stimulate the heart.

Asthenic Conditions.—Army surgeons may frequently be obliged to operate on men who are much fatigued, improperly nourished, starved even, or in a state of great excitement. It is well to bear in mind the fact that all of these conditions may be accompanied with an acidosis of such a degree that the anesthetic may readily produce respiratory depression and paralysis, or a postoperative acidosis with the accompanying persistent vomiting may produce profound shock. If the condition of the patient permits, the operation should be postponed twenty-four to forty-eight hours to allow normal metabolism to become reëstablished. The alkali diet mentioned above, with a good sleep and plenty of water, will produce the desired result. If it is impossible to postpone the operation, alkalies should be introduced. Fischer's [9] solution by rectum—500 c.c. every four hours—is excellent to terminate an acidosis quickly. The importance of sleep and the general comfort of the patient, mental as well as physical, have already been discussed above.

POSTOPERATIVE CARE

Nausea and Vomiting.—Immediately after the operation, if the anesthetic be ether or chloroform, there is usually more or less nausea and vomiting. In some cases, the vomiting is persistent, and may become a very grave and troublesome complication. Probably the anesthetic is a cause in many cases, from direct irritation of the gastric mucosa.

Some cases undoubtedly owe the persistent vomiting to an acidosis. As pointed out above, the patient may have a slight acidosis before the operation, and the anesthetic and operation increase the acid content of the blood beyond the point at which the lungs and kidneys can easily maintain the balance. In these cases, again, the condition should be avoided by proper care *before* the operation.

If in spite of pre-operative precautions the patient develops an acidosis, the most efficient emergency treatment is Fischer's solution by rectum, and fruit juices by mouth. As soon as the patient can eat, the alkali diet should be given. It should be remembered that alkalies should not be given in large amounts after the reaction of the urine is neutral.

Careful Ancsthesia Necessary.—Another factor may be loss of tone of the gastro-enteric musculature, with the accompanying paresis and perhaps dilatation of stomach and bowel. Acapnia may be a factor in these cases, due to the rapid breathing while under the anesthetic, with the resulting diminution of the carbondioxid content in the blood. The treatment here is prophylaxis. The anesthetist should give the smallest necessary amount of the anesthetic, and should give it in such a manner as to avoid the so-called *excitement stage*. A certain amount of rebreathing permits the patient to conserve his carbondioxid.

Postoperative Renal Irritation.—In all cases following ether and chloroform anesthesia, fluids should be given freely to minimize the irritation to the kidneys by the anesthetic. The frequency with which albumin, and in some cases blood and casts, are found in the urine after operations indicates that the condition of the kidneys should be carefully watched, and the irritation reduced to a minimum. The functioning ability of the kidneys is impaired by ether (and probably by chloroform) in direct ratio to the depth of anesthesia. If fluids cannot be taken in sufficient quantities by mouth they may be administered by rectum, subcutaneously or intravenously.

SURGICAL SHOCK

Crile's Work.—The factors that produce the condition known as *shock* are not well understood. Crile has tried to explain the condition as due to overstimulation of the afferent nerves, and has tried to block the impulses from the operating field by injections of local anesthetics,—his famous anoci-association method.

Cannon's Theory.—Cannon,[10] in his last Shattuck Lecture, summarizes in his usual masterly way the clinical signs and symptoms of shock, and explains the condition as due to (*a*) stimulation of the vasomotor center by deficient circulation; (*b*) constriction of the peripheral arteries; and (*c*) "trapping" of the blood in the splanchnic vessels; because of (*d*) constriction of the branches of the portal vein in the liver. He calls attention to the fact that the portal vein lies between two capillary regions,—the capillaries in the stomach, bowels, pancreas, and spleen, and the capillaries of the liver. There is a drop in the blood pressure from about 120 mm. in the aorta, to 10 or 12 mm. in the portal vein, and a further drop to practically zero in the vena cava. If the vessels in the liver are constricted, there may not be sufficient force behind to drive the blood through, hence the accumulation in the splanchnic area. The problem in shock, then, is to get the blood out of this area and back into the general circulation.

Cannon thinks that the usual methods of treating shock, i.e., raising the foot of the bed, bandaging the extremities, pressure on the abdomen, etc., are ineffectual. The same is true of the usual drug treatment. Adrenalin is contra-indicated, because it contracts the splanchnic arterioles and distends arterioles elsewhere,—an effect just the reverse of that desired. He suggests the intra-abdominal use of pituitrin, which might constrict the arterioles *outside* the liver, and drive the blood through the liver.

Work of Porter.—Porter,[11] who has written a most interesting and valuable series of articles on shock based on experience at the front in France, has used carbon-dioxid inhalations to increase respiration, and to draw the blood through into the lungs. He says the systolic pressure may be raised from 15 mm. to 30 mm. by this method. The patient's head is put in a closed box, and the CO_2 introduced. Simply letting the patient rebreathe his own breath in the box helps to conserve the CO_2 content, and induce deeper breathing.

It should be remembered in this connection that too great a CO_2 content acts as a respiratory depressant and eventually paralyzes the respiratory center.

Fat Emboli and Shock.—Porter thinks that fat emboli may be the cause of shock in some cases, as soldiers with severe injuries to the large bones are more likely to get in a state of shock than patients with other injuries. He supports this theory with some experimental work on rabbits injected intravenously with olive oil. The rabbits so injected become profoundly shocked.

More work on the whole subject of shock is necessary before we can thoroughly understand the condition, or develop an effective therapy.

POSTOPERATIVE DIET

Early Nutrition.—It is advisable to avoid too long a period of starvation or semi-starvation after the operation. Water should be given freely, but in small quantities, as soon as the patient is out of ether. If the patient happens to be undernourished, nutrient enemata may be given a few hours after the operation, and liquid foods by mouth may be given as soon as the nausea and vomiting cease. Fruit juices, milk with lime water added, milk and cream soups with potato and other soft vegetables added, are indicated.

If there is any question of acidosis, broths, eggs, and cereal gruels are contra-indicated. If the operation is not abdominal, ordinary diet may be resumed as early as the day after the operation.

Distention with Gas.—If there is much distention of the bowels with gas, care must be used to avoid the foods that are apt to ferment, and aerated drinks of any kind are of course contra-indicated as increasing the amount of gas. Egg albumen, broths, and milk are indicated. If sugar is given, it should be milk sugar, or some maltose preparation, as these ferment less easily.

Paresis of Bowel.—If there is paresis of the intestinal tract with acute dilatation of stomach and bowel, lavage is indicated, and should be repeated every three or four hours till the vomiting ceases. It should be remembered that acidosis is frequently a cause of persistent vomiting, and in these cases the urine should always be tested for acetone and diacetic acid.

POSTOPERATIVE CATHARSIS

Cascara.—If the operation is not abdominal the bowel should be restored to its normal routine as soon as possible after the operation. Mild cathartics, e.g. Cascara pill gr. iii t.i.d., in divided doses are preferable to larger doses of physic. If the operation is abdominal, and there is much manipulation of the gut, it should be remembered that the bowel will not return to its normal condition of tonicity for at least twenty-four hours, and cathartics of any kind would not be indicated for at least that period. There can be no general rule that is applicable to all cases.

Cascara in divided doses would be better than the usual calomel and oil, and would avoid all danger of mercurial poisoning, which occasionally occurs in cases with stasis or obstruction. Enemata can usually be relied on to empty the colon, unless there is paresis. Pituitrin is valuable in some cases of distention.

CONVALESCENT CARE

Caloric Intake.—The caloric intake of the patient should be carefully watched. About 1500 calories should be approximated while the patient is in bed, and this should be increased to 2500 or 3000 calories after the patient is up. If the patient is emaciated, even more nourishment should be given. A well-balanced diet should be prescribed. Under any condition, a minimum of 50 grams of protein should be given daily, and after the patient is up this should be increased to about 100 grams. Sufficient fruit and vegetables should be given to move the bowels without a cathartic, and to give the body the necessary salts for the body chemistry. The fat and carbohydrate intake should be varied according to the state of nutrition of the patient,—fat patients being allowed less fat and high percentage carbohydrate foods than thin ones. It should be remembered that the appetite is a very poor index of the needs of the patient, and this is just as true in convalescence as when the patient is in bed.

Intake of Fluids.—The fluid intake is also important. Insufficient fluid puts extra work on the kidneys and is conducive to constipation. From 2000 to 3000 c. c. should be ingested daily by the average person. Careful attention to the diet is the most important single factor in putting the patient speedily into good condition.

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CHAPTER VI

MAXILLARY FRACTURES (MECHANICAL)

Harold DeWitt Cross, D.M.D.

History and Construction of Appliances for the Treatment of Maxillary Fractures

This chapter will deal entirely with appliances, leaving everything in the nature of surgical features for the other part of the course. Unfortunately, in presenting this subject, the writer cannot utilize any models from his own cases, on account of being out of active practice for over five years, as these models belong to the Infirmary where he was previously connected. So that in order to present the subject it will be necessary to depend upon his own experience and upon such textbook drawings as he found most applicable to the illustration of the various cases.

TREATMENT OF MAXILLARY FRACTURES

History.—First in order will be considered the history of appliances for the treatment of fractures of the jaw. This is not merely for the purpose of giving interest or entertainment or even the history of the appliance used in the treatment of these fractures, but to familiarize the reader with the various methods which others have used and which are still in use, with such modifications and adjustments as each individual case seems to demand. It is important to realize that there is in the war today practically no new appliance, used in the treatment of maxillary fractures, which differs materially from those to be shown under the head of "history." The appliances look a little different, they are constructed out of different material, they are modified in this way and that way, but the fundamental principles underlying the application and purpose are taken directly from some of these original ones.

Primitive Methods.—From this standpoint it will be readily seen how important it is that one should become

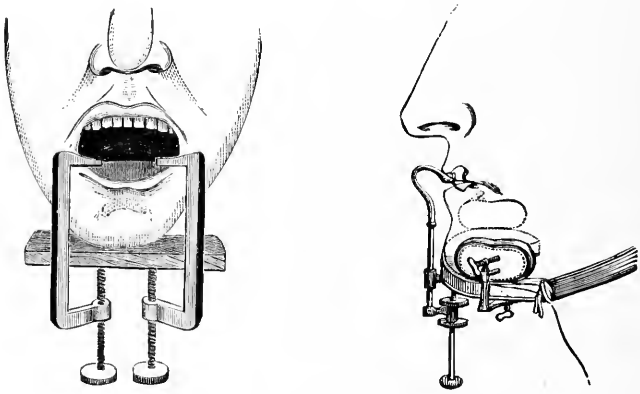


FIG. 44.—CHOPART'S APPLIANCE. (Kingsley.)

familiar with these original appliances, for during the last twenty-five years there has been no particularly new appliance brought out. In beginning the history of these appliances probably the earliest mention which it is possible to find is by Hippocrates in the fifth century B.C., where mention is made of the treatment of fractured jaws by means of ligatures passed around the teeth. The earliest definite appliance to which attention will be called is one that was used by Chopart in 1780, and which appears in Kingsley's "Oral Deformities" (*Figure 44*). It will be noted that this is a rather crude appliance consisting principally of a semicircular piece of thin iron resting on the ends of the teeth and a piece of wood beneath the chin, and from the exposed portion on either side an ordinary machinist's clamp is used to bind the portion in the mouth to the chin piece. One sees appliances of this nature still used occasionally with fairly successful results.

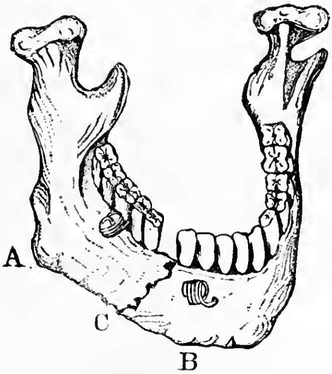


Fig. 45.—Bone Wiring: Modified Form. (Kingsley.)

Bone Wiring. — An old method of wiring the bone was one in which a wire was passed through holes drilled in the bone itself and the ends wound upon a split instrument, making a coil on either end to prevent the wire from slipping out and to force the ends of the bone more closely together. This was sometimes modified, as in *Figure 45* (*Kingsley*), by passing the wire down opposite the root of the tooth and the other end through a

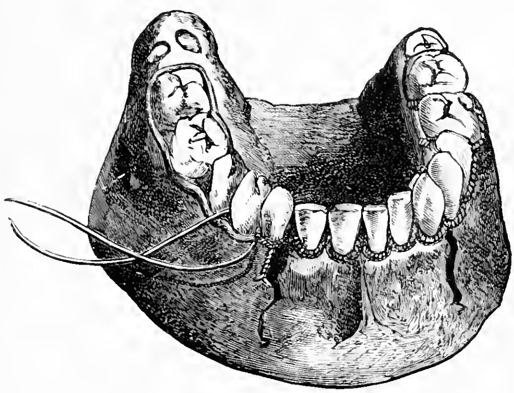


Fig. 46.—Ligature Method: Hammond Modification. (Kingsley.)

hole in the bone, twisting the ends in the same manner.

Ligature Method.—The next adaptation and modification of this method was the use of pins by a *Mr. Wheel-*

house of Leeds. Holes were drilled through the entire body of bone from the lingual to the labial side, and flat-headed pins were passed through these holes and the ends bent over, providing hooks around which a wire ligature was passed. This method was the forerunner of the device in which patella-hooks were used, which were placed in holes drilled in the bone and ligatured in a similar manner to the last method.

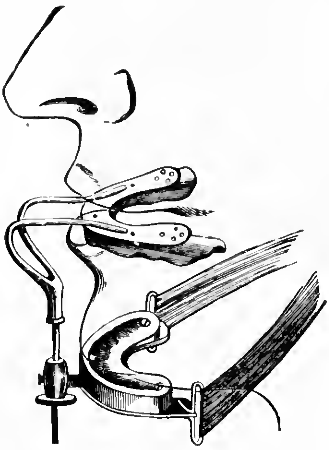


Fig. 47.—Ligature Method: Merged Clamps. (Kingsley.)

The *Hammond splint* shown in *Figure 254* (*Kingsley*) and applied to a model on the preceding page is an adaptation and extension of the ligature method, this splint consisting of a fairly heavy wire, from No. 16 to No. 14 gauge, extending entirely around the labial and lingual surfaces of the teeth, being joined to make one continuous wire. Separate loops of a smaller ligature wire were placed around individual teeth over

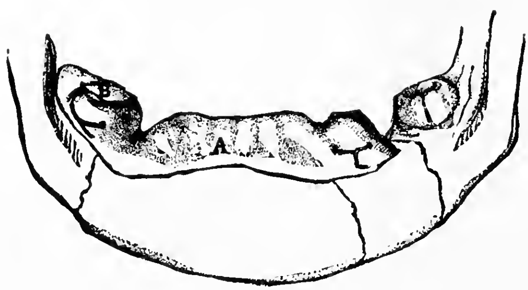


Fig. 48.—Metal Splint Devised by Moon. (Kingsley.)

the wire on one side and around the teeth over and under the wire, between the teeth on the other side and twisted firmly into position. This forms a very useful attachment for such cases as show a displacement only in a horizontal plane. Other fractures where the displacement is in a vertical plane are not so readily held in position by this method.

Figure 47 (Kingsley) shows an appliance where two clamps are merged into one so far as the attachment of the chin piece is concerned, and the upper portions are firmly attached to the iron splint inside the mouth. The chin piece is hollowed out to provide adaptation to the chin and is attached by a bandage to the back of the neck.

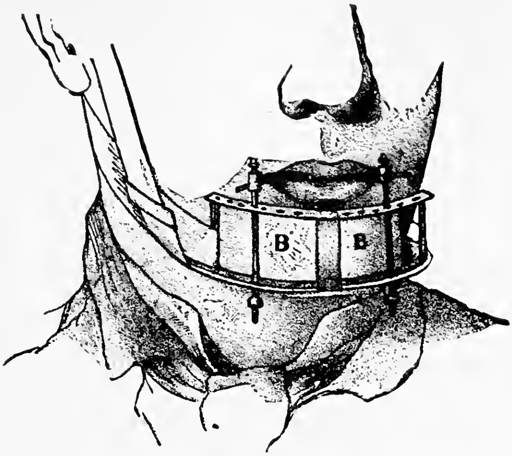


Fig. 49.—Modified Metal Splint. (Kingsley.)

Metal Splint. — *Figure 48 (Kingsley)* shows a splint devised by a *Mr. Moon,* consisting of a partially adapted metal splint which is attached to the teeth by means of wires passed through holes in it and around the neck of the tooth.

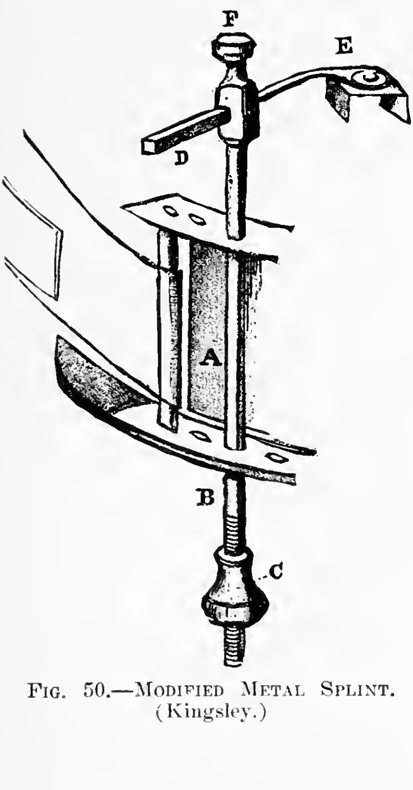


Fig. 50.—Modified Metal Splint. (Kingsley.)

In *Figures 49 and 50*

(*Kingsley*) is shown a modification of this device, in which there is a metal chin piece used, there being a flanged portion of the chin piece in the upper and lower part through which bolts are passed held in place by nuts beneath the flanges. This chin piece was held in place by a strap passing from it around the back of the neck and another one over the top of the head. This, as you may observe, provides a little more substantial apparatus than the previous one.

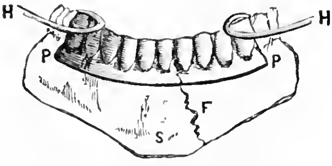


Fig. 51.—Hayward Splint. (Kingsley.)

Hayward Splint.—*Figure 51* (*Kingsley*) is known as the *Hayward splint* and is in a way a modification of the Moon splint, being also made of metal, but more accurately adapted or swaged to fit the teeth. It is provided with metal arms soldered to the upper portion of the splint and so formed as to project out on each side of the mouth for the purpose of carrying the bandage from one to the other beneath the chin. This splint was planned in 1858 by Mr. Hayward

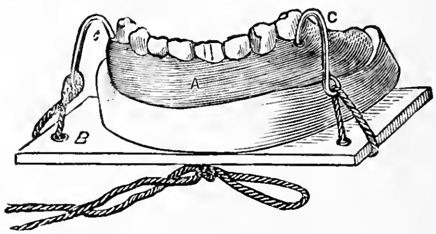


Fig. 52.—Bullock's Modification of Hayward Splint. (Kingsley.)

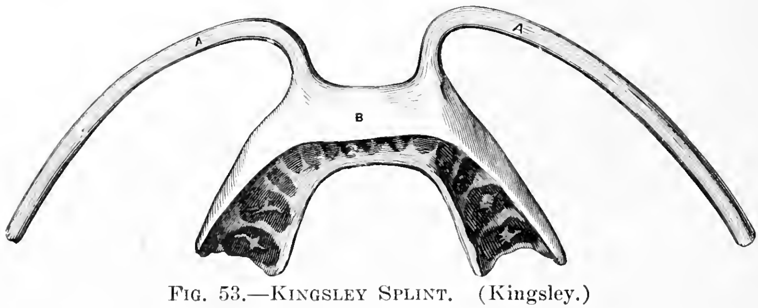


Fig. 53.—Kingsley Splint. (Kingsley.)

of London and is usually considered the first actually fitted splint which was ever devised.

Adaptations.—The next splint, *Figure 52* (*Kingsley*), devised by *Dr. Bullock* of Savannah, Georgia, was made very similar to the Hayward splint except that it was vulcanite in place of metal. Arms were used similar to those of the Hayward splint and it was maintained in conjunction with a wood chin piece, which was attached, not by a bandage, but by stout cords.

Fig. 54.—Interdental Splint (Gunning). (Kingsley.)

Figure 53 (*Kingsley*) is a further modification or adaptation of this same principle. It is known as the *Kingsley splint*, which is usually considered the forerunner of the modern vulcanite splint, and is made with arms or without, either rigidly attached or detachable. These three splints, the *Hayward, Bullock and Kingsley,* form a distinct series in the development of the "fitted" splint.

Fig. 55.—Interdental Splint Used in Confederate Army. (Kingsley.)

Interdental Splint. — The foregoing may in a measure terminate what may be classed as the history of appliances, for, from this time on, practically all of the appliances were modifications of these already referred to. The first of these modifications is called the *interdental splint.* It was constructed by *Dr. Gunning* of New York in 1861, and it practically consists of two splints placed over the teeth of each jaw with a space provided for the passage of nourishment. *Figures 54 and 55* (*Kingsley*) represent an appliance of this nature and show an interdental splint in place on the teeth, a wood chin piece and a strap bandage being applied on the outside. This was considerably used by *Dr. Bean* of Atlanta in 1864 in cases of fractured jaws occurring in the Confederate army.

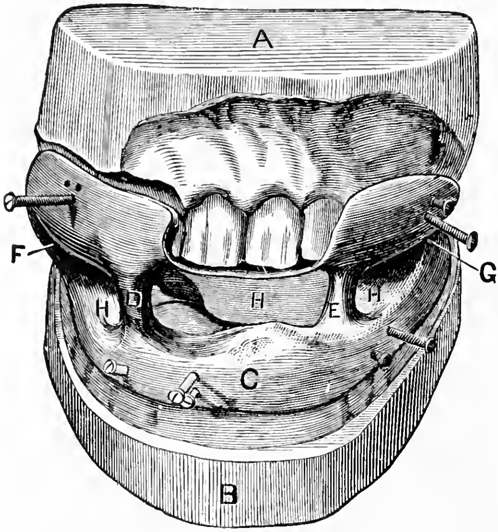


Fig. 56.—Interdental Splint (Allen). (Kingsley.)

Figure 56 (*Kingsley*) represents an interdental splint (a modification of the one previously referred to), by *Dr. Harrison Allen,* attached by means of screws or bolts passed through the interdental spaces. This particular splint referred to was devised for use on an insane patient with whom all ordinarily used appliances were unsuccessful because he proceeded to remove them when left alone. This, however, proved to be a permanent attachment and has many applications to

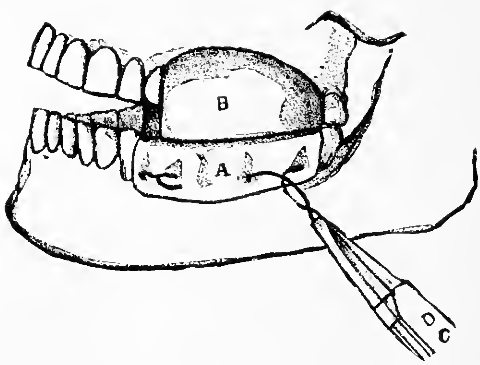


Fig. 57.—Modified Moon Splint. (Kingsley.)

cases other than those of insane persons, for in many instances it is difficult to retain these splints in position.

Figure 57 (*Kingsley*) represents a modification of the original Moon splint, which was partially attached to the teeth by means of wires.

Crib Splint.—*Figure 58* (*Kingsley*) represents a splint which would be suitable for a fracture of the superior maxilla, this particular one being especially adapted to cases where the process is so fractured that the teeth project outwardly from their original position, necessitating the use of either ligatures or rubber bands around the hooks to draw them back into position. This splint should more accurately be termed a *crib splint,* because it does not cover the occlusal surface of the teeth or the hard palate. In several other fractures of the jaw, especially those where the bones of the jaw are separated from the other bones of the face, the jaw tends to drop downward; the jacket splint covering the occlusal surface of the teeth and the hard palate, with arms similar to the Kingsley splint, is here used so that a bandage or rubber band might be passed over the top of the head and carry the splint with the jaw up to its original position.

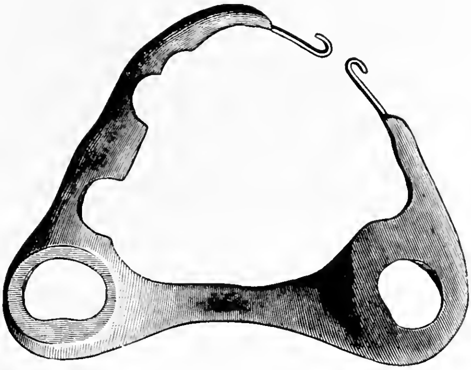


FIG. 58.—CRIB SPLINT. (Kingsley.)

Another type is the Kingsley splint constructed with detachable arms, the attachment being made by means of rectangular metallic boxes inserted in the splint in the region of the bicuspids and first molars. These boxes are either soldered to the splint, or are attached during the process of vulcanizing, by being embedded in the vulcanite and held in place by temporary bars.

FORMS OF FRACTURES

Some cases illustrating the forms and shapes of fractures will now be considered, and also their displacement, in order to better determine the purpose of splints and appliances and the particular service which they are intended to perform.

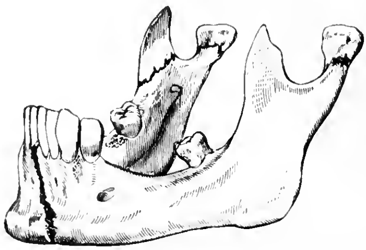


Fig. 59.—Multiple Fracture. (Kingsley.)

Multiple Fractures. — It is only by means of studying the forms of the fracture and the displacements so occasioned that it is possible to devise appliances for their correction and retention. In *Figure 59* (*Kingsley*) is shown a lower jaw fractured in four places, the condyloid processes on both sides and the coronoid process on one side being in-

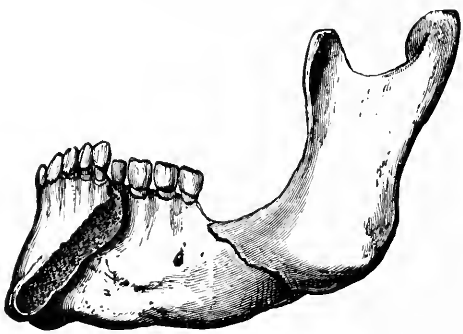


Fig. 60.—Separated Double Fragment. (Kingsley.)

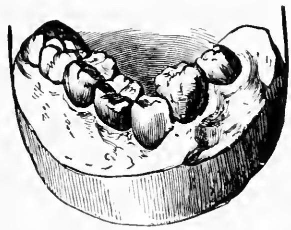
volved as well as the body at the median line. In this instance of course it is impossible to attach an appliance of any description to any of these fractures excepting

FIG. 61.—DEFORMITY AFTER NECROSIS. (Kingsley.)

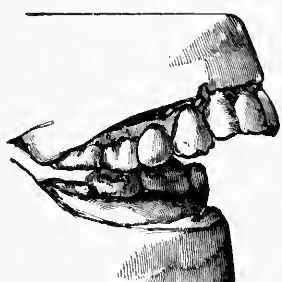
the one at the median line, the others being reduced and held in position by holding the jaw in occlusion.

Figure 60 (*Kingsley*) represents another case where a double fragment from the cuspid to the second molar separated from the rest of the bone and moved bodily inward toward the tongue. This case entails such an appliance as will make it possible to hold this displaced fragment in position and approximate the ends of the fractured bone.

In *Figure 61* (taken from Kingsley) is shown a case of necrosis and deformity resulting from such a multiple fracture. The portion of the jaw between the cuspid teeth has been entirely lost, the muscles have drawn the fragments of the mandible closely



(a) Front View.



(b) Side View.

FIG. 62.—UNUNITED GUNSHOT INJURY. (Kingsley.)

together, thus forming a very sharp V-shaped arch. In *Figure 62 a and b* (*Kingsley*) is shown another type of deformity resulting from a fracture, and one for which it was necessary to devise a special appliance.

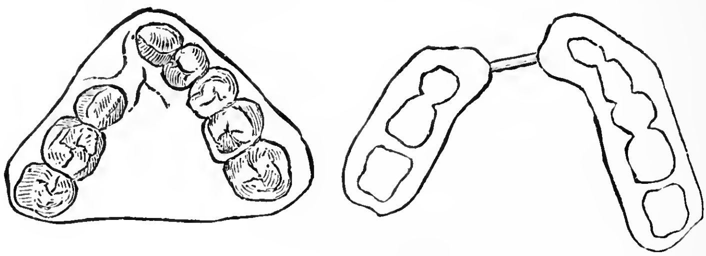


Fig. 63.—Split Jacket Plate with Jack-Screw. (Kingsley.)

This was a case of an ununited gun-shot injury and necessitated the construction of a split jacket-plate and a jack-screw to force the ununited fragments sufficiently apart to permit of the insertion of a bridge to retain the fragments in their normal position. *See Figure 63* (*Kingsley*).

Special Appliances

A short series of cases, with the appliances which have been specially devised for their correction, will now be considered.

Fracture with Displacement of Fragments.—*Figure 64* (*Kingsley*) is a case of triple fracture, one fracture on the right side between the cuspid and the lateral, a similar location on the left side and between the first and second molars on the left. This case shows a typical displacement of fractures near the angle. It is important to bear this displacement well in mind and not to be misled by its appearance. In many instances of this displacement the patient, not realizing his difficulty, has applied to a dentist for relief, the tooth being longer than it should be. The tooth in this case was the second molar and its fragment was in normal occlusion; but the displaced fragment being lower than this, gave the tooth the appearance of being too long. In certain instances it has been extracted for no other reason than the inability of the patient to bring the displaced portion into occlusion. This, of course, is an absolutely erroneous diagnosis, as the fragment or displaced segment is the one which should be brought up into occlusion by being raised in relation to the other or stationary fragment. Instances in which this tooth has been extracted or where, owing to its extreme looseness, it is necessary to extract it, complicate the treatment of the case to a considerable extent, it being then necessary to construct

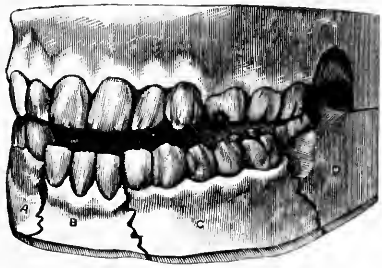


FIG. 64.—TRIPLE FRACTURE. (Kingsley.)

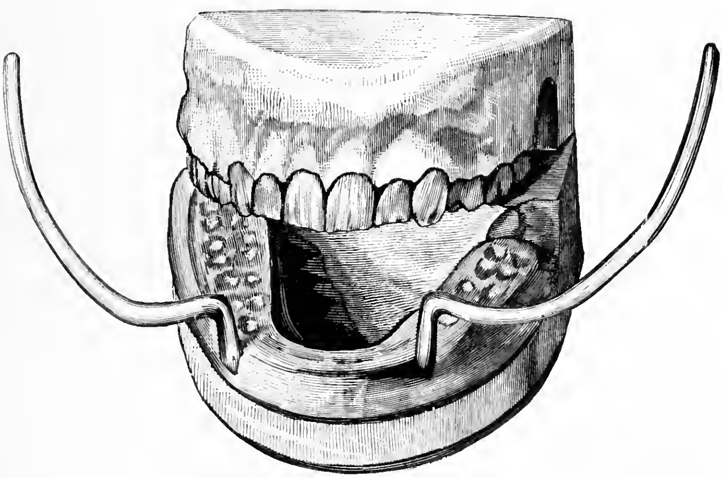


FIG. 65.—VULCANITE PLATE WITH ARMS. (Kingsley.)

an extension on the splint or such other appliance as may be used. This extension will impinge on the bone of the ramus portion and hold it down in the same position that the teeth held it in normally. This particular case was treated by means of a vulcanite plate with arms, the typical Kingsley splint, which is shown in *Figure 65* (*Kingsley*).

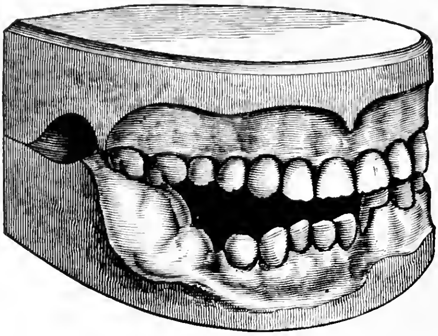


Fig. 66.—Fractured Fragment with Four Teeth. (Kingsley.)

Figure 66 (*Kingsley*) shows another case of triple fracture. In this instance the fragment which was displaced between the other stationary portions of the jaw was relatively small, althought containing four teeth. It was entirely loosened and separated from the bone to such an extent that it was later removed as

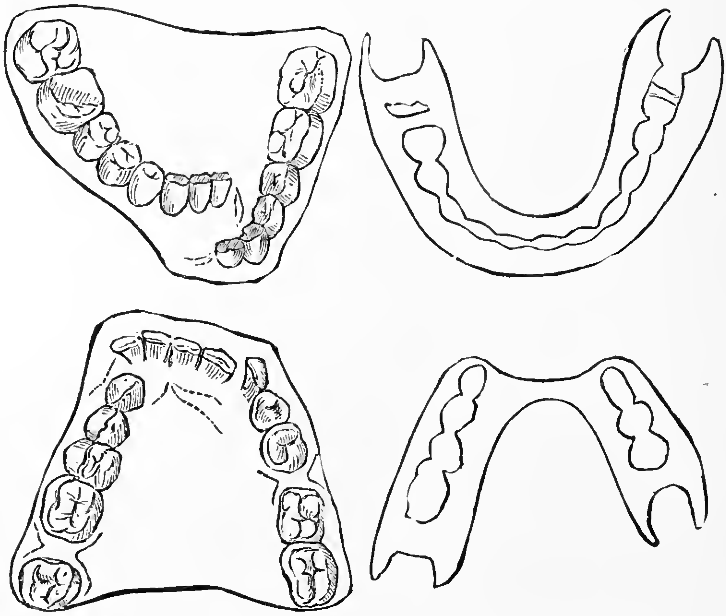


Fig. 67.—Models of Displacements and Splints Used for Fixation. (Kingsley.)

a sequestrum. The Kingsley splint and arms with bandage and chin piece were used in this case. In *Figure 67* (taken from Kingsley) are illustrations from two cases showing models of the displacement and the splints used for fixation.

TYPES OF APPLIANCES

The appliances suitable for the treatment of maxillary fractures may be classed under three heads: first, *splints;* second, *bands* and *ligatures;* third, *bandages* and *chin pieces* or other combination.

Fixation.—The purpose of the appliance in the treatment of a maxillary fracture is the reduction of the displacement and the *fixation* of the parts. It is impossible to overemphasize the importance of fixation. And it must be just as nearly absolute as it is possible to obtain. If the fixation is not definite, the fracture will not readily unite. Therefore, every modification and every appliance should be devised and applied in order to produce this *absolute fixation* of the fragments of a fractured jaw. The difficulty in applying this principle to a lower jaw is very great, more than to any other bone in the body, on account of its shape, the attachment of the muscles and the function of those muscles so closely allied with the functions of life itself. Every breath one draws, every time one swallows, there is a contraction of the muscles attached to this bone, and it is with the utmost difficulty that fixation is accomplished. None of these difficulties is present to any great extent in cases of fracture of the upper jaw. As there is an almost entire absence of muscular attachment, there is no movement as with the lower jaw. In treating fractures, especially fractures occurring on the battle field, prompt attention is essential, and it is extremely necessary and desirable to prevent, as far as possible, functional disturbance and deformity. It should be the purpose in treatment of such cases to apply such simple apparatus as may be put in place quickly and will permit of the cleansing of the wound and reëstablishment of the function of the parts.

Fractures of recent origin are very easily and quickly reduced ordinarily and may be done at once. Cases of long standing, of delayed attention, usually have to be reduced by a slower process,—by such long continued pressure as is produced by orthopedic appliances.

Temporary Treatment.—In treating cases for transportation from the field or any case which can be given only temporary attention, it is important to bear in mind the possibility of causing more displacement than originally occurred by means of bandages or other appliances. This is especially true where nothing but the bandage is applied and where the form of the fracture itself is such as to permit the ends of the bone to slip past each other and to be pressed together by the tight bandage. If the fracture is square and the ends of the bone impinge directly upon each other, considerable pressure may be applied without danger of causing displacement, but with a diagonal shaped fracture even a slight pressure, lasting over a period of a day or two, will cause such displacement as later may give considerable trouble, pain and delay in reduction. In cases of this kind it is far better to wire the lower jaw directly to the upper, which will give support and prevent such displacement taking place.

Splints

Various Types.—There are several kinds of splints: first the *jacket splint,* which may be an upper or a lower, and may be constructed of vulcanite or metal. The metal may be swaged or cast, and there may or may not be arms employed.

Next is the *interdental splint,* which is a double jacket splint, covering the teeth of both jaws, adapted to form one splint but with spaces for the passage of nourishment provided by opening the bite slightly.

Third the *edentulous splint,* which is an interdental or, more properly, *interedentulous* splint for the edentulous cases.

Difficulties of Splints.—Splints are adapted to a certain class of cases, it being almost impossible to treat some cases without their use. But the use of splints entails certain very definite difficulties. In the first place, considerable time must be consumed in their construction, probably at the best a matter of six or eight hours, while frequently this time is extended to as many days. In addition to this delay, it is a difficult matter to construct a splint. A series of correct mechanical steps is required, the failure or imperfection of *any* of which means that *all* that follow will be inaccurate. This is similar to the difficulty in the construction of artificial dentures and may be likened to the building of a stone wall, in which the failure to place any one stone correctly interferes with the ultimate strength and accuracy of the remaining portion. This is the reason that dental students and practitioners have so much difficulty with mechanical dentistry; each step must be absolutely correct in order to have the completed apparatus correct.

There are certain things essential in the construction of the splint, the first being the impression.

Taking of Impressions

Plaster Impressions.—The impression should be taken in *plaster,* either in one piece, if there is not much displacement, or in sections if there is considerable displacement. It is ordinarily not desirable to make any attempt to reduce the fracture until after the splint has been made. Plaster is selected, first, because it is easier for the patient, no pressure being required; and secondly, because it gives accurate results. And in no class of work is it more necessary to obtain an accurate impression and an accurate model than in the construction of the splint. In case the patient is unable to open the

FIG. 68.—PLASTER MODEL, CUT AT LINE OF FRACTURE.

mouth sufficiently to admit of the introduction of an impression tray, the plaster may be carried into the mouth by means of a spatula and then worked around the teeth and a tray forced in after it, the rim of the tray having been previously nearly cut away.

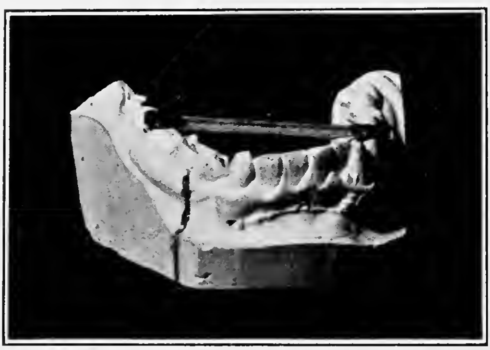


FIG. 69.—RE-POSED PLASTER MODEL, IMPRESSION.

Perfection of Model Essential.—The second requirement is a *perfect model.* This model must not be injured in its removal from the impression; there must not be a chip lost from it, not a corner of a tooth missing. It should be in hard plaster and should be treated with the greatest respect, as upon it, providing the impression has been accurate, depends the success of all succeeding steps. If the impression was taken in one piece the model must be cut apart at the line of the fracture (*see Figure 68*), the ends trimmed and brought together so that the teeth may be articulated with those of the opposite jaw, which, by means of the cusps and facets, may be very accurately done. If, on the other hand, the impres-

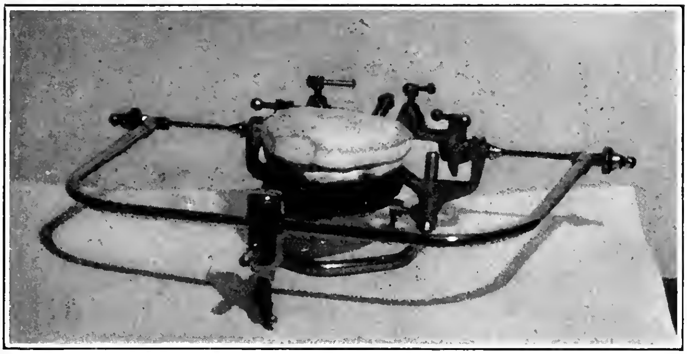


FIG. 70.—UPPER MODEL ATTACHED TO ARTICULATOR.

sion was taken in sections, this reconstruction or re-posing of the model can be accomplished just as readily, the only difference being that there is no necessity for cutting the model in two. After the model has been accurately *re-posed* (*see Figure 69*), it should be held in this position by means of temporary attachments of wax and splints of wood and new plaster added in order to make the two parts into one piece again.

Articulation.—After this has been accomplished it is necessary that the opposite model—ordinarily the upper one—should be set on the anatomical articulator by the use of a face bow (*see Figure 70*). This is essential on account of the fact that in the construction of the splint the *bite* must be opened, and the bite cannot be opened on a plane-line articulator or without the use of a face bow, except by disturbing the relationship of this bite. The face bow gives the relation of the model to the condyles of

Fig. 71.—Re-posed Lower Model Set on Anatomical Articulator.

the articulator, between the teeth and the condyles as it is in the patient, and locates the model on the articulator,

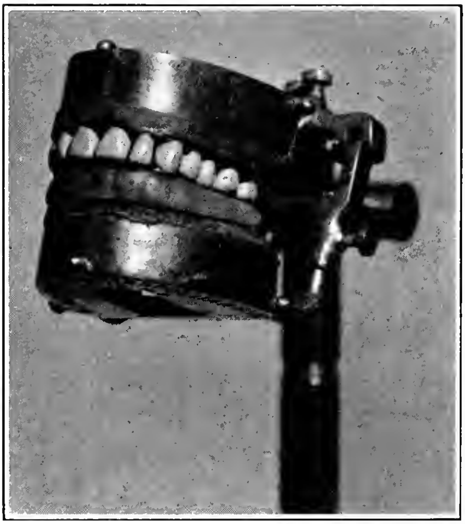


Fig. 72.—Simple Vulcanite Jacket Splint.

not only with the exact distance from the condyles to the cutting edges of the incisor teeth, but also locates it in reference to the horizontal and to the vertical positions. In other words, it locates it in three dimensions so that the bite may be opened and the splint adjusted. When that splint is placed in the mouth of the patient the teeth will fit into the splint just as they did on the model on the articulator; otherwise, there is great likelihood, almost certainty, of a misfit so far as the bite is concerned;

FIG. 73.—VULCANITE SPLINT WITH ARMS FOR BANDAGING.

the molar teeth impinging on the splint in their proper relation but the incisor teeth failing to come in contact with the splint.

Figure 71 shows the upper model attached to the articulator and the face bow removed, with the lower re-posed model occluded or articulated with the upper.

Packing the Mold.—Careful and accurate flasking and packing of the mold, having previously placed tinfoil over the teeth of the model, and accurate and complete closing of the flask after packing are absolute essentials. Regardless of how accurately every step up to this point has been followed, failure to close the flask completely on one side or the other will upset everything and all previous accuracy go for naught.

Occlusion.—It is also necessary that there should be an absolutely *square strike* of the opposing teeth upon the splint when it is in complete adjustment in the mouth. The molars, bicuspids and cuspids on *both* sides must all occlude on the splint, otherwise there will be a tilting of the splint and a lack of fixation.

Figure 72 shows a simple vulcanite jacket splint, properly adjusted in position with teeth occluding as described above; while *Figure 73* shows the same type of splint constructed with arms for use in bandaging. *Figure 74* illustrates a fitted metal splint made to be cemented on to the teeth.

FIG. 74.—FITTED METAL SPLINT.

Opening of the Bite.—In the construction of the interdental splint, in addition to the above it is desirable that the bite be opened as little as possible, first on account of the comfort of the patient. This may be determined by placing the joint of the thumb between one's own teeth and attempting to swallow, then place in the opening the tip of the little finger and swallow, and one will have no difficulty in determining which is more comfortable. Further than the reason of giving the patient the benefit of this additional comfort, which is in evidence every time he swallows, is the very evident one of permitting the closing of the lips to a sufficient extent to allow of drinking from a glass or cup rather than to have to use a feeding-tube. Another very important reason for this slight opening is that there is less displacement of the fragments; if the fracture is posterior to the first molar this displacement is considerably increased by opening the bite, and should be avoided when possible.

Figure 75 illustrates the features referred to above and shows a double jacket or interdental vulcanite splint.

A splint is not particularly applicable to fractures oc-

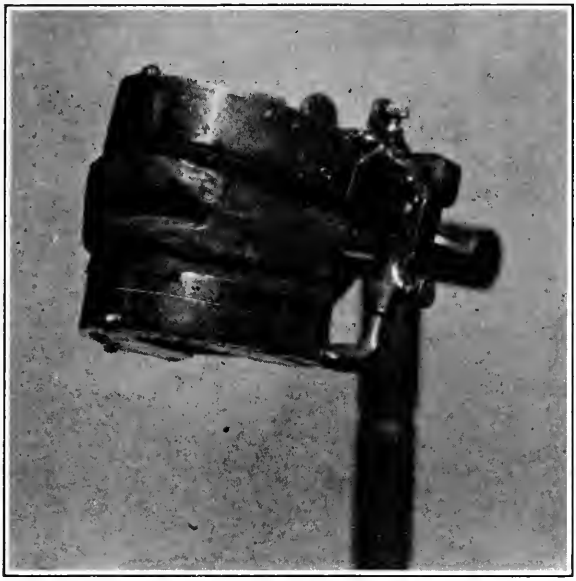


Fig. 75.—Interdental Vulcanite Splint.

curring in regions posterior to the first molar, there not being a sufficient number of teeth or a sufficient amount of surface contact with the splint to enable it to hold the parts in fixation. But for fractures anterior to the first molar, splints may be used if desired; they may be interdental, they may be a simple jacket splint of vulcanite, or may be a swaged or cast metal splint cemented on to the tooth.

Bands and Ligatures

Application to Emergency Work.—The great advantage of this type of apparatus is the possibility of its immediate application. Whereas the best time for a splint may be six or eight hours, ligatures may be applied immediately, and in simple cases be completely adjusted in six to eight minutes. This method is very useful for preparing cases for transportation, such as emergency work on the battle field or in a field hospital. Ligatures applied directly around the necks of the teeth are of course much more quickly adapted than where bands are used and the ligatures attached to them. The banding method, however, is much more elastic and, in the instance of the breaking of one of the wire ligatures, entails less difficulty. When ligatures are used around the necks of the teeth, if one breaks it is usually necessary to renew all of them, whereas, with the employment of bands, one may be renewed without disturbing the others.

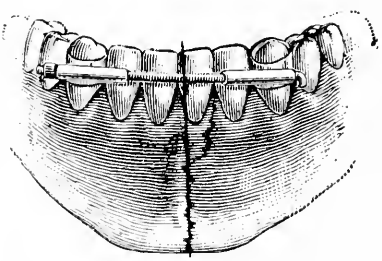


Fig. 76.—Angle Orthodontia Band.

Bands.—These clamped bands are practically *Angle orthodontia bands*, and may be applied very quickly, provided there is sufficient space between the teeth. They are provided with tubes, rings or studs for the attachment of ligatures or arch wires. Two Angle bands on the molars, provided with tubes through which an arch wire may be placed, and ligatures applied around the anterior teeth, provide a very quickly adapted appliance and one which satisfactorily maintains a very fair degree of fixation for transportation and which will in many cases answer all that is desired for a permanent appliance. (It probably would not be desirable for the average man to attempt to apply nuts to the distal ends of the arches while in an exposed position on the field.)

Angle Apparatus.—These appliances are usually known as *Angle No. 1, 2 and 3 apparatus* for maxillary frac-

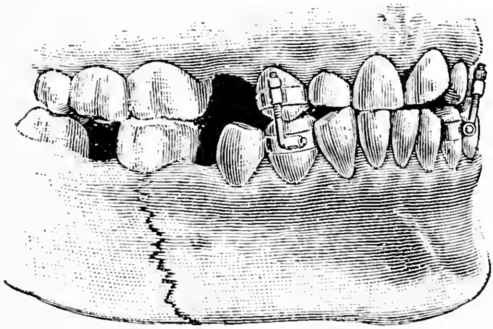


FIG. 77.—NO. 2 ANGLE APPARATUS.

tures. The No. 1 appliance shown in *Figure 76* (*Garretson*) is an ordinary expansion arch with bands. The No. 2 appliance, *Figure 77* (*Garretson*), consists of bands applied to teeth of both jaws attached nearly opposite to each other and provided with rings or studs for the

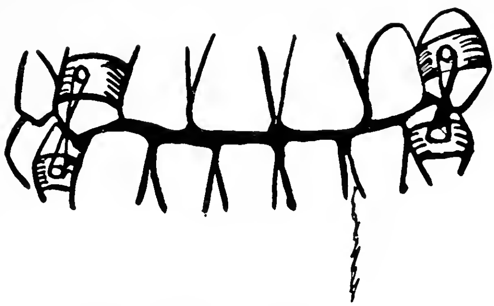


FIG. 78.—FIGURE OF EIGHT LIGATURE.

attachment of ligatures, or further modified by means of tubes and rings for the attachment of L-threaded rods and nuts. The No. 3 appliance consists of *patella-hooks* inserted in holes drilled in the bone in edentulous or semi-edentulous cases. Around these hooks wire ligatures are placed in the form of a figure 8 (*Figure 78*). The writer has used to advantage a modification of this appliance, utilizing, in place of the patella-hooks, ordinary silver-plated brass wood screws, three-eighths of an inch long, of fairly heavy diameter. The essential thing in the use of these screws is that the drill be very carefully selected as to its size, which should previously be ascertained by drilling a hole in a piece of bone and testing the screw.

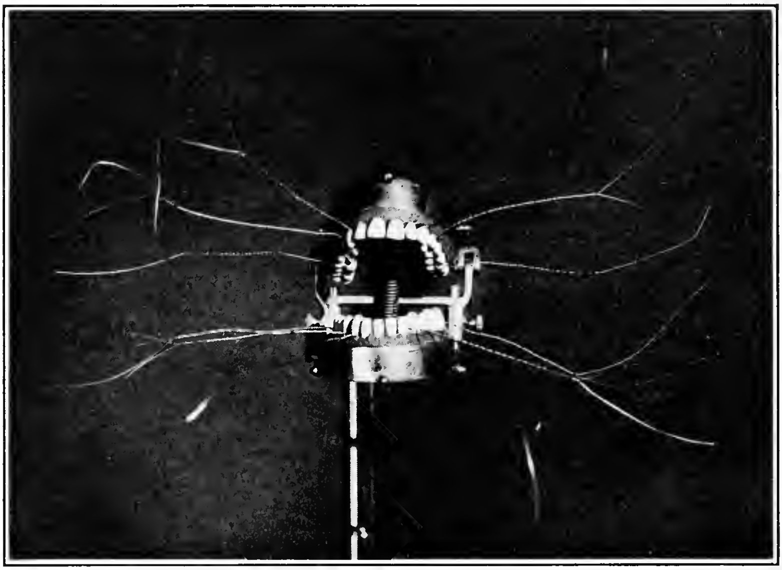


Fig. 79.—Ligatures Adjusted to Individual Teeth.

The correct adjustment as to size is that the drill be of a size to permit of one half of the thread of the screw becoming embedded into the bone and cutting its own thread. If the hole is too small the bone will be crushed and fractured; if it is too large the screw will not seat properly and will not provide a firm attachment.

Mode of Application.—This Angle apparatus may be used in edentulous cases by placing one or two screws in each fragment, or by using the screws in one fragment of the semi-edentulous case and attaching the ligature at the other end to a band or modification of a band attached to the teeth. The No. 1 or No. 2 appliance is the most universal of any, it being applicable to a fracture in any location, whether in the neck of the condyle, or in the body or in the ramus portion; the only essential requirement in this case being that there must be a sufficient number of teeth present to permit of the attachment of ligatures or bands, and a sufficient number of

FIG. 80.—LIGATURES IN FINAL ADJUSTMENT.

teeth to provide a fairly interlocking occlusion so that the jaw may be fixed between the stress of the ligatures and the strike of teeth. (Inasmuch as it is a requirement for enlistment that a man possess four teeth, two in each jaw, which are opposed or occluding, it may be possible to apply this apparatus to all cases of fractures occurring in the army.) (*See Figures 79 and 80.*) In applying the ligatures it is essential that they be so located as to draw the teeth more firmly into occlusion rather than to draw them out or to fail to draw them in. Fractures with much tendency to displacement should be wired across the seat of the fracture before ligating the teeth of the lower jaw to those of the upper, and it is frequently desirable to cross the ligatures in order to more firmly draw the fragments together. In general, the ligatures should be so placed that absolute fixation is accomplished, not only during the period of rest, but during the action of swallowing, as during this time more strain is put upon the appliance than at others.

Bandages and Chin-Pieces

Application.—The bandage was probably the first appliance ever used for relief or treatment of a broken jaw, it being the first thing which would be suggested to the mind as a means of support. Bandages should be applied with due reference to the location of the fracture and should be so adapted as to hold the fractured ends together rather than to cause them to become separated. A bandage applied at the exact location of the fracture may frequently permit the extended ends of the bone to sag and cause a separation of the fragments, whereas if the bandage be applied slightly beyond the actual fracture the anterior fragment is better supported. A better way of accomplishing this is by the use of the splint or chin-piece, giving extended support to the fragment, the bandage serving merely to hold the splint or chin-piece in position. Several forms of bandages have been devised for use in connection with broken jaws, to many of which are applied the names of their originators. However, as with the other appliances, they are very similar and consist of modifications of a few principles. The simplest form of bandage is known as the *four-tailed* bandage, the name being derived from the shape of the bandage.

Four-tailed Bandage.—This is formed from a piece of cloth about a yard long and three to four inches wide, merely cut in two pieces from the ends, leaving a piece in the center four or five inches long, which slotted portion is applied directly to the chin, the two under ends or tails of the bandage being carried above the head and tied and the two upper ones being carried around the back of the neck and tied, thus forming a crossed support and chin-piece bandage. The tied ends are again, in turn, tied to each other so that the ends going over the top of the head are attached to those going around the back of the neck, thus providing a firmer attachment than would otherwise be accomplished. The best permanent bandage is either the *Barton* or a modification of it. The four-tailed bandage is shown in *Figure 81* (*Kingsley*); the Barton bandage and its modifications and chin-pieces are also shown. (*See Figure* 82, on page 194.)

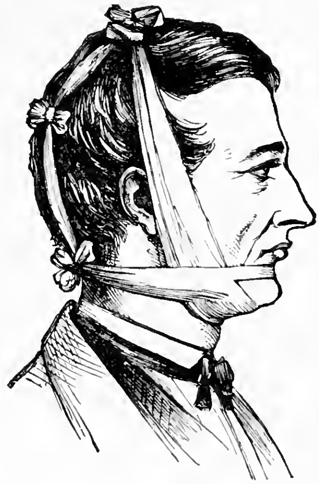


Fig. 81.—Four-tailed Bandage.

Barton Bandage.—The Barton-Gibson bandage is preferably a gauze roller, one and a half inches wide and from ten to fifteen yards long. It should be applied rather more tightly than is ordinarily done for head bandages. During its application it is essential that the patient's teeth should be closed tightly, otherwise the bandage will be very loose when the teeth are closed. This is a point that requires particular attention, for it is a great temptation to the patient to place the tip of his tongue between the teeth in order to avoid tight bandaging. Of course when the bandage is applied tightly care should be exercised that it does not produce soreness over the exposed portions of the lower jaw, also that it does not encroach too much upon the throat, as otherwise serious complications might arise.

Chin-pieces.—Chin-pieces are made in various forms and of various materials:—gutta-percha, modeling compound, binders'-board, wood, starched gauze, plaster mask, etc. They are, when properly constructed and applied, a decided addition to bandages alone and to appliances inside the mouth.

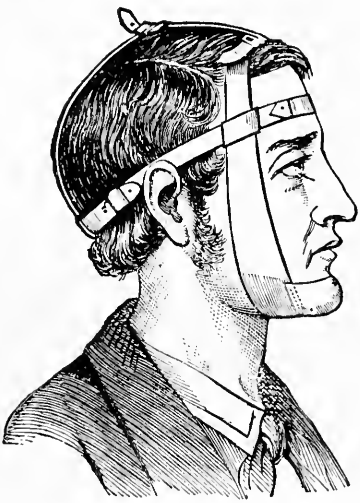


Fig. 82—Showing Application of Chin-piece.

A very quickly and easily made form of chin-piece is cut from a piece of binders' board.

It is desirable to emphasize what was referred to in the beginning, that all recent methods and appliances for the treatment of maxillary fractures are merely repetitions or modifications of old methods as far as fundamentals are concerned, but also that, in cases occurring in the recent war, these same fundamentals have been applied and practically no device radically new has been used. The writer has gone very carefully over the records and photographs of a large number of cases which have been treated in France, and finds the above to hold true in every instance, as will be seen by cases reported by Dr. Geo. B. Haynes, "Dental Cosmos," 1916. To be sure, the cases are more numerous than they have ever been before, and on account of the type of warfare in trenches, with consequent exposure of the head, there has been more plastic surgery and bone grafting necessary on account of such great loss of tissue; but the appliances for the reduction and fixation of fractures and for prosthesis to be used as a foundation for plastic surgery have been the same.

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CHAPTER VII

MAXILLARY FRACTURES (SURGICAL)

Albert L. Midgley, D.M.D.

Scope of Chapter.—Some of the information presented in this chapter is to be found in the textbooks and the remainder is from the writer's own experience, embracing the treatment of seven hundred and seventy-eight fractures of the maxillary bones. While the treatment of every case is individual in itself, yet, as a whole, the application is somewhat similar. The subject will be dealt with as thoroughly as possible in the way of theory and treatment, and by treatment is meant surgery and the surgical application of splints. For reading and study of this subject Brophy's "Surgery of Fractures" is recommended and also the March, 1917, issue of the *Journal of the Allied Societies*, which contains an article by Dr. Kazanjian, who, as is generally known, is doing wonderful work in Base Hospital No. 20, in France. Some of the statements in this chapter, particularly in regard to gunshot wounds, are taken from his works and also from the articles on fractures appearing in the various dental journals since the war began.

FRACTURES OF UPPER JAW

Fractures of the upper jaw are considered first. They may be complete and incomplete. There may be a fracture of both maxillae or a fracture of but one. A *complete fracture* may involve the nasal process, the anterior or posterior wall of the antrum and the alveolar and palatal processes. By *incomplete fractures* are meant partial ones which may not extend entirely through any one process or piece of bone.

Types of Fractures.—To simplify matters it may be stated that fractures may be classified as *simple:* that is, when there is no wound leading from the fracture through the mucous membrane or the external tegument; *compound:* when there is such a wound; *multiple:* when there is more than one fracture; *comminuted:* when the bone is crushed; *complicated:* when it involves injury to nerves or arteries, or when it is accompanied with dislocation, or some serious condition such as pneumonia, or, in the case of vessels, the laceration of the vessels and nerves with accompanying bleeding and partial paralysis; *impacted:* where a piece of the bone is driven into another piece; and the *greenstick,* where the fracture is incomplete.

Anatomy of Maxillae.—The maxillae are protected below by the mandible; above by the frontal and malar bones; anteriorly by the nasal bones; and laterally by the malar bones, the heavy masseter, buccinator and orbicularis oris muscles. It can be seen from its anatomical position and protection that it is not so liable to receive the direct force of violence as is a fracture of the mandible, that is in speaking of fractures that occur in civil life.

Symptoms.—In fractures of the maxillary bones the principal subjective symptoms are pain and tenderness; the objective symptoms are contusions, lacerations, discolorations, and drooling, which latter condition occurs with every fracture and is a state with which one has always to contend. The reason for this is because it not only serves as an irritant to the integument, but also because it is an ideal medium for the growth of the products of decomposition that may be lying in the mouth, inviting them to go into the line of fracture;

thus producing an infection which prolongs the stage of the illness and prevents callous formation with the subsequent calcification of bone. Crepitus is also present. In examining fractures of the superior maxillary bone, it is essential to remember that it is not always wise to elicit crepitus, particularly in fractures that are simple and ones in which the fracture is partial. This is important in fractures of the palatal process because the vault of the palate has a direct relation to the brain, and an infection may go through the line of fracture to the meninges of the brain, producing meningitis with possibly fatal, if not serious consequences. Then too it is not good surgery to needlessly stir up a bacterial breeding pool. Therefore, the point to be borne in mind in a discussion of upper jaw fractures, if they are of the palatal process, is not to do too much palpation to elicit crepitus. The possibility of antral involvement in this connection is also obvious.

Diagnostic Signs in Superior Maxillary Fractures.— Many fractures of the superior maxilla and fractures of the neck of the condyle of the mandible are followed or accompanied by fractures at the base of the skull. As a rule, in every fracture of the upper jaw there is bleeding through the nostrils. In many fractures at the base of the skull there is bleeding through the nostrils and from the ears. Therefore, differentiation should be made between these two conditions in making a diagnosis, which of course is a simple matter in most instances in fractures of the jaw. It is well to remember that practically every fracture of the superior maxillary bone is accompanied with bleeding from the nose. Sometimes this bleeding may be quite severe, particularly if it involves the internal maxillary artery, and in some of these cases fatal results have followed because of the fact that the hemorrhage of the internal maxillary artery could not be controlled.

Infection

Tetanus.—It is hardly necessary here to take up the pathology of tetanus but on account of the possibility of this occurring as a result of gun-shot wounds, etc., a study of the text-books upon this subject is recommended. It is well to remember that the latent type of the disease sometimes appears and that both dental irritation and temporary mandibular irritation should not be confused with it. Quite frequently in fractures of the mandible there is a trismus from the induration in the masseter region, and this occurs most frequently in cases at the angle or above that point and the joint.

Points of Involvement.—The involvements of fractures of the superior maxillary bone are the maxillary sinus, frontal sinus, the ethmoid, sphenoid, nasal and the malar bones. The infection resulting from fractures often involves the maxillary sinus and it is quite necessary for the dentist in many cases to enter this sinus to relieve the pus that is constantly accumulating. In fact, outside of respiratory diseases and the general lowered resistance that often accompanies fractures, there is nothing to fear except infection with necrosis of bone, and this infection is, of course, more prone in tubercular and specific cases.

Causes of Pus Formation.—The chief reasons which cause these infectious conditions to abound in fractures are uncleanliness and the presence of a foreign body. Of course, for the army dentist foreign bodies will be either bullets, shrapnel and so forth, or spicules of bone, and these are usually the cause of pus formation. In the writer's experience there has not been one case, where all the spicules of bone have been removed, in which there has not been an absence of flow of pus at least within two days later, and in most instances one day later. Therefore the important point is to get the spicules of bone that have no live connection removed from the site of fracture, if the flow of pus is to be stopped. It will never stop as long as those spicules of bone are there. When a fracture is treated for six or seven months, the patient having fistulous openings on the face with pus flow not checked, it is certain that there are spicules of

Fig. 83.—Fracture Between Lower Right Cuspid and First Bicuspid. Showing the importance of an extra oral radiograph, as the unerupted third molar may be an irritant. A indicates spicule of bone in the line of fracture; B indicates partially erupted inferior third molar; C indicates line of fracture.

bone in there or that necrosis is present. Examination of various radiographs, etc., strengthens the opinion that there is no justifiable reason for letting them remain there. Incidentally there is perhaps no better instrument for removing these pieces of bone than the pyorrheal planers and scalers that are used for the removal of tartar, such as are employed in prophylactic work.

These instruments may be used for this purpose since they are readily adapted to any surfaces of the teeth and may be equally well applied to any surface of the bone where there has been a fracture.

Value of Radiographs.—Sometimes the radiograph may not show that there is a spicule of bone. The operator should then have two or three more radiographs

FIG. 84.—FRACTURE AT THE NECK OF THE CONDYLE AND IN THE BODY OF THE MANDIBLE. Showing the necessity for both intra- and extra-oral radiographs.

taken at various angles because in some instances, at a certain angle, it is impossible to detect a small spicule of bone and such a fragment may be the cause of a persistent flow of pus. Every dentist has had radiographs made when he is searching for the cause of an obscure, persistent neuralgia and all know how difficult it is to determine that hypercementosis exists or is the cause of this pain. One knows also that a slight hypercementosis may be the cause of a very severe neuralgia and that this may not be perceptible in the radiograph, especially if taken at only one angle. If, however, a number of radiographs have been made at various angles it is quite a simple matter to detect a slight hypercementosis, and this may be causing severe symptoms. This is perhaps a little foreign to the subject, but has a practical bearing upon the practice of dentistry and oral surgery. Then too it emphasizes the importance of a series of radiographs in searching for the cause of the flow of pus.

Dead Pulps.—Another point to remember in this connection is the fact that the pulps of teeth may have died as the result of the impact, and these dead pulps are a prolific source of irritation and incubators for pus formation that may be present in the line of fracture. The tooth may have a very good color and to all outward appearances seem to be alive and yet the pulp may be dead, and, with the resulting pus formation, feed the line of fracture. Therefore, if a dentist makes up his mind when treating a case that a spicule of bone or some foreign body is there, or that the pulps are dead in some of the nearby teeth, he will no doubt have gone a long way in doing a great deal of good to his patient in preventing the continuance of this state of affairs.

Diagnosis and Methods of Examination

Diagnosis.—Speaking of the diagnosis, it is usually simple enough. It is not only necessary to determine that a man's jaw has been broken, but it is also equally important to make out the line or lines of fracture, in order to know the parts that are involved. Now of course modern surgery teaches and demands that a radiograph be made of all cases, but an army dentist will be in a position, many times no doubt, where an X-ray machine will not be at hand. Therefore it is quite necessary to map out some method of making an examination and adhering to it. One good way to make out the line of fracture and the extent of it is by palpation.

Palpation.—The following is the method used by the writer to determine the area, extent and lines of fractures of the maxillary bones. Standing in front of the patient, the fingers of the left hand are used in the mouth and the fingers of the right hand outside the mouth in examination of the patient's left jaw. The position of the left and right hand fingers is reversed when examining the patient's right jaw. Beginning the digital examination in the joint region on the left side and following the surfaces of the bone continuously the right joint is reached. It is not necessary nor is it good surgery to skip about from this place to that while palpating to elicit crepitus. The index finger is placed in the mouth on the internal surface of the ramus as far up as one can go and the tissues are pressed from the outside gently,—the word *gently* must be emphasized for reasons stated earlier, namely,—to avoid pain and infection. Pressing the tissues from the outside against the index finger that is within the patient's mouth, and placing the ear close to the patient's face (particularly from the angle to the joint) one may elicit crepitus by the sound. When pressing and pulling to determine the line of fracture, the fragments can be moved in every possible direction, but not violently. In this way the exact area, extent and lines of fracture will probably be determined in every instance.

Fractures in Military Life.—It is very important to remember, when this examination is made, that a bullet may have destroyed osseous tissues in one area causing a compound fracture and in another part of the jaw there may be a simple fracture as the result of the transmitted force, or by a fragment of bone acting as a secondary projectile. Generally speaking, in most fractures of the upper jaw in civil life, there is no loss of osseous or soft tissue, the prognosis is very favorable and there is no functional impairment nor anatomical deformity; but in the cases seen in military life there is no question but that there is a great loss of hard tissue, with the resulting dropping in of the bridge of the nose and lower borders of the face in those cases where the palatal and alveolar processes have been entirely shot away. It is a strange thing that many of these cases have not been followed by extensive loss of soft tissue. The wound may appear very wide and the dentist may feel that he is incapable of uniting that wound with any degree of success by plastic operations or by the use of splints. It must be remembered, however, that that wound appears much wider than it would appear if the contracted tissues were in a normal condition. The borders of the wound are contracted because of the injury; the products of inflammation and infection have further contracted it and, as a result of the fracture, the traction balance is lost, all of which causes a gaping wound. So, the point to be borne in mind in the facts just stated is that apparently large wounds may—after the products of inflammation have departed, the wound treated and cleansed and splints and appliances used—not amount to a great deal in the way of anatomical disfigurement.

Removing Foreign Bodies and Maintaining Asepsis

Oral Asepsis.—Now, of course, it is always desirable to remove a foreign body, but when to do it is the question. That depends on the experience and judgment of the operator; the vitality of the patient; the condition of the wound and the extent of the operation. It might be said here, in connection with pneumonia, that at most of the hospitals it has been found that septic pneumonia has followed in every case in which the patient had taken ether for some surgical condition before having had his jaws operated upon. This is the strongest evidence for the cleansing of the oral cavity before any major operation. This fact above everything else, shows us the importance of keeping the mouths of these men clean, because their jaws have lost functional capacity and for the time being the patients are mouth breathers and are constantly inspiring air vitiated with septic matter. In many instances, when an operation has been performed, men have been given morphin and have lost their laryngeal reflexes, with the result that they have actually inspired septic matter. It is very evident therefore that *thorough cleansing of the mouth is the first thing to be done.* The mouth and tissues must be kept in as clean a condition as is possible, because the results obtained are always in direct relation to the amount of asepsis maintained in the surgeon's technique. For the same reasons that the treatment of root canals or the extraction of teeth is attended with far better results when every method is used to ensure asepsis, so also the best results are no doubt obtained here by absolute cleanliness.

Time for Removing Foreign Bodies.—When a man is suffering from a great deal of shock, fatigue and low resistance, it is folly to try to remove a foreign body but the time for removing it, as has been said before, is determined by the patient's condition, the extent of the operation and the involvements and size of the wound. If the operation be a minor one and one which can be done under novocain, this may be performed without injuring that man's physical or nervous system to any appreciable extent; but if it be one of those extensive fractures, involving the removal of a number of pieces of bone, and if the patient be in a low state or just recovering from pneumonia, removal of a foreign body should not be attempted. On the contrary the dentist should attempt to keep the mouth clean, having it syringed at stated intervals so that the patient may not swallow and ingest the accumulating pus.

Cleansing the Mouth.—Speaking about cleanliness, the use of sulphonapthol is about as efficient and economical as anything that there is in the pharmacopeia. The parts should be rubbed well with a solution composed of iodin crystals ten parts; menthol crystals ten parts; benzol one hundred parts. In applying this iodin preparation it should not be painted lightly, as is often done when making an injection with novocain, but rather applied with vigor in order to get not only the medicinal, therapeutic values of the solution, but the mechanical, frictional, cleansing effect, rubbing it in well and wiping the parts first with alcohol. Before this is done the patient should gargle the throat and rinse the mouth well, vigorously using the cheeks as a bellows, thus mechanically flushing out the débris and the pus products that are constantly forming. It is perfectly well known to all that no antiseptic or germicide that can be borne by the tissues is in the mouth long enough to actually kill germs for it takes acids or boiling for twenty minutes to kill the organism with its spore formation. This is the chief reason for vigorous, mechanical irrigation.

Value of Iodin.—As an experiment to bear out what has been said about the iodin solution, the next time the reader extracts a number of teeth, let him have the patient rinse the mouth as he has ordinarily done in the past. Then let him select a few of the teeth and rub this iodin solution well into the mucous membrane about them, and inject iodin gently into the pockets if pyorrhea is present, and note the difference in the way those gums heal in comparison to the tissues where this treatment is not followed. If this is done once the experimenter will never extract a tooth without following this line of procedure or a somewhat similar one, equally effective from the standpoint of surgical asepsis.

Feeding

In the feeding of these cases, the liquid diet is the only thing which can be used for a time. It all depends upon what splints are used, as to whether the diet will be liquid or whether it will be semi-solid. Of course, too, the extent of the injury and the loss of functions of the jaws as the result of the wound are factors that are to be considered in determining upon the diet to be used. In this liquid diet it is sometimes necessary to feed through the nose. No attempt should be made to feed a man through the nose before this organ has been well cleansed, and after cleansing it, the cavity must be sprayed with a two per cent novocain or a one per cent cocain solution. This is quite important in feeding with a tube through the nose, if the patient is to be given any degree of comfort.

Taking Impressions

As a general rule it may be said that it is best to take impressions for working models in modeling compound. Some men advocate the use of plaster. However, this is unnecessary because it causes a great deal of discomfort to the patient and some of the plaster is apt to run down the lines of fracture and this may be very difficult to remove. The textbooks recommend the approximation of the fractured ends and holding them in place while the impressions are taken. This is quite a difficult thing to do and one may consider himself very fortunate when taking an impression of a fracture case if he gets clear-cut, well-defined impressions of the teeth alone, to say nothing of being able to hold the ends of the fragments together while taking the impression. When the operator does approximate and manipulate the fragments, he should bear in mind that he must be as gentle as possible, for reasons which have been mentioned before. The oral cavity and the line of fracture should be flushed out gently in order not to move decomposed matter to such an extent as to open another avenue of infection.

Irrigation.—While speaking of irrigation, it might be mentioned that in cases of fracture with antral involvement, one must spray or irrigate *very, very* gently to avoid forcing septic matter into the accessory air sinuses, thereby doing the patient more harm than good. The solution should always be warm. The use of peroxid of hydrogen should be discouraged in this class of cases, and, in fact, in any abscessed tract, especially if that tract has no fistulous opening. Any surgeon who has had much experience with peroxid of hydrogen does not wish to use it on account of the possibility of opening a new avenue of infection. The free atoms of oxygen are liberated and these have an affinity for the canaliculae of the bones, leaving them open and allowing ready ingress for pus and other infectious matter. Therefore the use of peroxid of hydrogen is contra-indicated.

ANESTHESIA

Novocain and Suprarenin

Local Anesthesia.—It may not be out of place to say here just a few words about novocain, since it will be much used in connection with treatment of fractures. No one should attempt, of course, to set a fracture of the lower jaw, anterior to the angle, without a mandibular injection on the same side and a mental injection on the opposite side to the seat of the fracture. Nor should anyone attempt to set a fracture of the superior maxilla without proper conductive local anesthesia. Local anesthesia is preferable to general because there is less hazard of septic pneumonia.

Proper Care in Injection.—The causes of after-pain following an injection are: (*a*) unclean syringes and needles; (*b*) unclean technic; (*c*) stale or unsterile solution; (*d*) alcohol in the syringe; (*e*) too much of the solution; (*f*) injecting the solution too rapidly; (*g*) injecting into the muscular tissue. If all of these causes are eliminated it is certain that there will be little or no after-pain from novocain injections. The writer believes that many men use too much of the solution for a given injection and that it acts as a mechanical irritant, even though

Fischer and others claim the solution is isotonic. The writer is also of the opinion that the depression that sometimes follows one of these injections is due chiefly to the suprarenin. It can readily be understood that the tissues cannot absorb and diffuse two cubic centimeters as readily as they can one cubic centimeter. Therefore in a solution in which the strength of the novocain only has been increased there will be less irritation with a smaller quantity of the drug and the depression will not be greater because there is no increase in the quantity of the suprarenin, which, of course, is the depressing agent in novocain injections. To overcome these two last named difficulties, irritation and depression, the quantity of the solution must be cut down but the strength increased. In increasing the strength of the solution it is done with an *F* tablet, which contains no suprarenin. For instance, it is preferable to use a 1 c. c. solution containing an *E* and *F* tablet rather than to use a 2 c. c. solution containing one *E* tablet. In this way a stronger anesthetic solution is obtained. There is also less danger of the solution acting as a foreign body, on account of the quantity having been halved. If uncleanliness is eliminated, the suprarenin reduced and the principles of the injection technic just outlined followed, it will be found that novocain is a great boon to the patient and to the operator. It lessens pain and reduces disagreeable after effects.

Technic.—A few words upon the technic of injection will be said here. It is taken for granted that syringe, needle and contents have been sterilized. It must be insisted that the patient gargle his throat and flush his mouth, using the cheeks as a bellows to accomplish thorough irrigation. Alcohol is applied on the area in which the needle is to be inserted and the iodin solution well rubbed in to get mechanical, frictional cleansing and tanning of the area. The needle is inserted slowly, pushing the contents of the syringe ahead of the needle and depositing the solution slowly so that after-pain and unpleasant sequelae may be under control. The bone is followed. The needle is removed and care taken that it is sterilized before making another insertion in the immediate, adjacent or distant tissues. Often men will use the utmost care in the preparation of their syringe, needle and solution, and yet, if they have not used the entire contents of the barrel, will commit the grave error of making a second insertion without sterilizing that needle. Some practitioners like platinum needles, others prefer the steel. The claims set forth for the platinum needles are ease of sterilization and that they are not likely to break. The disadvantages of the platinum needles are that they easily become dull and often bend while being inserted, which brings about loss of direction in depositing the solution. The writer uses a new steel needle for each barrel content. It is always sharp, it costs eight cents, it is worth eight cents, for it has done its duty, and there is less likelihood of breaking one off in the succeeding patient's mouth if it is used but once and thrown away. Steel needles rarely break in the hands of a careful operator and if they do, his technic is so under control that they are not lost in the tissues but are easily removed.

Regulation of Bowels Necessary.—It should be said that, in fracture cases, on account of the loss of chewing capacity by the patient, it is necessary that the bowels be kept well regulated. The absorption of toxins, etc., is always to be guarded against, and this matter is a very important part of the treatment of a case.

TREATMENT OF THE FRACTURE

Importance of Reduction and Maintaining Fixation.—There is one point which should be emphasized, namely, that reduction of the fracture is the condition to be aimed at all the time during the healing, and by all means maintained by fixation. If the splint should come off it must be put on again as soon as possible, always bearing in mind the ever-present condition that may occur, and that is infection. To prevent infection and re-infection the spicules of bone must be removed and cleanliness maintained by frequent gentle irrigation with warm solutions.

Drooling.—Drooling is a very annoying condition which accompanies practically all maxillary fractures. A very good method of handling this condition is as follows: one end of a napkin or handkerchief is taken and the patient holds one corner of it between the inner surface of the lower lip and the labial gum, over the incisor region of the lower jaw. If it is allowed to hang down as directed this drooling will be controlled. Some men pack the mouth under and along the tongue with gauze but if the method just suggested is followed the patient will not be annoyed with drooling to any great extent.

FRACTURES OF THE MANDIBLE

Displacements

Fractures of the mandible, even in civil life, are compound as a rule. This jaw is more frequently fractured than the upper jaw, because it is not protected so well anatomically and is therefore more exposed to the various forms of violence. In one case seen the fracture occurred between the cuspid and the first bicuspid on the lower jaw, with the long fragment drawn down and the shorter one drawn up. This introduces a very important point, namely, displacement and a study of muscular traction.

Typical Case.—To make the description and study of displacement as clear as possible, a case will be cited. The fracture is between the lower right cuspid and first bicuspid. The long fragment in this case has both pairs of superior and inferior genial tubercles. Therefore there will be a downward, inward and backward displacement of the long fragment and an upward and outward displacement of the short fragment, because the balance of muscular traction has been lost. The long fragment assumes the position stated, on account of the action of the geniohyoid, the geniohyoglossus and the anterior belly of the digastric. The shorter fragment takes the position described because of the traction of the strong masseter and the internal pterygoid muscles. With this case firmly fixed in mind the reader will have a pretty good idea of the position of the fragments following a fracture in this area. A fairly good conception as to where the line of fracture is located should always be gained by a study of the anatomical and muscular relations. To make the description more clear,—if the fracture was in the median line, between the superior and inferior genial tubercles on one side and those on the other there would be little or no displacement because the muscular traction balance would not have been upset to any extent. By making a study of the muscles involved in the area of a fracture, and by being familiar with their actions, much time may be saved in mapping out the line of fracture, and in deciding upon what type of splint is practical.

Fig. 85.—Study of Displacement. Fracture between lower right cuspid and first bicuspid. Long fragment displaced downward, short fragment displaced upward.

Fractures at the Angle of the Mandible.—Fractures at the angle of the mandible are prone to little or no displacement, because the masseter muscle as a rule has fibers inserted on either side of the line of fracture and the strength of this muscle is well known. This is the reason why it is difficult sometimes to make out crepitus

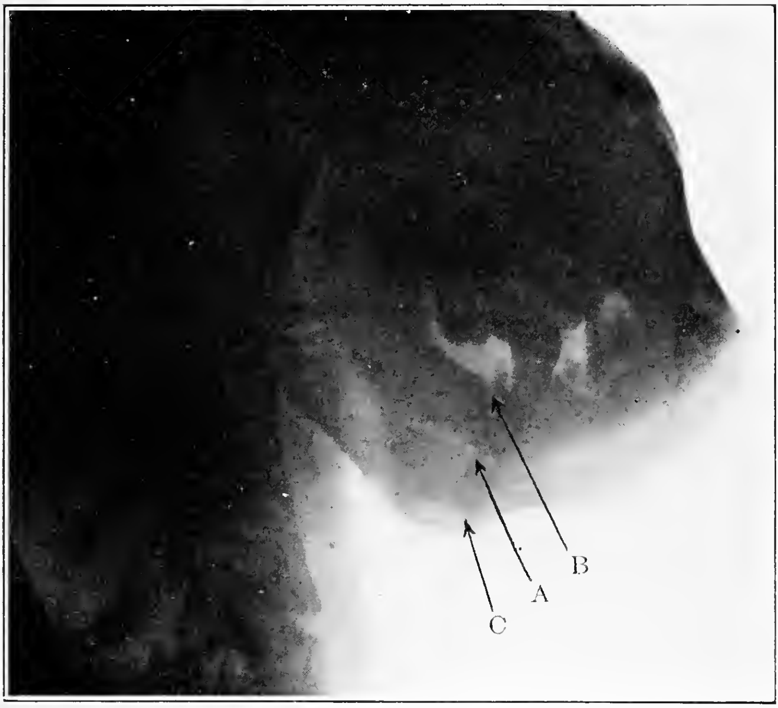


Fig. 86.—Fracture Anterior to Angle with Characteristic Little Displacement. A and B indicate spicules of bone; C indicates line of fracture.

in a fracture at the angle of the mandible. Other conditions that add to the difficulty in examination in this area are the induration and swelling of the tissues. Therefore, considerable study should be undertaken on the causes of extreme and minor muscular traction, because this has a great deal of bearing on the type of splint or method to be resorted to in bringing about reduction, maintaining fixation and getting a fairly normal occlusion of the teeth. In obtaining a favorable result as far as occlusion goes, we may not be able to produce that idealistic orthodontic occlusion which is read of in the text-books, but the lines of occlusion should be so well fixed when a fracture is set that it will compare favorably with the occlusion that was present before the fracture occurred. In some cases a far better occlusion of the teeth may be secured in the finished case that the patient possessed before the fracture took place, without endangering the symmetry of the face.

Splints

Use of the Skull Cap.—The first surgical principle in the treatment of every fracture is *rest.*

To assist in maintaining rest, for the first few days, while the splints are being made and after they have been put in, a skull cap should be used in every case. In making one of these skull caps, the main point to be borne in mind is that the two small flaps to which the buckles are attached and which are sewed to the piece of webbing that encircles the head, should be stitched to this webbing at such an angle that when the piece of webbing supporting the chin is attached to these buckles, the force will be exerted in a plane that extends from the mental prominence to the glenoid cavity. This is extremely important when the skull is used for anchorage. It is always necessary to use one of these skull caps, or some similar device, when making use of the interdental vulcanite splints which are often used in extensive fractures. If, when inserting one of these interdental vulcanite splints, it does not appear to fit, and the fragments cannot be fitted into place, the operator need not feel discouraged. He should bring about as much reduction as possible and hold it, tightening on the buckles. The next day, when the patient comes in, one may be greatly surprised and pleased to notice that the fragments have settled into correct position or nearly so. This has happened in the writer's experiences so frequently that it is not at all disappointing if the parts do not go into place on the first visit of the patient. On account of infiltration of the tissues with the products of inflammation and because of muscular traction, it is not likely that the fragments should go easily into place but,

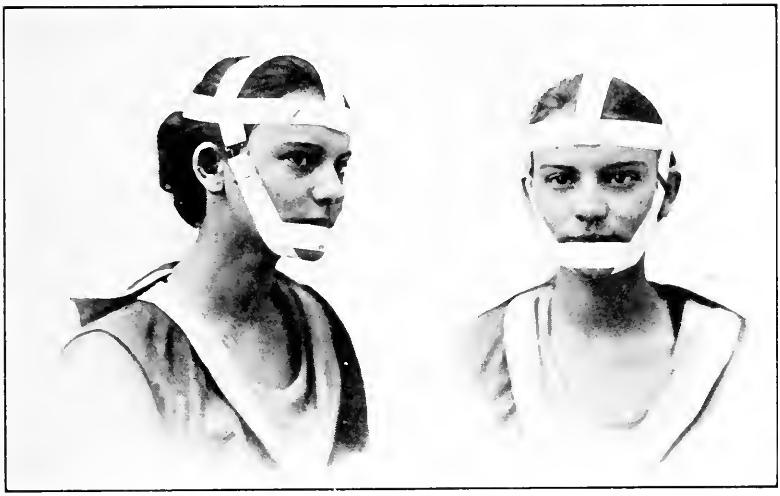


FIG. 87.—FRONT AND LATERAL VIEWS OF SKULL CAP IN POSITION. Straps adjusted to show necessity of exerting pressure in a plane from the mental prominence to the glenoid fossa.

with the surgical rest that intervenes between the first and second visits, the swelling and inflammation having been greatly reduced, the fragments will slip more easily into position.

While the subject of splints is under discussion it might be well to say that the ideal splint for a given case is one so constructed that the dentist *may watch the occlusion, maintain cleanliness, allow the patient use of the jaws in the mastication of soft substances, and all the time control reduction by maintaining fixation.* With the *interdental vulcanite splint,* assisted by the skull cap, reduction is held, but watching the occlusion and promoting cleanliness are lost sight of to a great extent and mastication is impossible. With the aluminum jacket splint it is possible to keep the parts clean, hold reduction and allow the patient some use of his jaws, but it is not possible to control the occlusion to the same degree that might be accomplished *with the bands to which bars have been soldered.* The use of wires alone, not in connection with bands, is advised as a temporary technique only. For maintaining fixation permanently they are too irritating.

This in a very few words describes the whole story of the various types of splints and their values. Every splint used is a modification or combination of any one or all of these. The selection of the splint, the type to be used, the modification and its adaptation depend upon the experience, judgment and ingenuity of the operator, and in the practice of dental surgery there is nothing more fascinating, more interesting and satisfying, than to mould a misshapen and disfigured countenance back to its normal appearance.

Study of Recoil

Fractures Where Teeth are Missing.—A very common site of fracture is where one of the molar teeth is missing. In such a case the man may have received the blow on the opposite side and with one of the molar teeth missing on the near side, the recoil spends itself at the weakest part of the bone,—namely, where the tooth is out. In examinations it is necessary to study thoroughly by palpation areas where teeth are missing and to grasp the fact also that while a man apparently has but one fracture there may be another on the opposite side, where the jaw has been weakened by previous extraction of a tooth. A fracture may also be present in the condyle area as a result of this recoil. This is a very important and interesting study and a condition that is commonly found.

Fractures of Symphysis.—Fractures of the symphysis in the median line have little or no displacement as a rule, for reasons stated earlier. Such a case could be treated by banding the laterals and cuspids on either side

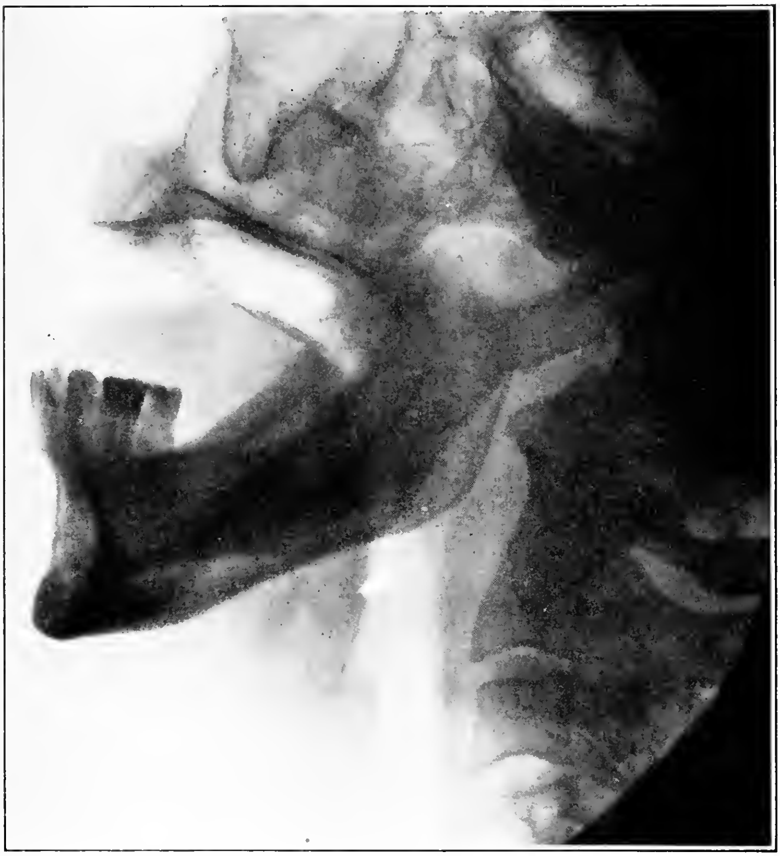


FIG. 88.—FRACTURE AT THE NECK OF THE CONDYLE.

of the line of fracture, and, having soldered a bar both labially and lingually to these bands, cement them to the teeth and thus bring about reduction. Always assist in maintaining fixation for a few days by the use of the skull cap.

Fracture at the Neck of the Condyle

Fractures of the coronoid processes are rare. Fractures at the neck of the condyle, while not common, are found sufficiently often to bear in mind that they may occur. An x-ray picture of such a fracture is shown (Fig. 88). While discussing fractures at the neck of the condyle, it might be well to give the differential diagnosis between it and a dislocation.

Fig. 89.—Showing Bands, Bar and Intermaxillary Elastics in the Treatment of a Case in which both Condyle and Body of the Mandible have been Fractured. (From Brophy's "Oral Surgery.")

Differential Diagnosis.—In fracture at the neck of the condyle the jaw is always displaced to the same side on which the condyle is fractured, while in a dislocation the displacement is always toward the opposite side. To make it a little more clear,—if there is a fracture of the left condyle, the displacement is toward the left side. If on the contrary there is a dislocation of the left jaw, the displacement is toward the right side.

Treatment of Condyloid Fracture.—The treatment of a case of fracture at the neck of the condyle on the left side with another fracture between the lower right bicuspids on the opposite side was as follows: Bands were made to encircle two of the teeth on either side of the fracture in the bicuspid region and strong metal bars were soldered both labially and lingually to these bands. These bands were cemented to the teeth and thus this bicuspid fracture was reduced and fixed. If the operator

FIG. 90.—EXTENSIVE NECROSIS. Showing dangers of inviting pathological fracture by radical operation for the removal of sequestra.

had used a vulcanite splint and controlled immobility it can readily be seen that, while the fracture at the neck of the condyle was uniting, adhesions might form in the temporomandibular region, with resulting ankylosis. To prevent the possibility of such a condition arising, intermaxillary elastics were employed, such as are used in orthodontia cases. It is not necessary to describe the insertion and attachments of these for the technique is known to all.

In studying this case a little more closely, it may be said that in the bicuspid fracture fixation of the parts and normal occlusion were maintained; the area was kept clean

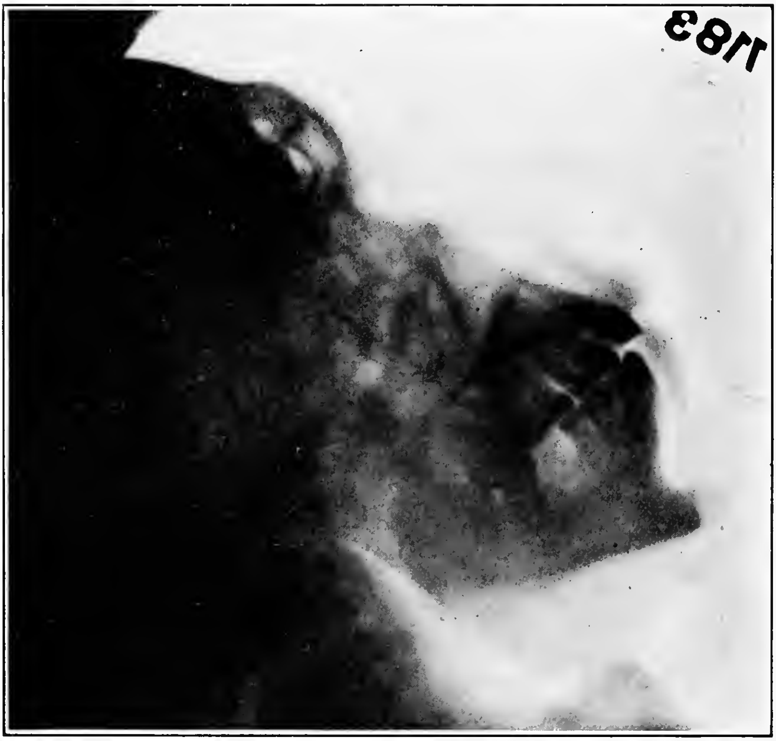


Fig. 91.—Extensive Necrosis. Same as Figure 90. (Six months later.) Showing result of conservative treatment of extensive necrosis.

easily and the patient enjoyed the use of his jaws in the mastication of very soft solids and by the continued force of the maxillary elastics the head of the condyle was given some degree of motion. This is a very clever and ingenious way of handling conditions of this sort. Another point that this case strongly emphasizes is this, —that before the operator makes up his mind what splint he should use he must have every fracture definitely, accurately and clearly outlined.

Danger of Pathological Fracture.—A case in which necrosis is present and which involves the body of the bone from the angle on one side to the angle on the other is next studied (Figs. 90 and 91). Here it was feared that if a radical operation were performed, as is often done in necrosis cases, and an attempt was made to remove all the dead bone, the remaining healthy bone might be weakened

FIG. 92.—PATHOLOGICAL FRACTURE. Upper right hand picture shows fracture in body of bone. Lower picture shows molar tooth, removal of which, with pus formation, so weakened the bone that fracture followed.

to such an extent that the man might suffer a fracture or fractures of this delicate horseshoe-shaped piece of bone, with permanent loss of function and unsightly disfigurement, because it would be impossible to unite the fragments so that the lower borders of the face might be restored to anywhere near their correct anatomical position. Such a type of fracture is styled a *pathological fracture* and is not the result of direct violence, but is caused by a functional force exerted upon a bone weakened by disease. Rather than perform this radical operation it was decided in this case to act very conservatively and remove the sequestra as they formed. The parts were kept as clean as possible by frequent irrigation and light, delicate curettement and the area stimulated now and then with aromatic sulphuric acid applied on a piece of cotton. The man was given a Moffatt syringe with instructions in its use and advised not to swallow any of the constantly accumulating pus. (Figs. 90, 91.)

EXTERNAL INCISIONS, PREVENTION OF POINTING AND DRAINAGE

The writer of this chapter does not wish to discourage the attempts that have been made in the past to teach students not to make an incision externally upon the face, but every rule has its exception, and it would be far better surgery in some cases to make a small incision externally upon the face with the resulting minimum disfigurement. It must be stated, however, that in the vast majority of conditions met with in dental and oral surgery, an incision within the oral cavity is all that is required to gain free and complete drainage. When an incision is to be made externally upon the face, the question of the position and possible extent of the resulting disfigurement should be ever present. Therefore, before using the knife, the cardinal principles of site, shape, size and direction of incision should be given serious consideration. Above all, never make an incision in cross section to the fibres of a muscle In certain cases if the incision were not made externally and if nature were allowed to follow her own course, the result would be a puckered wound with an unsightly scar.

It is necessary in some cases to make the incision externally upon the face because the abscess is pointing at a distance of an inch below the inferior border of the mandible, and it can be readily understood that even though free incisions are made within the mouth, it is quite an impossibility to thoroughly drain that abscess through the oral cavity. This may be compared to draining a barrel with the drainage made through the middle of the side rather than through the bottom. An abscess may be prevented from pointing externally upon the face by free incision within the mouth, by the use of the ice bag externally and by supporting the skin in the affected area with five or six coats of collodion.

Technique of Insertion of Wick

In placing a wick in a fistulous tract which extends from the inside of the mouth to the outside of the face, the following technique has some value. After the wick has been put through the wound for the first time, in the usual manner, with a probe,—always from without inward, and the area on the face has of course been sterilized before doing this,—at the second visit of the patient, before removing the wick it is necessary to cut off that portion of the wick exposed on the face on which the discharge from the wound has become dry. Next a piece of silk about a yard long is tied on the wick at this still protruding outside end, at a point where the discharge from the tissues has not become dried; then the wick is removed by pulling the attached piece of silk through the wound into the mouth and out through the oral orifice. Next the wick is cut off from the floss and the ends of floss tied together. After the tract has been irrigated the floss silk is cut, tying the wick on the end that comes through the face. The floss silk is grasped between the fingers of one hand and with the fingers of the other holding the wick it is given a quick pull in an outward inward direction, leaving the wick in place, with little or no discomfort to the patient. All of this is very simple and possibly quite elementary and yet these points in technique are overlooked many times by brilliant operators. The value of this procedure is that it increases speed and cleanliness and minimizes pain. The dried end of the wick is cut off because in pulling it through the wound it would cause unnecessary pain. The wick is pulled in an outward inward direction so as to avoid needlessly placing a greater number of microörganisms in the wound. The ends of the floss are tied together so that they will not come out through the wound when the fistulous tract is irrigated. Everyone should remember, in placing wicks, that they become foul quite rapidly and this is not going to enhance the rapidity of the healing process, therefore a frequent change is necessary. In fact, the whole question of the surgical treatment of fractures simmers down to fundamental mechanics together with absolute cleanliness, careful surgery and common sense.

Radiographic Precautions.—Here it should be reiterated that it is not safe to rely on one radiograph taken in a certain position but to have a number of them made at various angles in order to avoid confusion in the interpretation of the radiograph and thus escape the crime of faulty technique.

Treatment of Scar.—In cases of external incisions upon the face, the amount of scar may be minimized by drawing the lips of the wound together with zinc oxid strips after the pus flow has ceased, and also by not resorting to the use of the wick unless it is absolutely essential. If one is needed, however, use it for as short a period of time as is necessary. In connection with those cases in which pus has been flowing from the line of fracture for some time, it is a wise procedure to freshen the edges of the fracture by curettement; and no instruments are better adapted for this purpose than the pyorrheal planers spoken of earlier in the chapter.

Packing of Wounds in the Mouth

It is a well known fact that if a piece of cotton is placed in the socket of an extracted tooth it becomes foul in a short time even though the cotton be saturated with some antiseptic. Therefore cotton should not be used, for it is entirely unnecessary if one adopts the following method and technique. If it is desired to keep the lips of the wound open, to assist in free drainage, a roll of sterilized rubber dam is used, which has previously been immersed in camphophenic liquid or some other equally good non-irritating antiseptic and analgesic. If the periosteum has been removed from the bone because of some slip in the operator's control, there will very frequently be a severe after-pain. Quite often there is severe pain following a simple extraction with no loss of bone or periosteum. In these cases the wound should not be packed with cotton, as previously stated, but camphophenic and orthoform should be used. The former is a germicidal antiseptic and analgesic and comes in a liquid state. The latter is anesthetic and sedative and is a white powder. The two are mixed to the consistency of stiff putty and inserted in the socket or in the wound and the pain will be thus controlled, the wound clean and the lips of it spread apart. Should pus be flowing from the wound the preparations should be mixed to a looser consistency and applied loosely and gently in the cavity. In the writer's opinion it far excels the iodized gauze or Buckley's euroform because the case is handled more cleanly and there is thus less irritation to the tissues.

Suturing Bone with Metallic Substances

In treating of suturing with a silver wire or any metallic substance, it should be stated that in practically every case, in which suturing was employed in a fracture, where there could be invasion of microörganisms into the line of fracture from within the mouth, the result was necrosis. A bone would have no chance to unite with many such wires acting as foreign bodies to the tissues and cutting off the blood supply because the vitality of the part would be so sapped by this technique that necrosis would surely follow. There may be exceptions to the rule that suturing through the jaw bones invariably results in necrosis, but the exceptions are few. It is to be used only when no other method may be employed and rather than use it it is better to sacrifice some occlusion, with a possible resulting asymmetry, rather than hazard the train of evils that attend and follow an extensive necrosis.

Hemorrhage

Factors Inducing Hemorrhage.—A word about hemorrhage and its control will be said here.

Injury to a vessel, foreign bodies, the spread of the infection and incomplete fixation of the parts are dominant factors in producing hemorrhage. Especially severe in these gun-shot wounds is the hemorrhage that follows injury to the lingual artery, but pressure with gauze and some sort of appliance to hold the gauze around and under the tongue is an important means of controlling it. In this connection it should be stated that there is danger of the gauze having been left in the mouth for too long a period of time, thus producing an infection which will be secondary to the conditions that caused the flow of blood. As to the control of hemorrhage, it is of course familiar to all, but possibly one or two practical points may be mentioned which may prove of great value.

Treatment of Hemorrhage.—The patient should be directed to make a mush bite in modeling compound; the impressions thus formed are filled with light gauze saturated with adrenalin; this modeling compound splint with the gauze therein is inserted; a skull cap such as previously described is put on and the buckles tightened. Thus a very efficient method of controlling hemorrhage is obtained. Pressure may be exerted in some cases by inserting a cork stopper about which gauze saturated with adrenalin has been wound. This is inserted between the patient's upper and lower teeth and he is directed to close his jaws and use the skull cap. Calcium lactate is advocated by the textbooks. According to the writer's experience its real value is questionable. The use of horse serum is often very efficacious and should be thought of in this connection.

Résumé of Foregoing Matter

An attempt has been made thus far to emphasize some of the important features presented in the diagnosis and treatment of maxillary fractures, principally those met with in military life. The importance of absolute cleanliness as far as possible in the oral cavity has been given marked attention. The spicules of bone that might be lodged in the soft tissues or in the line of fracture, which acted as irritating influences, have been discussed and the importance of iodin has been considered as being second to none in completing the cleansing of the oral cavity. Gun-shot grounds have been discussed and it is known that the speed, size, shape and character of the missile, the angle at which it struck the tissues and the amount of tissue dislodged are important considerations in determining the extent of the injury to both osseous and soft tissue.

It has been stated that a bullet may enter the jaw at a certain angle and dislodge a piece of bone, which piece of bone passes with almost explosive violence through both hard and soft tissue ahead of it, acting as a secondary projectile. It may readily be seen then that the amount of injury to both soft and hard tissue would depend largely upon the size, shape and force of the bone projectile, so-called, as well as the size, shape, speed, etc., of the missile. This is very important to bear in mind when examining wounds, for it is good judgment to determine the way the projectile hit the tissues because the extent of injury done is thus presented a little more clearly than it otherwise might have been. It is essential to bear in mind that the contraction of the tissues on account of the injury, the pus formation, the loss of functions of the jaw, and the displacement of bone caused by unbalanced muscular traction, are the factors that make for the gaping wound so often seen. A man not familiar with such conditions might make a prognosis that was far from what it should have been. The fact that all the tissues in the mouth are subject to such easy infection with the anatomical and physiological balance upset leads one to look immediately for infection after every such wound and to be on guard against such a possibility.

It has been shown that where there is a compound fracture in one section of the jaw there may be a simple fracture, with no break in the continuity of the surface, in another part because of the transmitted force. That condition occurs frequently even in private practice. The diagnostician in cases of this sort should have the possibility of such a condition ever present in his mind and make a thorough examination, mapping out the lines definitely and following the anatomical areas carefully in determining the extent and number of fractures. In plastic operations it is necessary to restore functional activity and minimize the deformity. Therefore it is very important not to attempt any operation of this character while pus is flowing from wounds in the mouth and while the parts are not made immovable. There is a great tendency for infection and gaping of the wounds made in the plastic surgery because of the pus formation and the movements of the jaws.

Tetanus.—The tetanus organism has also been touched upon and mention has been made of the possibility of latent tetanus. It is advised that all become familiar with the pathology of this condition and its differentiation from trismus of dental origin and temporomandibular irritation, for the ability to recognize it in an obscure or attenuated form may be the means of saving a life.

Subjects Discussed.—The writer has also discussed drooling; insertion of wicks; displacements; fractures at the angle; certain splints and why they are used; differential diagnosis of fracture at the neck of the condyle and dislocation; a study of recoil; therapeutics; illustrations with description of cases have been given and the surgical technique and treatment discussed. The technique of conductive anesthesia has been covered and possible complications considered in detail; free drainage was dealt with at some length. Here it is sufficient to say that it is of the first importance to establish free drainage and to remember that most of these abscesses which are secondary to a fracture are caused by spicules of bone and that confined pus and irritation from wounds may cause the greatest amount of injury to the human organism because of absorption. Besides the removal of these spicules of bone, care must be taken of roots of teeth and tartar. It must be remembered, however, that the extent of the operation and the vitality of the patient are important considerations in determining whether one should or should not attempt to remove foreign bodies immediately.

Thus far discussions of the theoretical and technical sides of this subject have been covered. The practical side of the question will now be touched upon. With the assistance of illustrations the study and treatment of some of these cases seen by surgeons in the war will be followed.

PRACTICAL ASPECTS OF TREATMENT

Unerupted Malposed Third Molar.—The first illustration shows an unerupted malposed third molar lying longitudinally in the ramus, midway between the angle and the joint with necrosis of bone. This emphasizes the importance of always having a radiograph made to study any diseased condition which involves the teeth or the osseous tissues within the dental field. The advantages of the radiograph in this case were many. It immediately disclosed the cause of the pain and governed the technique in operating. It showed how easily access could be gained to the tooth from within the mouth through the thin lamina of bone overlying the crown of

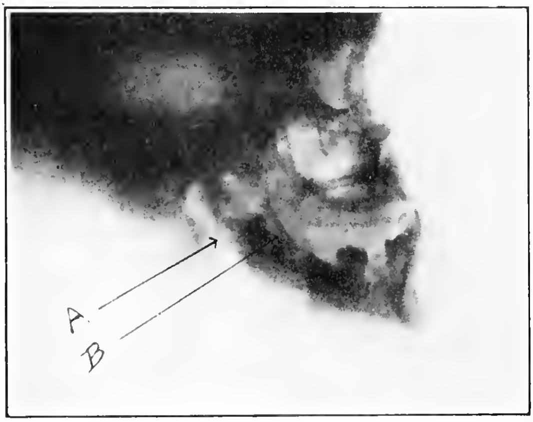


Fig. 93.—Unerupted Malposed Third Molar. A indicates malposed third molar; B indicates carious bone about tooth. Shows danger of inviting fracture.

the tooth at the anterior border of the ramus. It also indicated the liability to fracture the bone through the socket of the tooth if undue force was used in its removal, for the length of the tooth from the crown to the apex of the roots was almost equal to the depth of the ramus in an anteroposterior direction. It may also be stated here that with the history and clinical symptoms in addition to the radiographic picture it is fair to presume, that the bone was diseased and that, the tooth being loose in its socket, not much force would be required to remove it. This proved to be the case. The value of the radiograph is fully demonstrated in this one case.

In the study of all radiographs, conclusions in support of clinical evidence, symptoms and history must be reached. As the late Doctor Murphy of Chicago so well stated, "A radiograph may make a diagnosis in some cases, but a radiograph plus the use of our cortical cells makes a more accurate and scientific diagnosis in every case."

Fracture Between Cuspid and First Bicuspid.—I recall a very interesting case in which the radiograph showed not only a fracture between the cuspid and first bicuspid on the lower left side, but also the root of the lower left second bicuspid with radiolucent area (which was not to be seen in visual examination), and an impacted inferior third molar on the same side. The picture emphasized very forcefully the real necessity and value in having a radiograph made, not only intra-orally but also extra-orally, before attempting to set a fracture. In connection with this fracture a supposed case might be cited. The fracture might have been set and a week afterwards the patient might have developed swelling and pain, either in the line of fracture, the second bicuspid area, or in the angle region. Had not the radiograph been made one might conclude that there was infection from spicules of bone in the line of fracture, but with the radiograph, attention is immediately focused upon the possibility of either the hidden bicuspid root or the malposed molar being the seat of the trouble. In other words,—with the radiograph one gets a clearer conception of conditions than one would otherwise have had. It makes for a more accurate diagnosis, does away with unnecessary removal of tissue and in many cases points the way for surgical procedure. Of course with a radiograph taken before the fracture was set, the hidden root would have been extracted for reasons that have been stated earlier.

Quite frequently old roots that are lying dormant apparently, blaze up with abscess formation as an indirect result, it would seem, of impact in the region in which they are situated.

Fracture of Mandible.—The next picture (Figure 94) shows a case of fracture of the mandible as shown by a line between the lower right second bicuspid and first molar and it can readily be seen from the radiograph

FIG. 94.—FRACTURE BETWEEN THE RIGHT INFERIOR SECOND BICUSPID AND FIRST MOLAR. A points to spicule of bone, the removal of which was followed by absence of pus formation; B points to line of fracture.

that there seems to be little or no break in the continuity of the inferior border of the bone. Whether it is displaced inwardly or outwardly is known from the clinical evidence, and as a result of clinical and radiographical evidence combined, it is concluded that the muscular traction is but slightly unbalanced. Such a fracture may be treated in a number of ways, preferably with the bands on the teeth with labial and lingual bars soldered thereto; with the aluminum splint which jackets the teeth above the gingival border or with the interdental vulcanite splint; or with wires ligated about the necks of teeth, the ends of which have been twisted and tightened to similar wires on the teeth of the opposite jaw.

Splint of Preference.—In this case the band with the bars is undoubtedly the best method in the treatment of Figure 94, because it is the most clean, because it gives an opportunity to observe and control occlusion, because the patient has some functional capacity under treatment even though it be diminished, and because there is absolute fixation of the parts. This splint will hold because there is little or no muscular traction to work it from its anchorages. The aluminum jacket splint might be used, but it is the second choice because control of occlusion is not possible. The vulcanite interdental splint might be used but should be advised against because it is unclean, because one cannot study the occlusion, and because the patient has no use of the jaws in the mastication of semisolids. The wires might be used, as described earlier, but the use of them is not recommended in this case because there is little or no muscular traction, because the edges of the fracture can be easily placed in apposition, because the method is unclean, inviting chronic gingivitis; and because mastication of substances is impossible. Relative to the interdental splint, it may be said that it is now used only in cases where a number of teeth are missing, where there is great muscular traction, or where there is loss of osseous tissue. The fulcrum to assist in fixation of the parts with the interdental vulcanite splint is the skull, by means of the skull cap previously mentioned or some modification of it. In all cases, especially for the first few days, a skull cap is used at night on account of the tendency of the patient to open the mouth while asleep and in this way work the splint from the teeth.

Fracture Between First and Third Molars, Second Molar Missing.—Figure 95 illustrates a fracture in the body of the bone just anterior to the mesial surface of the third molar with spicules of bone in the line of fracture, the removal of which is absolutely necessary to stem the flow of pus.

In the study of the picture we are impressed very forcefully with the importance of retaining this third

FIG. 95.—FRACTURE OF THE BODY OF THE BONE BETWEEN FIRST AND THIRD INFERIOR MOLARS WITH THE SECOND MOLAR MISSING. Showing the importance of saving teeth to maintain fixation and preserve symmetry of the face. A and B indicate spicules of bone; C indicates line of fracture.

molar, for if we removed it the approximation and fixation of the distal fragment of the fracture to the anterior fragment would not be under positive control and therefore an asymmetry of the face would be invited after union had taken place. Had we removed this tooth it would not have been possible to control this distal fragment with that degree of scientific accuracy which would be possible with the tooth in place and we might have an outward or an inward displacement of the ramus with the consequent asymmetry of the face, although our occlusion might be fairly perfect. The retention of this tooth also made it possible to use the angle bands with wires to maintain fixation after the spicules of bone had been removed with pyorrheal planers and the parts thoroughly cleansed.

Fracture in which Vulcanite Interdental Splint is Used.—It is necessary in the treatment of a case such as shown in Figure 96 to use the interdental vulcanite splint. Since we have no tooth in the distal fragment in this case it is necessary in reducing the fracture on our plaster model to be guided in bringing about proper relations by studying the direction, extent and amount of displacement and the muscular traction exerted.

Having approximated the fragments on the model as nearly correctly as our judgment directs us, a vulcanite interdental splint is made and inserted. Lateral and anteroposterior radiographs are now made with the splint in position, to show how nearly correctly the fragments are in apposition. If they are not in proper relation warm modeling compound is placed in the vulcanite splint at the proper place to exert pressure in a direction which will bring about the desired apposition. The splint, with the modeling compound attached, is inserted and radiographs are again made to learn if the parts are in correct anatomical relation. If they are not, this process is repeated until the desired apposition is brought about. When we have this approximation satisfactorily adjusted, the modeling compound is replaced with vulcanite in the usual manner and the jaw finally set, with the skull cap in position to assist in maintaining fixation.

Reduction and Fixation by Wiring the Teeth.—The method of reducing a fracture and maintaining fixation by wires consists in simply wiring the teeth of one jaw to those of the opposite jaw. It is sufficient in the bicuspid or molar regions to wire one tooth in the upper jaw to the corresponding tooth of the lower jaw. In the incisor region, however, it is better to wire two teeth in the upper jaw to two teeth of the lower jaw. This method has the advantage of easy adaptation, but if continued until union has taken place, without constant supervision, might cause a gingivitis that might terminate in extensive destruction to the dental organs and bone.

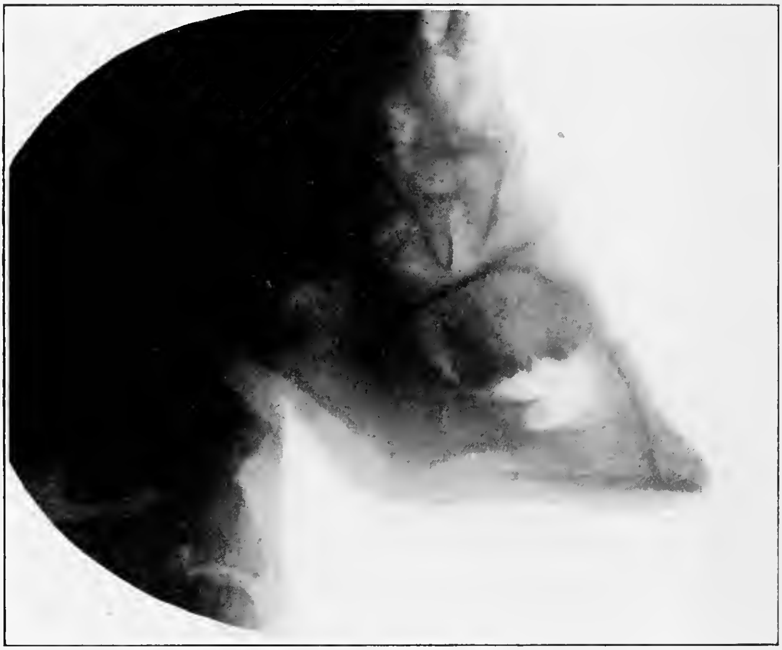


FIG. 96.—FRACTURE OF THE BODY OF THE BONE WITH CONSIDERABLE DISPLACEMENT AND NO TOOTH IN THE DISTAL FRAGMENT.

It is a very efficient and simple method of reducing the fragments and maintaining fixation and in many cases it is quite invaluable, but in most cases is to be used only as a temporary treatment.

The latter part of this chapter is aimed to cover the subject of splints and their adaptations to different cases, even those in which there is an immense amount of destruction of the tissues. The splints described, with modifications of them, are the only ones that have been used up to the present time in the work in the war zone.

Conclusions.—The chief points to be remembered in a given case are to get at the fracture early, to cleanse the mouth and wound well and preserve this cleanliness, to remove the spicules of bone, to reduce the fragments, to maintain fixation, and to watch the occlusion.

CHAPTER VIII

EXTRACTION OF TEETH

BYRON H. STROUT

As a preliminary it may be supposed that it has been decided that a certain tooth or teeth must be removed. There are of course many conditions which may cause an operator to reach this conclusion, and perhaps it will be well at the outset to catalogue some of the reasons for extraction.

EXTRACTIONS OF THE PERMANENT TEETH

REASONS FOR EXTRACTION

Pyorrhea.—All teeth are to be extracted that are so loosened by pyorrhea or other disease that usefulness is at an end, provided no hope of cure remains.

Insecure Roots.—All roots or portions of teeth not sufficiently solid to support crowns should be removed.

Roots with Apical Abscess.—All roots which, though solidly placed, and firm in their sockets, are still hopelessly affected by apical abscess should be eliminated.

Incurable Apical Abscess.—Any tooth, no matter how firmly fixed, how good or how useful, which has an incurable apical abscess, with or without a fistulous opening, should be reckoned a candidate for the forceps.

Supernumerary Teeth. — Supernumerary and misplaced teeth in many cases will require extraction. In this class will be found many of the most difficult extractions. Some of these cases, notably unerupted and impacted third molars, will tax to the utmost the skill of the surgeon.

Sound but Useless Teeth.—Extraction of sound teeth may be required in preparing mouths for artificial substitutes in those cases where, from carelessness, disease or malpractice, so many teeth have been lost or destroyed as to make the retention of the remainder worse than useless.

These classes as they have been enumerated will include practically all conditions in army practice where extraction is necessary or advisable.

EXAMINATION OF THE MOUTH

A decision that extraction is necessary having been made, it is imperative before proceeding with the actual operation that a careful and thorough examination of the mouth and of the tooth or teeth involved be made.

Examination of Tooth Structure.—The examination of the tooth should determine the amount of substance present, and its condition, whether firm and solid, or softened by decay. It should be noted whether the tooth substance is destroyed below the margin of the gum, and if so, how far below that margin. A special examination must be made of the central portion of badly decayed teeth to determine how solid a shell may be remaining. Often upon the result of such an examination depends the selection of the proper instruments for the performance of the successful operation.

If many, or any, perfect teeth remain in place, their shape must be noticed, especially as to whether they are short and thick or long and slender; the rule being that short, thick teeth are firmly planted in a solid alveolar process, while long and slender teeth as a rule are less firmly seated in an alveolar process of much less solid structure.

Examination of Alveolar Process.—The structure, size, etc., of the alveolar process must be examined to determine whether it be thick or thin, high, or low and flat. It should be noted whether the teeth stand alone supported by solid bone all about, or if they are in normal apposition to each other, supported mesially and distally only by thin laminae of bone. This examination may aid in determining the direction for the application of the necessary force, and oftentimes may aid in forming a judgment as to the amount of force likely to be required.

Condition of Gums.—The condition of the gum and tissues about or near the teeth should be noticed. It is essential to see whether the tissue appears of normal pink color and of firm consistency, or pale and flabby, or if it is dark and purplish and congested with blood. It must be noticed whether or not there is an inflammatory process present. A *normal gum* shows that no special precautions need be taken. A *pale and flabby gum* may indicate a lowered general vitality, with possible tendency to severe, or even excessive hemorrhage after operation. A *turgid* or *purple appearance* may indicate deep-seated trouble, as necrosis of bone near or about the tooth to be extracted, requiring extra precautions to be taken as to asepsis and after treatment. Any inflammatory process present in or near the operative field requires that special aseptic care be taken, especially if any injection or wound other than that made by the extraction be required.

INSTRUMENTATION

All these points having been carefully noted, one is ready to proceed to the selection of the proper instruments with which to perform the operation.

To describe in detail the numberless forms of forceps to be found on sale at the present time would be manifestly impossible. It will suffice to describe the essential forms of forceps required, and then to point out those which have in the writer's experience been found to be most desirable.

Types of Forceps

Beaks

The first part of the forcep to be noticed is the beak, or grasping portion.

Types of Teeth.—There are roughly three forms of teeth requiring extraction: (*a*) Single-rooted, as the incisors, cuspids, and bicuspids; (*b*) two-rooted, with the roots mesio-distally placed (the lower molars); and (*c*) three-rooted, with two buccal and one lingual root (the upper molars). There are also two classes in which the relative position of crown and root are reversed, upper and lower teeth.

Forms of Beaks.—Obviously then, there must be forceps with beaks shaped to grasp single-rooted teeth, and these must be made in two general forms, for upper and lower teeth. There must be forceps with beaks formed to grasp the two-rooted molars; these are all found in the lower jaw. There must also be forceps with beaks fitted to the three-rooted molars; these molars are all found in the upper jaw, but occur on right and left sides; therefore it will be necessary that the beaks of these forceps be made in pairs.

A set of forceps, then, for extracting teeth of ordinary forms must include one for lower incisors and bicuspids, one for upper incisors and bicuspids, one for lower molars, and two, right and left, for upper molars, making five pairs in all. These five are absolute necessities.

Special Forceps Required.—Experience has shown that one meets with many small, single-rooted teeth, also small roots of multirooted teeth. For these are required narrow-beaked or so-called root forceps for both upper and lower jaws. It has also been found that many upper third molars are not normally placed, and frequently are abnormally formed, as well as some second molars. For these are required a third pair of upper molar forceps, with differently formed beaks, placed upon the handles at a different angle. These will add three pairs to the set, making eight pairs in all.

Beaks of Special Width.—Again, it is frequently found that there are anterior teeth much crowded, and with one or more forced out of line. Such teeth are of ordinary size, and are firmly fixed in the alveolar process, but overlapped by other teeth in such a way as to preclude the possibility of using forceps of ordinary width. For such cases the so-called *hawk-bill* forceps have been designed. The beaks are narrow as those of the small root forceps, but additional strength has been provided by greatly thickening them. Very useful also are those forceps designed for badly broken down teeth and roots, with beaks of the same width as the ordinary incisor forceps, but with the ends rounded and sharpened. Such forceps are called alveolar forceps, because of the ease with which the beaks may be forced between the tooth and the process.

Handles

Shape of Handles.—Next in importance to the shape of the beaks is that of the handles. These should be so formed as to afford an easy and firm grasp for the hand, long enough to give sufficient leverage that force may be easily applied to the tooth, and so roughened that the hand will not easily slip upon them. In many patterns of forceps the handles are so short that extreme strength is required to dislodge a firmly fixed tooth.

The handles should be as nearly straight as possible. Many patterns have one of the handles formed with a crook intended to engage one or more of the fingers. At the present time, however, most operators agree that such crooks are rather a detriment than a help.

Joint of Handle.—The joint should be as strong as possible, as it is required to withstand a terrific strain. The older models have the joint finished in an octagon shape. Most modern patterns are oval, all angles being carefully rounded for the purpose of avoiding as much as possible the danger of injury to the lips and cheek of the patient.

Pivot of Handle.—The pivot itself or fulcrum of the lever should be as near the beak as possible. The nearer the pivot is placed to the grasping portion of the beak the more power. Where the joint comes together in the act of closing the forceps, the edges should be rounded over to help in avoiding pinching of tissue in the joint.

Various Instruments

Other instruments required in the operating kit of the extracting surgeon will be mirrors, dressing forceps, or, as dentists usually call them, pliers, explorers, several stout, short-bladed hatchet excavators of various angles, and elevators.

Elevators

In common use are three forms of elevators: straight, right-angled, and obtuse.

Straight Elevators.—The straight elevator is a simple stout blade, concaved on one side, convex on the other, the end rounded and sharp-edged, the whole somewhat spoon-shaped. The handle should be of metal to withstand sterilizing by boiling, and large enough that it may be firmly grasped. This instrument is used mainly for removing badly broken-down roots in the anterior portion of the mouth.

Right-Angle or Coolidge Elevator.—The right-angle elevator should have a metal handle of ample size, a short, stout shank, and a blade approximately three-eighths of an inch in length, projecting at nearly, though not exactly a right angle from the shank.

Blades.—There are many variations in the shape of the blade. The form which most find useful is curved slightly in its length, the convex side of the blade also rounded in its width, ending in a sharp-edged rounded end. The inner side is somewhat concave in both directions. Some patterns of this form of elevator are made in pairs, a separate instrument for right and for left. It has been found more practical to combine the two in one, both blades being mounted on opposite sides of the one shaft. Thus the instrument needs only to be turned in the hand to be available for either side. It is important that the convexities of the instrument be smoothly rounded, and that the edges be sharp. The blade should be made as thin as possible, and still retain sufficient strength to sustain the very heavy strain often put upon it. This pattern is known as the Coolidge, from Professor J. B. Coolidge, the designer.

Obtuse-Angle Elevator.—The obtuse-angle, third molar, or lower wisdom elevator, should have, like the others, a metal handle, and a short, stout shank. The handle must be large enough to afford a firm grasp for the hand. The blade in this instrument extends from the shaft at an angle of forty-five degrees. The blade should be about three-eighths of an inch in length, with a width of three-sixteenths of an inch at the widest part, tapering to a point. The outer surface should be perfectly flat, the inner convex, thickest at the widest portion, running to nothing at the point. The edges should be sharp. This elevator is practically solely used for the removal of lower or third molars.

The mode of using the various instruments will be spoken of fully when describing the extraction of the teeth to which they are adapted.

OPERATIVE PROCEDURE

Anatomy of Jaws.—In the upper jaw on the buccal and labial sides of the teeth the process is thin, these sides being nearly vertical. On the lingual side the process is much thicker, the bone curving away from the teeth in a concave line toward the center of the palate.

In the lower jaw the reverse is the case, the inner plate being vertical and thin, while the outer plate is thick and heavy. The bone is thickest opposite the molars, gradually thinning towards the anterior portion of the mouth, until about the lower incisors the bone is of about the same thickness labially as lingually.

These anatomical facts must be kept in mind when applying force to a tooth for the purpose of its removal.

Position of Operator

A proper position of the operator in relation to the patient adds greatly to the ease and certainty with which the operation may be performed. The position varies as the tooth to be removed is situated in the upper or lower jaw; also according to the style of instrument used for the operation.

Generally in extracting upper teeth the operator's position should be to the right of, and slightly in front of the patient. This is supposing the operator to be right-handed. If left-handed, reverse the positions as to right and left.

The Chair.—The chair should be elevated to bring the patient's head about on a level with the shoulder of the operator, and slightly tipped backward. The left arm and hand should be back of, or above the patient's head, and the fingers of the left hand engaged in holding the lips and cheek of the patient, so that a clear view of the tooth to be removed may be obtained (Fig. 97).

Operator and Patient.—In extracting lower teeth the operator should stand behind the patient, and slightly to the side of the tooth to be operated upon. The chair should be lowered to the fullest extent, and tipped well back. As in operating upon the upper teeth, the left hand holds the lips and cheek away, while the right wields

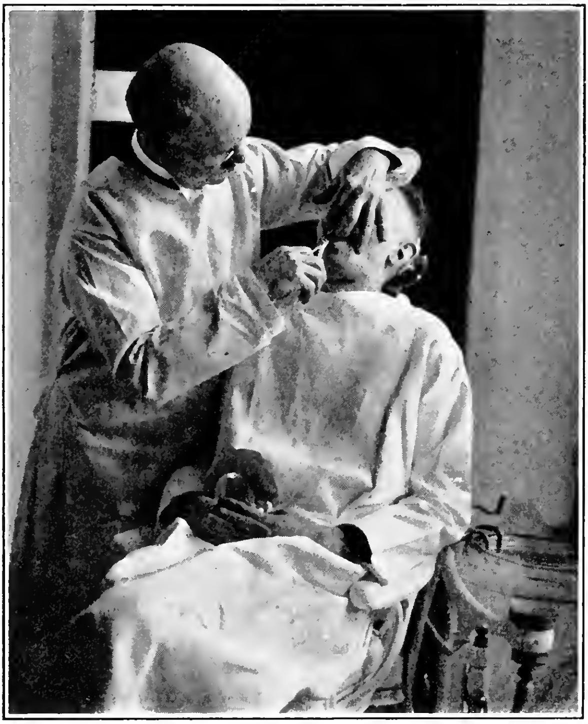


Fig. 97.—Position for Upper Extraction.

the forceps. This description applies when using forceps of the Coolidge pattern.

If, as many do, one should use forceps, the beaks of which are turned at a right angle with the line of the handles, then the operator would stand in front instead of behind the patient, the chair low, but erect, the chin and jaw of the patient grasped in the left hand and the right holding the instrument (Fig. 98).

Hand Grasp.—The proper hand grasp of the instrument is a matter in which there is more or less difference of opinion. It is probable that the conformation of the operator's hand may have a good deal to do with his method of grasping the forceps. The hand-grasp, for most operators, for the upper forceps is as follows: (*a*)

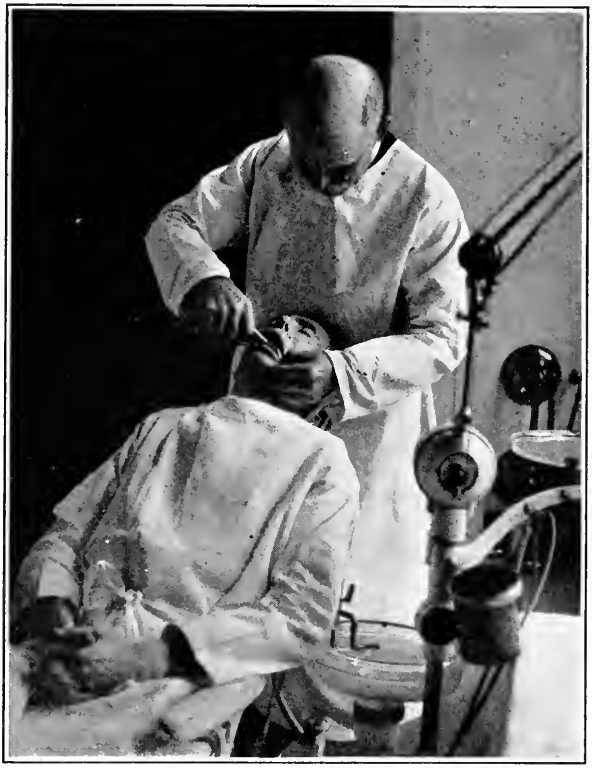


FIG. 98.—POSITION FOR LOWER EXTRACTION.

the forceps should be laid with the angle of the bayonet turned upward, diagonally across the palm of the open hand, the handles resting near the base of the palm opposite the thumb, the upper portion of the handles crossing the tip of the forefinger; (*b*) without moving the fingers, the thumb is closed over one handle of the forceps, in such a way as to hold the forceps firmly; (*c*) placing the tip of the forefinger inside the handle near the joint, the tips of the other fingers are allowed to lightly grasp the outside of the same handle. In this way the thumb holds one beak of the forceps immovable. The tip of the forefinger acts as a wedge or spring to open the beaks to the desired degree, while the other fingers act to close them. The mutual action of all the fingers

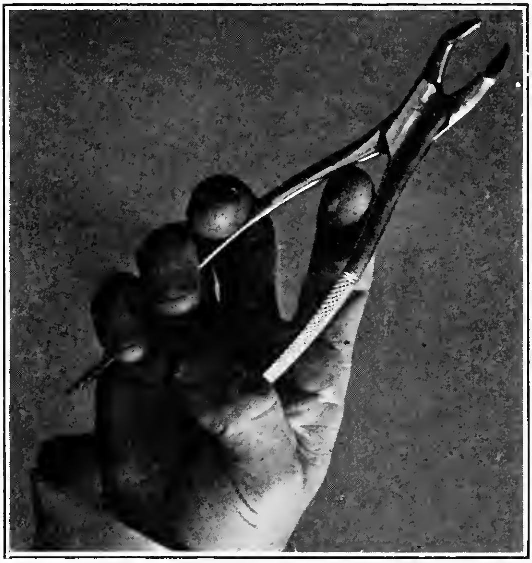


Fig. 99.—Palm View, Handgrasp, Upper Forceps.

allows the beaks to be opened to the proper distance and there immovably held (Figs. 99 and 100).

When the instrument is properly grasped, a slight turn of the wrist forward brings it into proper position for operation upon any upper tooth.

In the more common method of grasping the forceps, the instrument is laid across the palm of the hand less diagonally, more at a right angle with the fingers, resting more on the base of the fingers than on the palm, the bayonet projecting downward instead of upward. The end of the thumb is placed against the inner side of the outer handle, while the ends of the fingers grasp the outer side. In this method the pressure of the thumb governs the amount of the opening of the beaks.

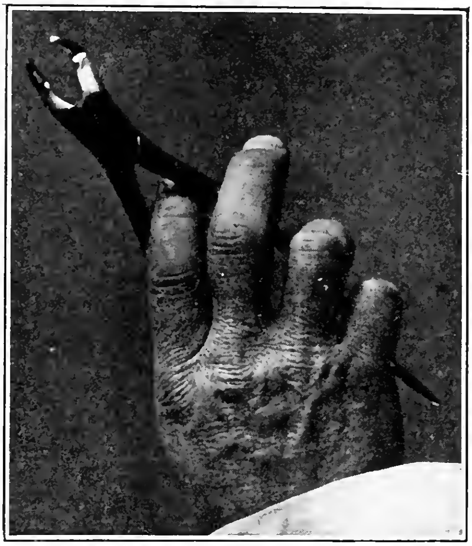


Fig. 100.—Dorsal View, Handgrasp, Upper Forceps.

The first method seems to be better, for the reason that it gives a more positive power of governing the opening

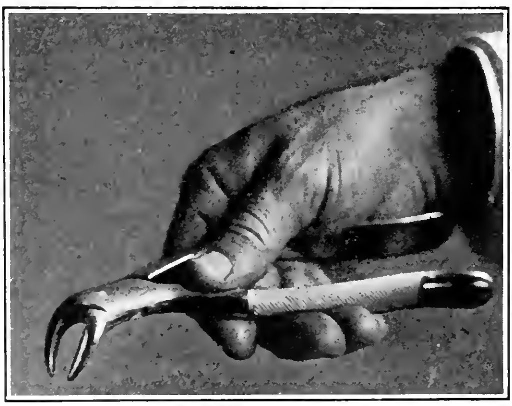


Fig. 101.—Handgrasp, Lower Forceps.

of the beaks, but more especially because of the better position of the wrist joint, forearm and elbow during the operation. In the first method the lines of force are nearly straight, while in the second the wrist is turned at an awkward angle.

The position or grasp of the hand in using the lower forcep is exactly the same as the second method of grasping the upper (Fig. 101).

Stages of Extraction Technic

In the actual operation of extraction there are three stages to be borne in mind: (*a*) the seizing of the tooth between the beaks of the forceps; (*b*) the loosening of the tooth in its socket; (*c*) its final removal from the jaw.

The Preliminary Stage

Choice of Surface.—First one blade or beak of the forceps, the handles being held by the proper hand grasp, is placed upon one side or face of the tooth to be extracted, being governed by the condition of the tooth, in the selection of the side or face of the tooth to be used as a guide. Naturally the surface which most nearly approaches an undamaged condition will be the surface selected. Next, the other, or as it may be called, the movable beak is closed upon the tooth until it very nearly touches the opposite surface.

Grasping the Tooth.—The forceps are placed upon the tooth firmly and exactly. There should be little wavering or hesitancy at this stage. Every false motion causes added and unnecessary pain, and, in the case of timid patients, may cause them to lose courage altogether.

With strong pressure the edges of the beaks are then forced between the gum margin and the tooth as deeply as possible, being careful all the time that the beaks are not forced together so as at any time to grasp the tooth. During this part of the operation the necessity for a proper hand-grasp becomes very evident. The tendency is, as pressure is applied in trying to force the beaks upward or downward, as the tooth is situated in the upper or lower jaw, to also press the handles together, thus grasping the tooth and thereby defeating the effort made to get the beaks into proper position.

When the beaks have been forced as high upon the root of the tooth as possible, then, and not until then, the handles are closed firmly, so as to bring the beaks into intimate approximation to the tooth. It should be remembered that there is no danger of forcing the beaks too high upon the root.

Sufficient pressure should now be applied upon the handles to insure that the tooth be so held by the beaks as to make the tooth and the forceps one solid whole; the idea being that any force applied to the handles shall immediately be communicated to the tooth, with absolutely no lost motion such as would be caused by the beaks slipping upon the tooth, or by the opening of the joint of the forceps from the pressure applied. When the forceps have been properly applied and the proper amount of pressure brought to bear upon the handles, one is ready to proceed with the second step, which is the loosening of the tooth in its socket.

Loosening the Tooth.—This loosening of the tooth is a very important part of the operation. It is to be remembered that in many cases the teeth are so firmly seated in their sockets that direct force will often fail to dislodge them. Many teeth which in the service of a skilled operator seem very easy of removal, would resist the utmost effort of a strong man, if the force be applied directly without previous loosening. The methods to be used in loosening the teeth vary according to the kind of tooth, and its position in the mouth. The proper method or manner of applying force suitable for each tooth will be spoken of in detail later. No jerky motions are ever allowable. Whatever force is applied to the tooth should be gradual, and always under the full control of the operator. More failures in extraction are made by trying to jerk out a tooth than in any other way.

The tooth having been loosened, the final step in the operation, namely, removal, is to be taken. The method of doing this is obvious.

Removal.—Our detailed description of the operation will be commenced with the teeth which are usually easiest of removal, the incisors, upper and lower.

Of Incisors.—The upper central incisors are usually quite easily loosened. The cross section of this tooth at the neck is somewhat triangular, with the angles rounded. As the apex of the root is approached the section becomes more and more that of a cylinder.

The proper forcep for this tooth has beaks about as wide as the average diameter of the root at the neck of the tooth. Each beak is concaved, the inner on the arc of a smaller circle than the outer, so as approximately to fit the circumference of the tooth at the neck. One may use a pair of forceps either straight or bayonet-shaped. For very solidly placed incisors the straight instrument is preferable, but the type of forceps usually used is the bayonet, as this form is applicable to a much greater number of teeth than the straight form. The instrument is applied to the tooth as high as possible in the manner previously described, and the tooth grasped firmly.

Force is now applied to the forceps in a direction tending to rotate the tooth in its socket. This force is to be applied gradually, but firmly and decidedly, and never with any jerky motion. The tooth will usually start at the first application of force, but if, after reasonable pressure has been exerted in one direction, with no resulting movement of the tooth, the direction of the pressure should be reversed. If the tooth still remains firmly fixed, these alternations of direction of force should be made several times. If yet unsuccessful the direction may be changed, using pressure tending to tip the tooth somewhat toward the lip, with the object in view of breaking the thin anterior wall of the process.

It must be remembered that during all this application of force the object sought to be attained is the loosening of the tooth in its socket, and not its removal; therefore there should be no force exerted in the direction of the long axis of the tooth until by the movements described it has first been loosened. The amount of force which may be safely applied to a tooth in this manner without danger of fracture, varies greatly in individual cases. There is no rule that will tell when the limit of safety is reached, but experience will gradually teach the hand, so that by the feeling one may nearly always be warned before the limit is reached.

Of Laterals.—The upper lateral is to be removed in the same manner as the upper central. The same forceps are usually used, though often it may be well to substitute a pair having narrower beaks, on account of the average smaller size of the tooth. It must be borne in mind that the lateral is a much more slender tooth, that its root is apt to depart more from the circular cross section, and is also more likely to be crooked in its length than is the central incisor, therefore more caution is required in applying rotary force for the loosening of the tooth. A change from rotary to rocking motion will more often be necessary.

The forcep for the lower centrals and laterals is that known as the lower bicuspid, though it is often advisable to select one of the same general shape, but having beaks of less width. The beaks are concaved as in corresponding upper forceps. The concavity is, however, nearly the same in both beaks.

The lower incisors, centrals and laterals, are much flattened at their necks, and also, to a greater or less degree throughout the whole length of the root, in the direction from mesial to distal. This flattened form of the root section makes impossible any rotary motion for the loosening of these teeth. Fortunately the alveolar process, both labially and lingually, is thin and easily broken. The loosening movement, then, is a rocking movement, from lingual to labial and reverse. They are removed by direct pull after the tooth is felt to loosen.

Of Cuspids.—For the extraction of the upper cuspid the same forceps, bayonet shaped, are used as for incisors and bicuspids.

The root of the upper cuspid is longer than that of any other tooth in the mouth, and is usually very firmly fixed in the alveolus. The cross section of the root at the neck is very similar to the central. It is roughly triangular, with much rounded angles. Progressively toward the apex it becomes more or less round, with a tendency to an oval form, the longer diameter being from labial to lingual. To loosen this tooth the rotary movement is applicable, and as it is a very strong tooth, heavy pressure may usually be safely applied. It will often be necessary to supplement this by a labio-lingual rocking movement. As soon as the tooth is felt to move in its socket it is usually easily removed.

For the lower cuspid the forcep known as the lower bicuspid is to be used. The lower cuspid is very similar to the upper cuspid, except that it is more slender and the root has a greater tendency toward the oval form. The root, also, is more apt to be crooked. A division of the tip of the root into two prongs is not uncommon. On account of these differences rotation must be used for loosening with more caution than in the case of the upper cuspid, and more dependence placed on the lingual and labial to and fro movement. After loosening it is usually not difficult to remove.

Of Upper Bicuspids.—The upper bicuspid forcep is to be selected for use in removing the upper bicuspids. These teeth are flat rooted, with long diameter from buccal to lingual. The first upper bicuspid is often two-rooted. They are to be loosened by movements from buccal to lingual, and vice versa. The grasp of the forcep should be as high upon the root as possible. Force should be applied to them very gradually and carefully. They are slender and very easily broken, and the roots are often removed with much difficulty if broken off high up.

Of Lower Bicuspids.—Lower bicuspid forceps should be used for lower bicuspids. The lower bicuspids are not so flat as the corresponding upper teeth. They are much more slender both as to root and crown. Rotation for loosening is not always admissible, and extreme care must be taken in applying force for this purpose, as they are very easily broken.

All the teeth so far spoken of may be removed with the same forceps, that is, all the upper with the upper bicuspid forcep, and all the lower with the lower bicuspid forcep.

Extraction of Molar Teeth.—On account of the great difference in size and shape of the molar teeth, these require an altogether different instrument. The general pattern is the same as for the anterior teeth, both upper and lower, but the instrument is much heavier, and the beaks are so formed as to fit the molar crowns, thus causing them to differ in both form and size from those suitable for the ten anterior teeth.

Of Upper Molars.—The upper molar having two roots on the buccal side, the beak fitted for that side is provided with a point in the center, intended to extend between the bifurcation of the roots, while the lingual beak is simply concaved. This difference between the buccal and lingual beaks necessitates the making of the forceps for the upper molars in pairs, right and left.

The upper first molar is the largest tooth in the mouth. It has three roots, two buccal, one lingual. The buccal roots are slender and nearly in line with the buccal side of the tooth. The lingual root is the largest and diverges much more from the axial line than do the other two. To loosen this tooth the forceps are applied to the neck, forcing the beaks as high as possible. Force is then applied, tending to tip the tooth to the buccal. This application of force should never be sudden, but very gradual, all the time feeling resistance, applying more and more force until the tooth loosens or the limit of safety is reached. Usually this one motion will suffice to loosen the tooth. If it does not, one may need to reverse the direction. In any case one is always careful never to apply any force in rotation. Such will always result in fractured roots.

The reasons for applying the force toward the buccal are two: (*a*) the alveolar process on the buccal side is thin, and more easily broken than on the lingual; (*b*) the roots on the buccal are nearly on a line with the axis of the tooth, while the lingual diverges in such a manner as to make very strong resistance to force directed toward the lingual side. As soon as the tooth is felt to start, the opposite force should be applied, and by a combination of the two, with also direct pull, the tooth may be removed.

The situation and form of the upper second molar is so nearly like the upper first that as a rule the same directions apply. The roots of this tooth do not diverge so much from the axis of the tooth. They are more apt to be joined together to form a two-rooted or single-rooted tooth. For these reasons it is sometimes best to use a plain beaked forcep, that is, one without the point in the center of the outer beak. The application of force and position of operator and forceps is the same as for the upper first molar.

The upper third molar is normally of the same shape as the other molars. Practically it is almost always much smaller, and very commonly the roots are fused together, and often much distorted. The forcep for this tooth is the universal upper molar, with plain beaks. On account of the posterior position of this tooth a special instrument called the upper wisdom or upper third molar forcep is often used. This differs from the regular upper molar universal in that the beaks of the instrument are not in the direct line with the handles, as in the other upper forceps, but the beak joins the bayonet bend at a slightly acute, instead of a right angle, thus making it easier to grasp the tooth situated at the extreme posterior portion of the jaw.

The roots of this tooth are very apt to be somewhat twisted on the axis. On this account the application of force for loosening is a somewhat complicated and difficult motion to describe, being a combination of the direct buccal motion, as for the other molars, with also a forward twist. The only means of telling how much twisting motion to apply is the feeling communicated to the hand by the resistance of the tooth. Except for the difficulty of grasping this tooth, on account of its position, it is usually very easily removed.

It should always be remembered that the situation at the extreme end of the alveolar process of the upper jaw makes it easy to seriously fracture the process at this point. Sometimes when the roots are strong and firmly fixed, a large fragment may, if care is not taken, be broken off.

Of Lower Molars.—As the anatomical form of the lower molars differs from that of the corresponding upper teeth, so the beaks of the forceps used differ from the beaks of the upper forceps. The handles are also differently formed, on account of the different position of the operator, which has been described. The roots of the lower molars are two in number, one mesial, one distal. The bifurcation is very near the crown. Each beak of the forceps intended for lower molars has a point in the center, so shaped and curved as to fit it to enter the bifurcation of the roots.

Removal of Lower Molars.—In extracting teeth from the lower jaw, many times students have difficulty in seeing the tooth upon which it is desired to place the forceps. To prevent the instrument from hiding the tooth, the handles should be raised sufficiently that the tooth may be seen from under the beaks instead of over them.

The preliminary grasping of the tooth is the same as any other, using the hand grasp as previously described. The forceps should be carefully placed so that the central points of either beak will find and enter the bifurcation of the roots. The buccal and lingual grooves, when not obliterated, will serve as guides. The beaks are forced as far rootward as possible.

The first step in the loosening process is taken by firmly closing the forceps upon the tooth. If the beaks of the instrument used are properly formed, the tooth a normal one, and care has been taken to grasp the tooth in the proper manner, this motion alone will, in many cases, by the wedging action of the central points of the beaks, cause the tooth to rise from its socket, thus loosening it without further effort. If the closing of the beak fails to loosen the tooth, a rocking motion from buccal to lingual and vice versa should be given the tooth, increasing the force applied very gradually until the tooth starts. Theoretically, on account of the anatomy of the lower alveolar process, this force should be applied toward the lingual, just opposite to that required for loosening the upper teeth. In many cases, however, it will be found on trial that the tooth will start easier toward the buccal.

In any and every case as much force should be used, slowly and carefully applied in one direction, as in good judgment the tooth will bear without danger of fracture, then change should be made to the opposite direction, and the same thing done until the tooth starts. Quick, jerky motions cause more pain, are more dangerous and less effective for the object desired. When the tooth has become loosened, it is lifted out by direct force.

All directions for lower first molars apply to lower second.

Lower Third Molar.—Directions for the extraction of the lower third molar may naturally be divided into two parts: (*a*) cases in which the tooth presents in normal position and condition, in which case its extraction differs but little from that of the other molars, and is usually not difficult; and, (*b*) cases in which the tooth is abnormally placed, when sometimes the operation for its removal becomes almost a major surgical procedure.

Under normal conditions the root of the lower third molar, while typically bearing two prongs, is more often found with both roots fused into one. The root has an almost constant tendency to curve with the apex to the distal, sometimes very markedly so. When the tooth is in normal position, the procedure as for first and second lower molars will often suffice.

On account of the strong curvature of the root to the distal, and the crowding of the crown between the crown of the second molar and the ascending ramus of the jaw, a difficulty is often met with which is not easily overcome by the use of ordinary forceps. In such cases one may have recourse to the instrument known as the lower wisdom or third molar elevator, called by Winter in his "Exodontia," *Lecluse's Elevator.*

Lecluse's Elevator.—This elevator is a triangular, wedge-shaped instrument, bent on the flat at an angle of 45° more or less. The external or outer portion from angle to point is perfectly flat, while the internal surface is rounded from side to side. All edges are as sharp as possible. In use the instrument is forced between the second and third molars, as near the edge of the alveolar process as is feasible, with the flat side toward the distal. The action of the wedge shape will tend to dislodge the third molar backward. When the blade of the elevator is forced between the two teeth as far as possible, the handle is swept downward in the arc of a circle, and in the plane of the blade. It should be noticed particularly that the handle is not rotated upon its own axis. The effect of this motion, if correctly done, will be to engage the lower sharp edge of the blade with the anterior surface of the third molar. The rounded surface will roll upon the edge of the process, being prevented from sliding forward by the second molar. The combination of these motions will tend to raise the third molar from its socket and tip it backward. Here one must be sure no leverage is brought to bear upon the second molar, as is often mistakenly done while using this elevator. If successful the tooth will be so thoroughly loosened that it may be picked out with any appropriate instrument.

Avoiding Accidents.—One must bear in mind that this instrument with its short fulcrum and long handle is very powerful, and if not used with judgment and care may produce serious results. The most common accident met with in the use of the third molar elevator is the snapping off of the crown at the level of the alveolar process, a most distressing accident. It is perfectly possible, by careless use of this instrument, to produce an actual fracture of the body of the mandible, a more distressing accident still.

Removal of Roots

Roots of upper incisor teeth if simply broken off at the gum margin, or slightly below the same, are usually most easily removed by the use of a narrower beaked forcep of the same general pattern as the regular incisor forcep. The motions for loosening and extracting are the same as for solid teeth.

Instruments for Extraction.—In extracting roots with forceps, the use of instruments with too narrow beaks is to be avoided. While in some cases the beaks of these narrow forceps may more easily be forced under the gum and between the process and the root, at the same time, with them, it is much more difficult to secure a central hold upon the root, and therefore the liability of the forcep to slip upon the root is greatly increased.

Of Incisors.—For badly broken down incisor roots, the straight spoon elevator may often be used. This is to be forced between root and process as high as possible. The sharp end or edge of the elevator engages the root, and strong pressure is then made toward the labial surface and downward. The root will often slip out after the application of but little force. If successfully done this method will remove a very badly broken down root with surprisingly little laceration of the gum. In some cases the right angle elevator will be preferable. Roots of incisors which are almost entirely hollowed out by decay may sometimes be removed by the use of a screw elevator. This instrument is simply a slender, gimlet pointed screw, mounted upon the end of a straight shaft. The point is screwed into the hollow of the root, and by a combination of rotatory and dragging motions the root may sometimes be removed. For very badly broken down and splintered incisor roots, a short-bladed, stout, obtuse-angled hatchet excavator is often the most serviceable instrument. It is to be used in any manner indicated by the conditions found.

The roots of lower incisors are often more difficult to remove than those of the upper. Fortunately they are more seldom met with. The lower incisor or root forceps are usually indicated, or sometimes the right angled, double end, or Coolidge elevator.

Of Cuspid.—Cuspid roots, both upper and lower, are often removed with extreme difficulty. All methods as indicated for incisors may be tried. Some one of them will usually be found applicable. The roots being very long and firmly set, it will usually be found that forceps of some sort are indicated. If it is impossible to secure a firm hold upon these roots by forcing the blades of the forceps between the process and the root, it is allowable to grasp the outside of the process and crush through it, removing bone and root together. The incisor forceps, with what are known as alveolar beaks, are best for cases such as these. It is even allowable, in certain very difficult cases, to make the grasp outside gum, process and all. If this is done the forceps should be removed and a new grasp taken, as soon as the process is felt to yield, this in order to prevent a too severe laceration of the gum tissue.

Of Bicuspids.—Roots of the bicuspid teeth are to be treated essentially as are the roots already spoken of. If they are solid, that is not badly hollowed out, or not decayed to too great a distance below the gum line, the ordinary root or bicuspid forceps are suitable instruments for use. If they are very badly decayed these roots sometimes present many difficulties.

Coolidge Elevator.—The Coolidge, or right-angled, or butterfly elevator (all names for the same instrument) is the instrument which most commonly furnishes a solution of the difficulty. This instrument, one of the most useful in the extractor's kit, requires for its successful use both study and practice. Many operators, some of them good ones, never acquire the knack of using it. Many other elevators of the same general type, and intended for the same purpose, are in the market, but this form seems more nearly to fulfil all requirements than any other.

In use the sharp end of the blade is to be inserted between the edge of the process and the surface of the root to be extracted. There is sometimes some difficulty in finding this point. When found, however, the blade is to be forced into the space as far as possible. Often the mere forcing in of the blade will loosen the root sufficiently to make its complete removal easy.

If the root does not start at once, force is further to be applied by so turning the handle that the sharp edge of one side of the blade will be brought into contact with the side of the root; then, by making a long sweep with the handle, upward or downward, as the case may be, the sharp side of the blade engaging the body of the root, while the rounded surface rolls upon the edge of the process, the root will usually be lifted from the socket and its removal easily accomplished. The effect is that of a lever with the fulcrum very near the weight to be moved. If this operation is carried out as described, very firmly imbedded roots may often be removed with ease, and with surprisingly little laceration of the surrounding tissues.

The most common mistake that is made in the use of the elevator is that of using the point of the instrument, instead of the side, as the lever. This lengthens the distance from the weight to the fulcrum very materially, and results in two defects: (*a*) lack of power; and (*b*) extreme breaking and laceration of tissue if the root yields. Of course the point is often used, but most of the failures come from lack of appreciation of the fact that the side of the blade is most useful in difficult cases.

Sometimes a bicuspid root which seems to be difficult, especially one which is decayed or broken off far below the edge of the process, may, with apparent ease, be secured by forcing a stout, very short-bladed, right-angled excavator flatwise between the process and the root. When it is deep enough so that the edge of the blade will engage the body of the root the shank is slightly rotated, thus causing the point of the excavator to catch in the surface of the root. When this has been done a considerable force may be exerted in a vertical direction, many times resulting in the dislodgment of the offending root.

Removal of Upper Molars.—Paradoxical as it may seem, the roots of the upper molars are both easy and difficult of extraction.

If the three parts of the root of the upper molar are widely separated, each part is usually easily removed separately, either with small forceps, or if deeply imbedded in the tissues, the Coolidge elevator skillfully wielded. In these cases the elevator is to be used as indicated when speaking of bicuspid roots.

If the three portions of the roots are still joined together, or if separate but still close to each other, it may be very difficult to bring force to bear on them separately, with either instrument. In such a case it is sometimes feasible to grasp the three portions as a whole with an alveolar bicuspid forcep, carrying the beaks as high upon the mass as possible. When pressure is brought to bear by closure of the handles, the tendency is to force the three parts together, breaking the septa of bone between them, and thus loosening the whole. When this has been done it will in many cases be easy to pick out each root separately and thus finish the operation with little laceration of tissue, and with less pain to the patient than in any other way.

When the roots are separate, or when loosened and separated by pressure of the forceps, it is usually best and easiest to remove first the lingual root. As that root is much larger and stronger than the two buccal, its removal acts somewhat like the removal of the keystone of an arch. The supporting member having been taken away, the remaining members fall out easily.

Of Lower Molars.—In every lower molar extraction the tooth, previous to the commencement of the operation, should be carefully examined with the view of determining the strength of the crown. If the crown is evidently seriously weakened by decay, it is well to proceed in every case upon the supposition that there is a root extraction to deal with.

If one tries to use the lower molar forcep upon a seriously weakened tooth the result usually will be the breaking off of the crown low down, with the roots left, still firm in their sockets. In such a case the remaining portion may be difficult to extract, as the process may be firm, and the roots broken so low down that no guide is left to direct any instrument into position for their removal.

If, on the other hand, one selects a forcep, preferably of the bicuspid type, guiding the instrument on to the anterior or posterior root, as the condition of the tooth may seem to indicate, and forcing the beaks as far down as possible, one exerts force as one would for any lower single-rooted tooth. In fortunate cases the whole tooth may be loosened and easily removed. Under less fortunate, but still favorable conditions, the root grasped is easily removed, leaving the remaining one to be taken out separately, either with forceps or with elevator, as may seem best.

If an unfortunate case exists and the grasp upon the first root attempted fails, there still remains the second root upon which one may operate in the same manner.

In cases where the crown is wholly gone, and the roots are separate, it is usually best to start the operation with the elevator. Usually such roots are among the least difficult with which one has to deal, when properly approached.

Extraction of Impacted and Misplaced Teeth

Many cases are met with in which, from one cause or another, teeth erupt out of proper position. Often when removal of these teeth is required, one's skill and ingenuity are tasked to the utmost. Unerupted teeth also often are sources of trouble, and may require removal. The variations in these cases are so many, and the positions assumed by the teeth are so varied, that the operation for their removal can only be touched upon in a general way.

Deformities

Deformity of Bicuspid.—Of the deformities commonly met with, one quite often sees an irregular eruption of one of the bicuspids, either upper or lower. One of these teeth is often forced to take its place entirely out of line, either within or without the arch. The crown may present with its axis in the same vertical line with those of the other teeth, or it may point in almost any direction. On account of the crowding the roots of these teeth are often very crooked.

The problem is to find some instrument or form of forceps with which the tooth may be firmly grasped, and then to carefully loosen and finally remove it. The problem is made more difficult by the fact that the misplaced tooth is usually crowded closely into the embrasure between two other teeth, and thus the operator is prevented by the crowding from using the regular forceps. Often a strong, narrow-beaked instrument similar to the pattern of forcep known as the Hawk-bill may be used.

When one has succeeded in getting an instrument to grasp the tooth, one may proceed very carefully to loosen it. In doing this one must use extreme caution, trying motions in every direction, and at first with little force, for the breaking off of the crown of such a tooth may, and often does, entail an operation of considerable magnitude for the removal of the root.

Unerupted Teeth.—Unerupted teeth, if removal is required, sometimes present serious difficulties. Upper cuspids and lateral incisors are the teeth most commonly found in this condition.

Mistaken for Cancer.—The presence of these unerupted teeth is often not suspected until some time after the remaining teeth have been lost and artificial substitutes inserted. After a varying lapse of time, a tumor may appear somewhere under the plate, which breaking down leaves an open ulcer or cavity. The plate cannot be worn, and the patient often becomes greatly alarmed about the condition, especially if some inexperienced advisor (and such a diagnosis is often made) proclaims the trouble to be a cancer or some other serious lesion. The most common diagnosis is "bone cancer." Examination with probe reveals a hard tissue near the opening in the gum, the outlines of which are very often difficult to determine on account of the presence of caries or deposits of calculus. It may safely be said that any such condition is, ninety-nine times in one hundred, caused by an unerupted tooth.

Removal.—For the removal of these teeth, a free incision of the gum is required, outlining one or more flaps; these are separated from the underlying bone by the use of the periosteal elevator, thus gaining a clear view, after bleeding has ceased, of the field of operation. Hemorrhage, which probably will be free, may be controlled by the use of gauze packings. After the tooth and bone surrounding it are exposed and clearly in view, as much of the bone by the side of the tooth, or from both sides, should be removed, either with chisel and mallet, or with burrs in the engine, as will enable the operator to grasp the tooth firmly with a pair of forceps. When this has been done, the removal is usually easily accomplished. If hemorrhage continues, it should be controlled by firm packing, which may be left in place not longer than twenty-four hours. Otherwise, and if packing is used, after its removal, simple rinsing of the mouth with normal salt solution will be all that is required. Healing will usually be complete and uneventful.

Deformity of Lower Third Molar.—The lower third molar ordinarily is not a difficult tooth to extract, providing the anatomy of the tooth and surrounding parts be remembered; but from its tendency to vary both in position and form results the exceptional case where the operation, instead of an easy and simple one, becomes exceedingly difficult. One may be in practice for many years and never see a case out of the ordinary; again the first case to present may be full of difficulty. Unerupted third molars have been found in almost every imaginable position in the jaw. The more common form is where the tooth attempts to erupt in proper position, but with the crown presenting forward. In such cases some part of the crown impinges upon the second molar, which in conjunction with the ascending ramus acts as a stop to the further eruption of the tooth, and, as it were, traps it in its abnormal position.

Symptoms Accompanying Deformity.—The symptoms attending impaction or malposition are many, sometimes very severe, but often obscure. When entirely unerupted there may be severe facial neuralgia with no apparent cause. If in neuralgic cases no third molar is present, and no history of its extraction can be obtained, the region should be explored by means of the X-ray. Some puzzling cases have thereby been cleared up. The cause of the pain may be from pressure on the main nerve trunk in its course through the body of the jaw, or it may be from erosion of the root of the second molar, caused by the impingement of the crown of the impacted tooth. When the tooth has erupted so far as to show some portion of the crown above the surface of the gum, still being impacted, there may be, beside neuralgia (which, bear in mind, is not a disease, but merely, as the name implies, a nerve pain), many other troubles mainly due to infective processes, either of the pulp of the impacted tooth or of the soft tissues or bone adjacent.

From its protected position a partially erupted third molar is very liable to decay. The disintegration of the tooth may proceed so far and so insidiously as to cause the death of the pulp with little or no warning other than fleeting or transient pains. The final result, as in any other tooth, is alveolar abscess. The swelling in these cases is apt to be very great. It is not uncommon to see cases in which the patient is unable to separate the jaws even enough to admit a mirror. The swelling from its proximity to the entrance to the opening of the trachea and esophagus may become dangerous. There may be considerable suppuration and even necrosis about an impacted third molar when the pulp is not involved. Such conditions are often due to the bruising of the overlying tissue in the act of mastication.

The removal of the ordinary third molar has been previously spoken of. In cases suspected of being impacted, whether the tooth be entirely unerupted or partially visible, skiagraphs should be made in every case previous to any operation for removal. The resulting pictures may be of much, little, or no value. At least one will have the satisfaction of having done everything possible to determine the position and condition of the tooth. It is taken for granted that every possible exploration with probe and mirror has already been made. There are so many variations in position and conditions met with that it is obviously impossible to give any detailed description of the operation.

Operative Procedure.—In general it will be about as follows: As a first step an incision should be made long enough to thoroughly uncover the space occupied by the tooth. If the tooth is unerupted, this incision should be well toward the lingual side of the process. This incision should be in the line of the jaw, then either by continuing the original incision in a curved line, or by making a second cut across the jaw, just to the distal of the second molar, and well down to the cheek, a flap should be outlined. This should be dissected from the bone by the use of periosteal elevators. Bleeding will probably be free, and after raising the flap, and before proceeding further, should be checked by firm packing with gauze, or other appropriate means. After bleeding is stopped so that the field may easily be seen, one proceeds with chisel and mallet, or with burrs, as seems most convenient, to remove the bone from above, and often from one side of the tooth. This is easily said but in many cases is quite difficult to do.

After a sufficient amount has been removed, or what seems to be sufficient, one may try, either with forceps or elevator, to remove the tooth. If unsuccessful, and by that is meant if the tooth does not yield upon the application of a moderate force, the situation must be studied to determine whether to remove more bone, and, if so, in what direction; or whether to attempt the cutting of the tooth in two. This latter sounds like an easy solution but, like many other easily described operations, may present many difficulties.

In the end, somehow, the tooth is removed. The extent of cavity left in the bone will often be surprising. As after-treatment it is often well, especially if there be much tendency to hemorrhage, to insert a firm packing of sterile gauze. This packing should under no conditions be left in place longer than twenty-four hours.

Further treatment should consist only of copious and frequent irrigations of the wound with a bland wash, such as normal salt solution. This may be done by the patient. Forcible syringing or probing of the wound, unless it becomes septic, should be avoided. Many wounds which might otherwise do well, become septic from overtreatment. The desire to do something oftentimes produces the very result one is aiming to avoid. This applies to many other surgical conditions.

Common Accidents in Extraction

All operations, even the most careful, sometimes have accidents. Some are unavoidable. Others, like the extracting of the wrong tooth, are due to carelessness, and should never happen.

Fractures

Of the Teeth.—The most common accident is fracture of the tooth itself. This often happens to everyone, but may largely be avoided by careful examination previous to undertaking operation, and care in selecting suitable instruments. In extracting badly broken-down teeth, the patient should be warned of the danger of fracture of the tooth. Whenever this accident does happen, one need not be discouraged, but one can get a different instrument and dig deeper. One's mind should be made up to get every tooth one tries for.

Of the Alveolar Process.—Another not uncommon accident is fracture of the alveolar process. This is not, strictly speaking, an accident, as more or less fracture must occur in every extraction. It is only when large pieces are split off that it is regarded as anything out of the ordinary. When small pieces of the process adhere to the tooth and are removed with it, no harm is done; but it is well to remove them from the tooth before showing it to the patient, lest one be charged with breaking the jaw. Sometimes, especially in the upper jaw, large pieces of the outer plate of the alveolus may split off. If one's movements are slow, as they should be, such an accident will be observed before the piece is removed, and means should be taken to separate it from the tooth before finishing the operation. Afterward, if the piece is very large, it should be pushed back into place, and allowed to reunite with the bone to which it was originally attached. If large, jagged pieces of process are pulled out with the tooth there is apt to be a considerable laceration of the gum, and possibly considerable hemorrhage.

If the tuberosity of the superior maxilla is the point broken off, one must be very sure to separate it from the tooth and leave it in place. Severe hemorrhage is apt to follow laceration in this part of the oral cavity, which may be hard to control. Injury to various nerves may also be caused.

Actual fracture of the body of the bone is mentioned by various authors as an accident which may happen. But the chance of such an accident is very remote, unless previous disease exists.

Hemorrhage

Hemorrhage of more than ordinary amount will probably be met with by every extractor at some time or other.

The best means for controlling hemorrhage is pressure, exerted by means of gauze sponges. The pressure may be applied in various ways. In most cases simple packing, once or twice repeated, will usually suffice. A dusting of tannic acid or powdered alum on the surface of the packing may help. In more severe cases, a tight packing may sometimes be held in place by a figure-of-eight ligature between two adjacent teeth, passing over the top of the packing. Again, the packing may be made large enough to extend above the crowns of the adjacent teeth, and held in place by closing the jaw upon it. If all other means fail, a surgeon's services should be procured and such means taken as injection of rabbit serum.

Dropping of Tooth

Allowing a tooth to slip from the forceps and pass down the trachea is a most distressing accident, and one very apt to be fatal to the patient, unless immediately gotten out, either by tracheotomy or other means.

If the tooth should slip into the esophagus, no harm will be done.

After Treatment

In ordinary cases no treatment whatsoever is required, other than to warn the patient to keep the mouth clean with rinsings of saline solution. If apical abscess is present, it may be well to do a slight curettement of the part. The writer believes that most cases will do better without interference, unless more or less necrosis is present. In such cases, of course, the parts should be scraped until sound bone is reached. When many teeth are extracted, it is often well to cut out the septa of bone between them, and press the sides of the process together. Such treatment will hasten the healing and absorbing process, and tend to leave a more symmetrical foundation upon which to place artificial substitutes.

Dry Socket.—There is just one other condition that quite often arises which calls for a word. That is what used to be known as *dry socket*. In ordinary cases the socket from which the tooth has been removed fills with a clot of blood, which later becomes organized during the process of healing and repair. Sometimes the patient returns seeking relief from pain which has persisted over one, two, or more days. Upon examination one finds the socket empty, or possibly filled with débris, and very tender and painful. There are many remedies, but the most successful has been a thorough cautery of all parts of the socket, and especially the extreme apex, with 95 per cent carbolic acid. This is used on a cotton pellet, but not so wet that the acid will run over the gum, cheek or lips when introducing it. One application will almost always be sufficient.

CHAPTER IX

NOVOCAIN TECHNIC

William A. Gobie, D. M. D.

MANDIBULAR INJECTION

Procedure.—The retromolar fossa is located by digital pressure and by the internal and external oblique lines. The point of injection is situated about 1 cm. over the oc-

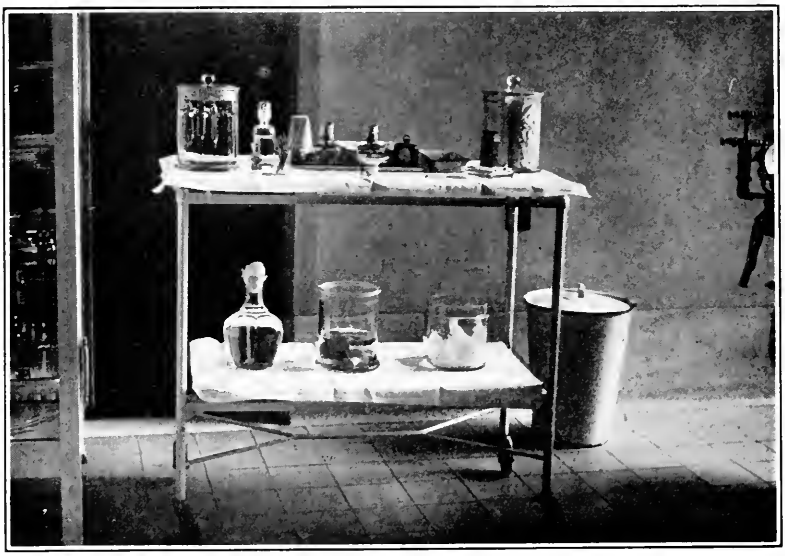


Fig. 102.—A Modern Equipped Table for Novocain Anesthesia.

clusal surface of the last molar. It is necessary to sterilize the point of injection by tincture of iodin.

The Needle.—The needle is held just like a pen-holder and inserted, having the barrel of the syringe over the opposite cuspid and first bicuspid. The bevel of the needle *must* be toward the bone (Fig. 103). The needle should follow the novocain solution and is then inserted backward and outward till it strikes the bone. Here it is withdrawn slightly and about 0.5 cc. of the solution is injected for the lingual nerve. The syringe is now moved

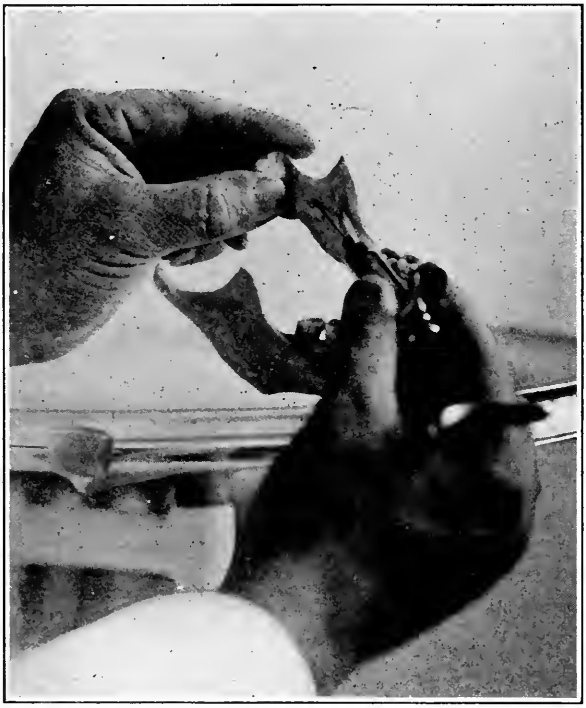


FIG. 103.—SHOWING DIRECTION OF NEEDLE IN MANDIBULAR INJECTION.

toward the side to be anesthetized, carefully keeping the needle in close contact with the inner surface of the ramus, and inserting it one inch, injecting in the sulcus mandibularis about 1.5 cc. of the solution, to anesthetize the inferior dental nerve just as it enters the canal. Then the needle is slowly withdrawn, injecting all the time. The whole operation *must* consume at least 40 to 60 seconds.

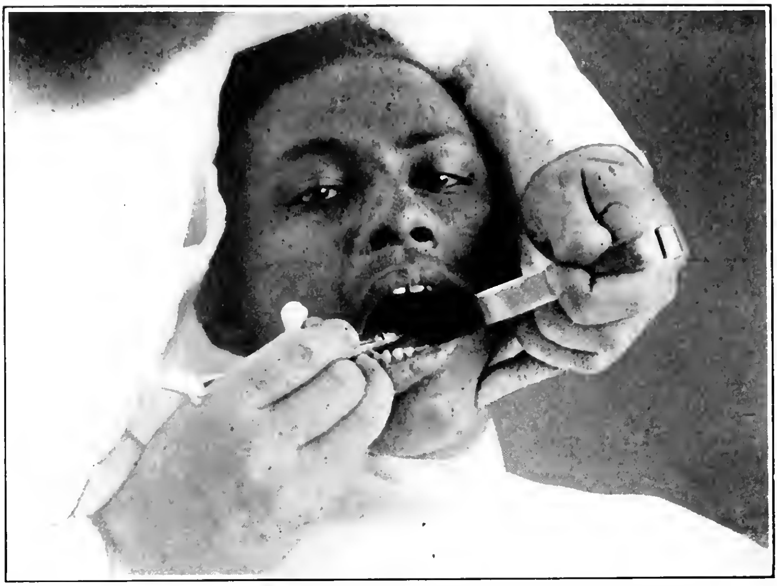


Fig. 104.—Showing Direction of Needle and Position of Syringe and Hands in Mandibular Injection.

Fig. 105.—Showing Direction of Needle in Zygomatic Injection.

Twenty minutes are allowed for the injection to take full effect and produce the necessary surgical anesthesia. (*See cuts.*)

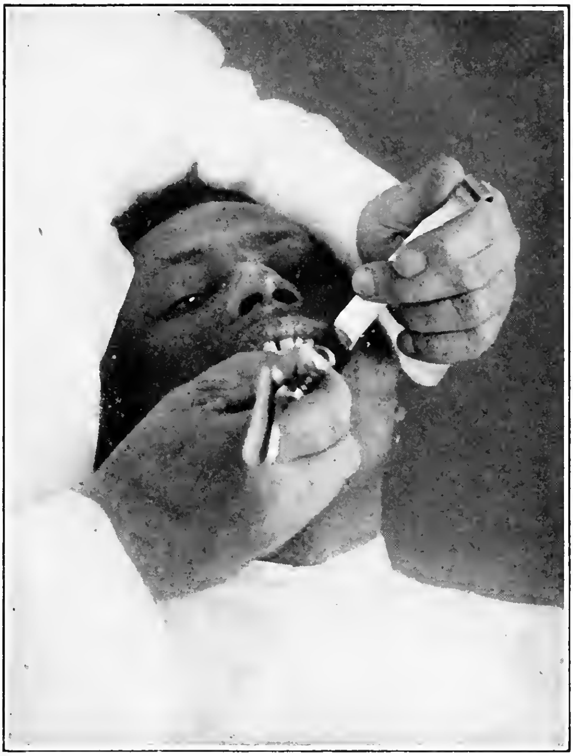


FIG. 106.—POSITION OF HANDS AND SYRINGE IN ZYGOMATIC INJECTION.

ZYGOMATIC INJECTION

The point of injection is located at the distal root of the upper first molar at a point where the buccinator muscle meets the alveolar process.

The point of injection is prepared as usual. The needle is inserted and directed backward, inward and upward, keeping in close touch with the zygomatic surface; injecting all the time as one goes forward. About 2 cc. of the solution is injected and the needle withdrawn slowly.

Fifteen minutes are allowed for the injection to take effect and produce the necessary anesthesia. (*See cuts.*)

INFRA-ORBITAL INJECTION

The infra-orbital foramen is located by digital pressure. Retraction of the lips is made and after preparing the place the long needle is inserted in the canine fossa,

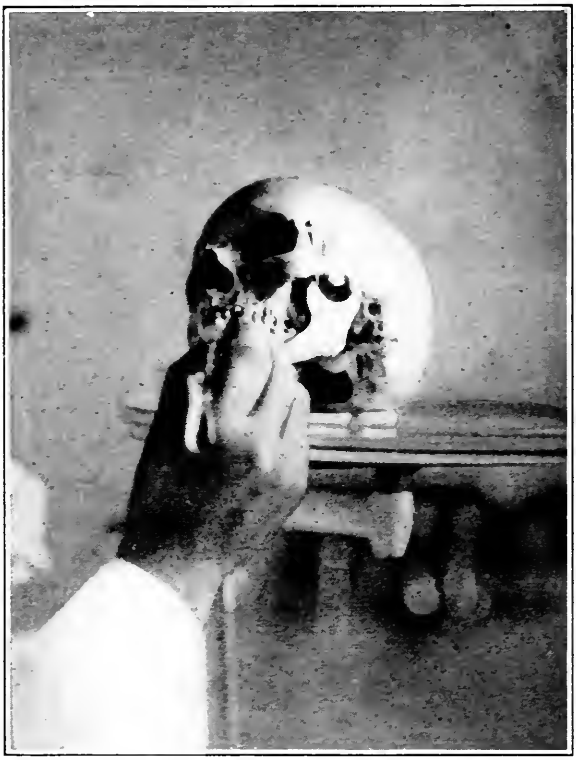


FIG. 107.—SHOWING DIRECTION OF NEEDLE IN INFRA-ORBITAL INJECTION.

as high as the reflection of the mucous membrane allows, or preferably just a trifle higher. The needle is advanced under the periosteum, until the needle point is felt under the palpating finger. About 1 cc. of the solution is slowly injected, at the same time massaging the cheeks evenly, so as to drive the solution into the foramen.

Ten minutes are allowed for the anesthesia to occur. (*See cut.*)

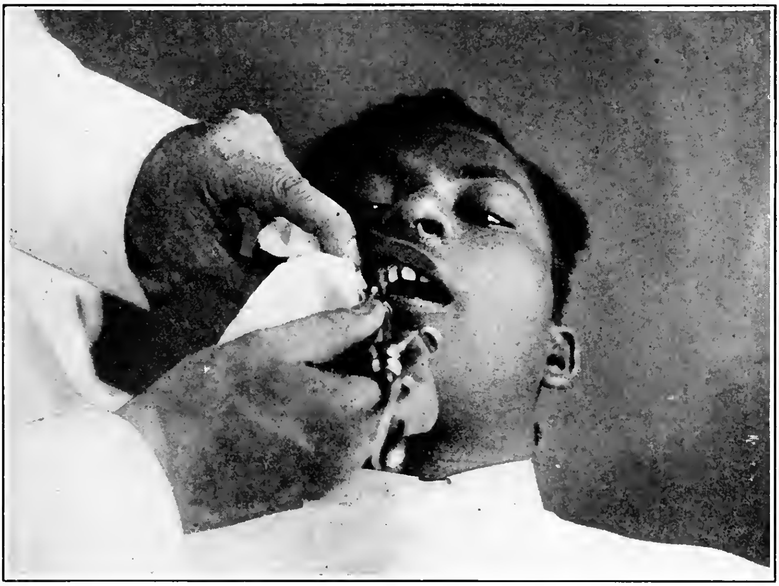


FIG. 108.—SHOWING DIRECTION OF NEEDLE AND POSITION OF HANDS IN INFRA-ORBITAL INJECTION.

MENTAL INJECTION

The lips are retracted and the mental foramen is located between the two lower bicuspids, between the gingival and inferior alveolar border. After preparing the place of injection as usual, the needle is inserted as shown in the figure, downward and slightly backward. About 1 cc. of the solution is injected while applying pressure with the finger-tip. For the lingual aspect about 0.5 cc. is given. This will give anesthesia for the bicuspids and cuspid.

Ten minutes are allowed for the solution to take effect. (*See cut.*)

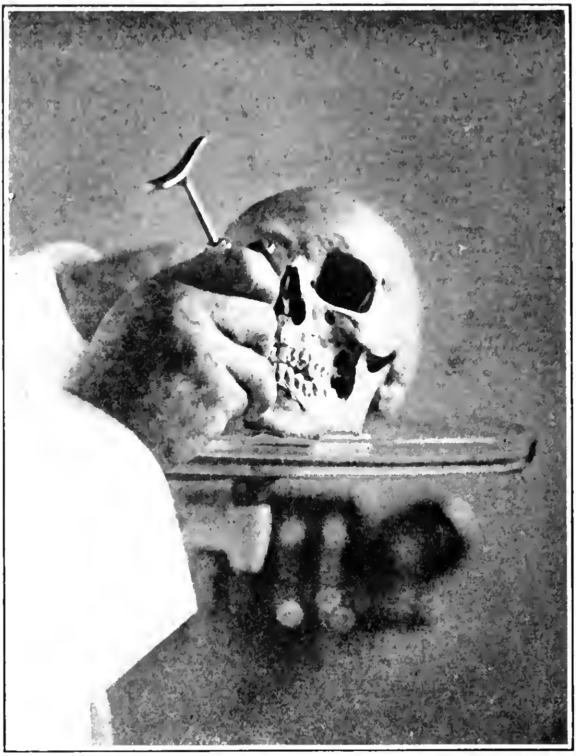


Fig. 109.—Showing Direction of Needle in Mental Foramen Injection.

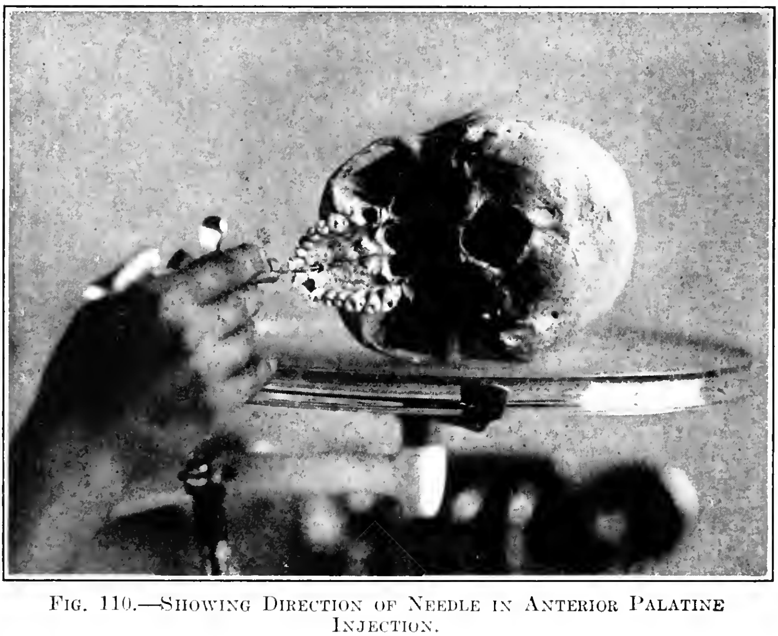


Fig. 110.—Showing Direction of Needle in Anterior Palatine Injection.

ANTERIOR PALATINE INJECTION

The anterior palatine canal is located in the median line, just posterior to the incisive papilla. The point of injection is prepared as usual and the needle inserted upward and backward and about 6 or 7 minims of the solution is deposited.

Five or ten minutes are allowed for the anesthesia to take effect.

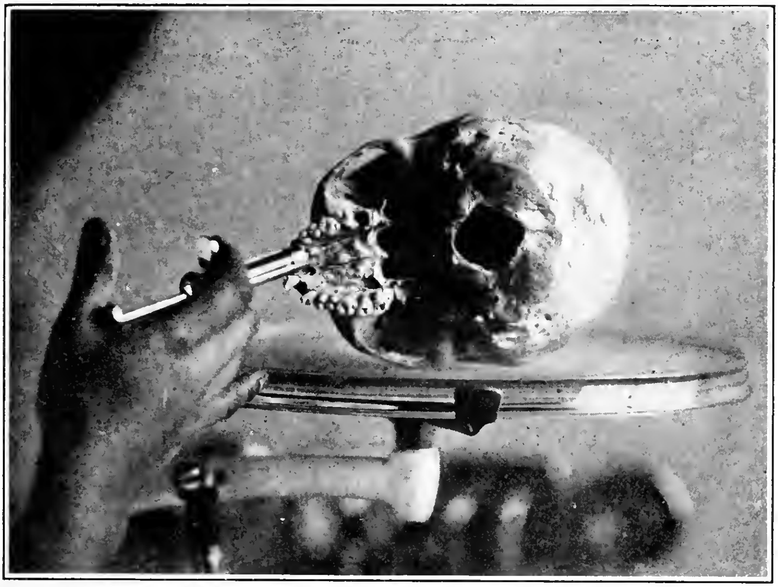


Fig. 111.—Showing Direction of Needle in Posterior Palatine Injection.

POSTERIOR PALATINE INJECTION

The posterior palatine foramen is located at the region of the junction of the soft and hard palates and distally to the last erupted upper molar. Preparing the point of injection as usual, the needle is inserted toward the foramen in a straight line. About 5 or 6 minims of

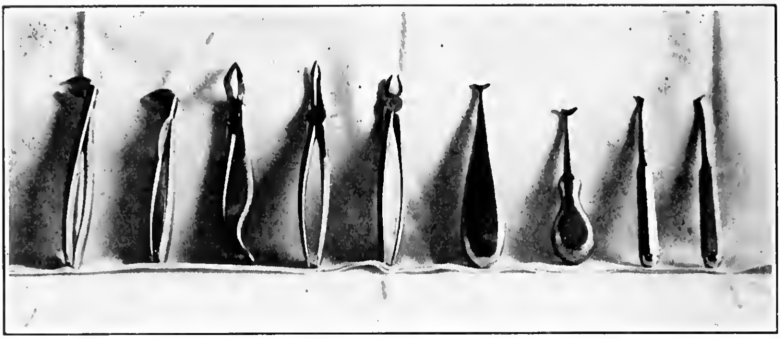


Fig. 112.—Author's Instruments Brought Down to a Minimum Number. 1. Lower molar forceps. 2. Lower anterior teeth. 3. Upper molar forceps. 4 and 5. Upper root and molar forceps. 6. Special elevator. 7. Fish-tail elevator. 8 and 9. Cryer right and left elevators. [Numbers read left to right.]

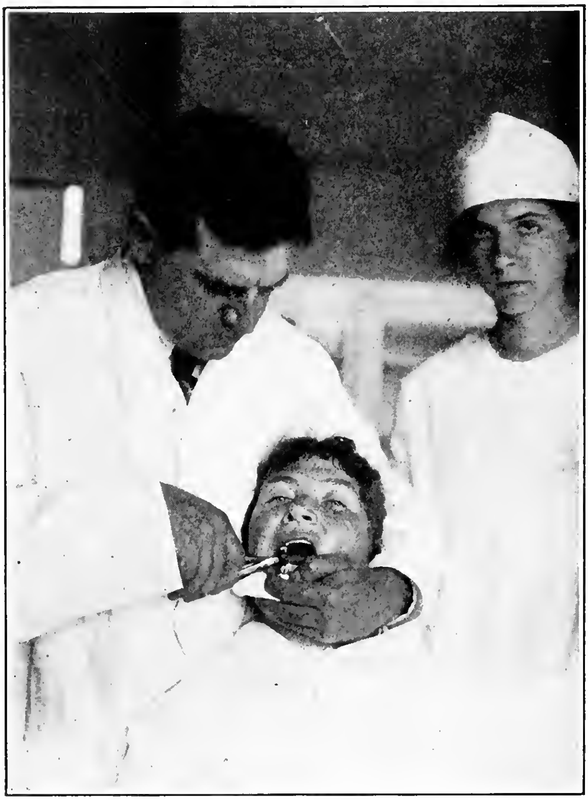


Fig. 113.—Proper Position of Operator, Hands and Forceps in Using Lower Molar English Forceps. (Note particularly the position of the left hand in supporting the jaw.)

the solution is enough. More will be distressing to the patient, as it will also anesthesize the soft palate.

Ten minutes are allowed for the anesthesia to occur.

GASSERIAN GANGLION INJECTION

This injection is necessary in cases of surgical operations of the face, tumor operations, or in resection of the maxillae.

FIG. 114.—PROPER TECHNIC IN LOWER ROOT EXTRACTION WITH SPECIAL ELEVATOR. (Note the throat-packing to prevent root going into the pharynx; and also the proper position of the left hand.)

Härtel's Technic.—According to the famous German authority, Dr. Härtel, the technic of injection is as follows:—The place of injection is prepared in the usual manner and the needle, which should be 5 or 6 ccm. long, is inserted in the buccinator muscle opposite the gingival margin of the second upper molar. Anesthetization is done superficially first and then the needle is pushed upward, accompanied by finger feeling between the anterior margin of the ramus of the lower jaw and the maxillary tuberosity to the fossa infratemporalis. After reaching the base of the skull the direction of the needle is determined by looking from the *front* so that the needle

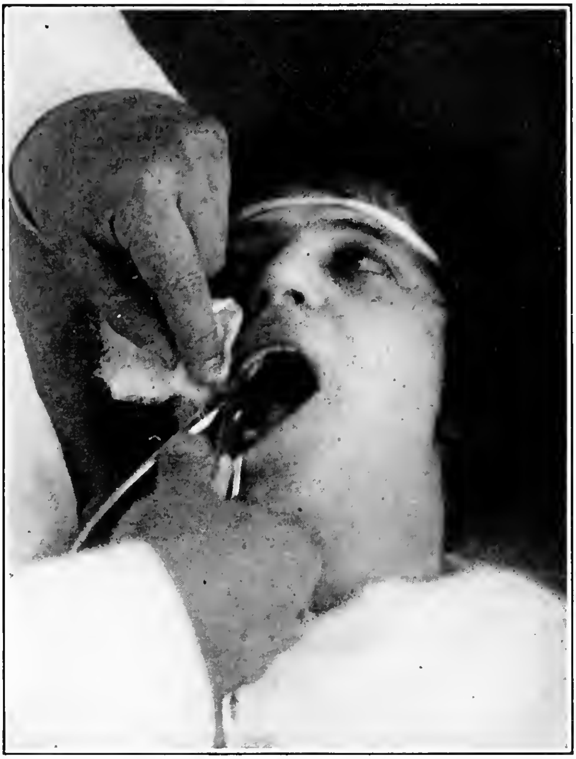


Fig. 115.—Proper Position of Hands and Forceps in Extracting Upper Right Molar.

points exactly toward the pupil of the eye on the same side; and looking from the side the needle points toward the tuberculum articulare of the zygomatic arch. It is necessary to feel one's way forward along the bone to reach the third division of the fifth nerve where it emerges from the foramen ovale. Here the patient experiences pain. One cc. of a two per cent (not more) novocain is slowly injected into the substance of the ganglion. The distance up to the point is five to six

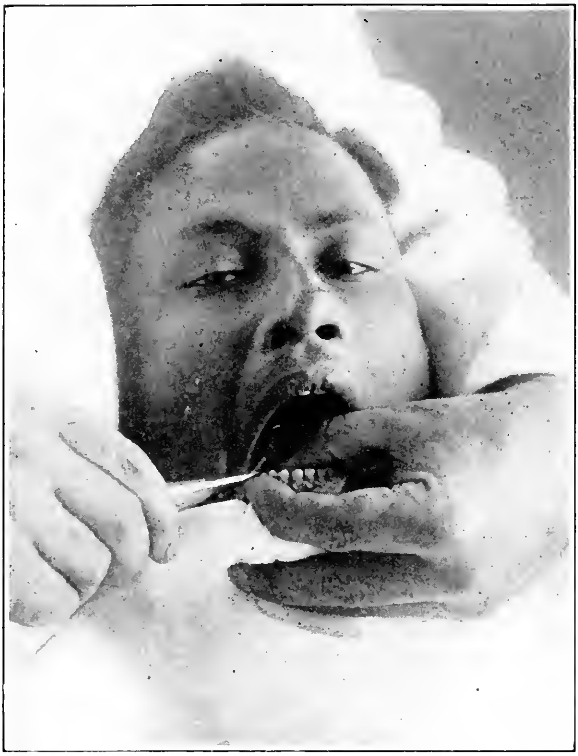


FIG. 116.—SHOWING PROPER METHOD OF USING SPECIAL ELEVATOR AND THE POSITION OF THE LEFT HAND TO PREVENT LUXATION OF THE ADJOINING TOOTH.

centimeters. Care in asepsis is necessary. Anesthesia is tested immediately.

CHAPTER X

SURGICAL TECHNIC AND BANDAGING

JAMES J. HEPBURN, A. B., M. D.

INFECTION AND ASEPSIS

Antisepsis.—The great progress which surgery has made during the past generation has been due to the elaboration of an aseptic technic more than to any other factor. Its growth had its real beginning at the hands of Lord Lister in 1867. He thought that wound infection was caused by microörganisms in the air, and, to combat them, devised an apparatus to spray the field of operation and surroundings with carbolic acid solution. This was followed by other methods of disinfecting wounds, such as the use of oxygen, nitrogen, alcohol, and so on. This was the age of antiseptics.

Asepsis.—Asepsis, as now understood, means the *absence of organisms;* absolute sterility, accomplished by mechanical cleansing, chemicals, heat, or all three combined. This means that the field of operation and everything which comes in contact with it must be free from organisms.

Causes of Infection.—Infection in a wound may be due to imperfect sterilization of dressings, ligatures, or other materials used in the operation; to the presence of organisms in the skin of the patient; or it may be caused by the introduction of organisms into the wound by the surgeon or his assistants. The last is probably the most frequent. Careful cleansing and scrubbing of the patient and all persons engaged in the operation, absolute sterility of dressings and ligatures, and a rigid aseptic technic, carefully and not casually maintained, should and does obviate wound infection.

Sterilization

Methods.—Heat is the most effective sterilizing agent, and, preferably, moist heat. Most instruments may be sterilized by boiling. Materials which will not stand

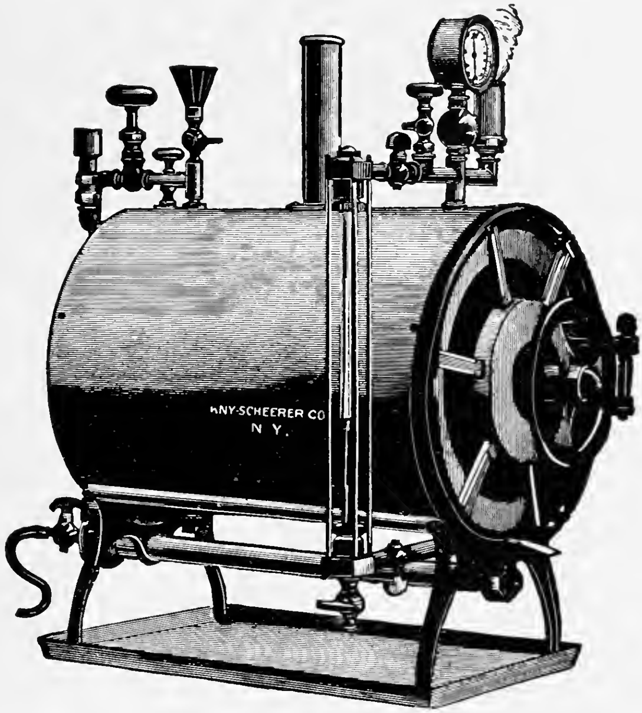


Fig. 117.—Steam Autoclave. (From Brewer's "Text-book of Surgery.")

boiling may be sterilized by steam under pressure. This is accomplished in a so-called autoclave, examples of which may be seen in every hospital. Various chemical agents are used to sterilize the skin, but, in order to be effective, they must be preceded by a thorough cleansing with soap and water.

Technic.—Without entering into a discussion of the relative merits of various methods, let it suffice to indicate the following simple and effective technic, which is in daily use, and which has given excellent results: *first,* the field of operation is scrubbed and a generous margin about it, with soap and water, for six or eight minutes; *second,* the soap is rinsed off with sterile water; *third,* rinsing is done again with 70 per cent alcohol; *fourth,* the field is swabbed off with benzin; *fifth,* the field is painted with one-half strength tincture of iodin; *sixth,* the patient is draped with sterile towels and sheets, leaving only the operative field exposed.

Equal care must be taken in the preparation of the surgeon and his assistants. The hands and arms as far as the elbow should be scrubbed with a stiff brush and plenty of soap for from six to ten minutes, rinsed in sterile water, and then immersed in 70 per cent alcohol for three minutes. When this is completed the men should all put on gowns, caps, masks, and rubber gloves, which have been previously sterilized.

Materials

Sutures.—Suture materials are those which are used to repair wounds. A ligature is a piece of such material used to tie off a blood vessel in order to prevent hemorrhage. Catgut is the most commonly used for these purposes. It is obtainable all ready sterilized, in glass tubes or in paper containers, in any size desired. Plain catgut disintegrates in the tissues in five or six days and is therefore unsuitable when security for a longer time is needed. For such cases catgut impregnated with chromic acid or iodin is available. These are all ultimately absorbed. Kangaroo tendon is another absorbable suture which was formerly very extensively used, and is still used to some extent when great and long-enduring support is desired; such as in the repair of hernia, or the suture of broken bones. Silk thread and linen thread impregnated with celloidin are both unabsorbable. They are used most extensively in intestinal surgery. The best material for a skin suture is silkworm gut. This is sterilized by boiling, has great strength, does not soften in the tissues, and does not tend to become loose. When a small scar is desirable, as in operations about the face, horsehair is the most useful. This material has neither the strength nor the flexibility of silkworm gut, but when carefully applied, is effective and leaves a better looking scar.

Dressings.—Dressings are materials used to remove blood from a wound during an operation, or to absorb fluids and protect a wound during its repair. Of the various substances used for this purpose, one need mention only the one which has supplanted all the others, and is now in practically universal use; namely, *absorbent gauze.* This is cheap, always obtainable, easily sterilized by heat, and can be prepared in any size or shape desired.

Drainage

Drainage is one of the most important of all surgical principles; so much so that, frequently, the management of drainage is as important in determining the outcome of a given case as is the performance of the operation itself. Drainage means that some steps are taken to provide an outlet through which secretions may escape from the depths of a wound to the surface. It is indicated in every case which is infected from the start, or which, on account of the nature of the injury, presumably, will become septic, or in cases where there is considerable bleeding.

Types of Drains.—Formerly rigid tubes of glass or metal were used for this purpose, but on account of their weight and rigidity they frequently caused damage to the surrounding structures, and have been largely discarded. Rubber tissue, soft rubber tubes, and gauze are now used almost entirely. Gauze drains have certain disadvantages; they quickly adhere to the surrounding tissues and therefore cause pain on their removal; they become saturated with coagulated secretions in a short

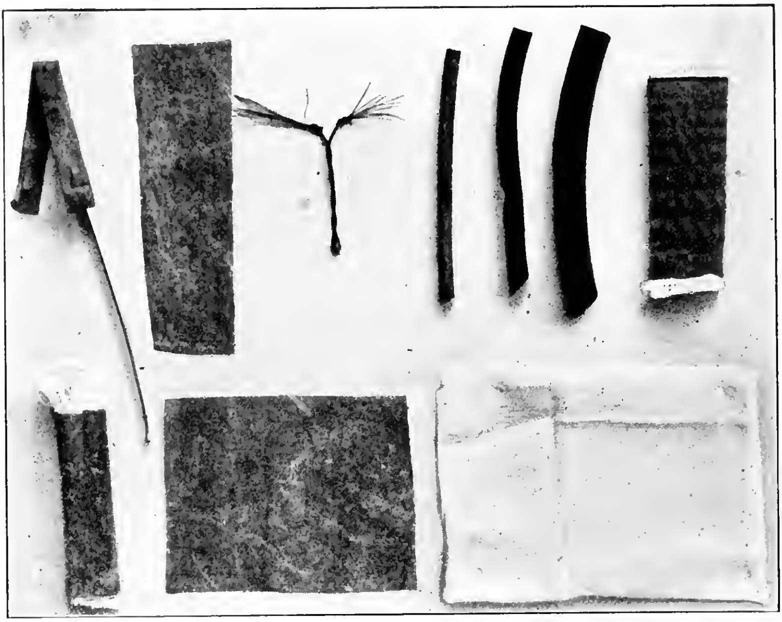


FIG. 118.—DRAINS FOR CLEAN AND SUPPURATING WOUNDS. *A*, Flat gutta-percha drain folded on a probe ready for insertion; *B*, a piece of gutta-percha tissue of the same size as *A*; *C*, horsehair drain; *D*, soft rubber tubes of various sizes; *E*, cigarette drain of gauze in a rubber finger cot; *F*, cigarette drain of gauze and gutta-percha tissue. At the right, a piece of gutta-percha tissue and a piece of gauze each the size of those from which the drain, *F*, was made. (Foote's "Minor Surgery.")

time and act more as plugs than as drains, therefore, when used, they should be renewed frequently.

Clean Wounds.—A clean wound, in which the hemorrhage has been controlled, should, of course, be sutured without drainage. An obviously septic wound should equally certainly be drained. Between these two extremes is a large group of cases for which the indications may not be so clear. The best procedure in such cases is to "play it safe." Otherwise stated the principle is, *when in doubt, drain.* Frequently in this class the drainage may only be temporary; in which case one has had the security of prophylaxis against infection and has lost very little either in time or in sightliness of the scar. On the other hand, if the wound does become septic, adequate treatment has already been provided.

Septic Wounds.—Septic wounds should be drained as long as they remain so, and at each dressing care should be taken to see that the drain reaches to the bottom of the sinus. Healing then takes place from the bottom upwards and there is no chance for a pocket to be formed in the depths of the wound.

Hemorrhage

Hemorrhage is always bothersome and frequently serious both in operative and traumatic wounds. The field of operation becomes obscured, and an excellent culture medium is provided unless the blood is cleared away and the bleeding stopped. Wounded vessels must be picked up in hemostatic forceps and ligated if necessary. General oozing in the wound can be treated by pressure applied with a gauze sponge. When the bleeding is considerable and its source cannot be found and effectively ligated, it is best to pack the wound tightly and apply a firm bandage.

SUTURING WOUNDS

Approximation of Parts.—In suturing wounds it is important to get accurate approximation of parts, and to replace structures as near as possible to their anatomical relations. One must be sure that the structures which one sews together really belong together. For example: it would be disastrous to suture the cut-off end of the median nerve to the cut-off palmaris longus tendon, under the impression that one was repairing the median nerve. Within a year the writer saw a case in which that very thing had been done. For another example attention might be called to the many unsightly scars which are often seen disfiguring the necks of friends and patients. Many of these are due, without question, to the failure on the part of the operating surgeon to approximate accurately the platysma myoides muscle.

For suturing the deeper layers of the wound, or, in other words, for buried sutures, some kind of catgut, either plain, or impregnated with some chemical, should be used. There are some exceptions to this, but as a rule an absorbable suture is needed, and catgut is the best of these. For the skin, an unabsorbable suture is preferable because it is smaller and therefore makes smaller holes in the skin, and because it is not affected by the body fluids and therefore is effective for as long as it is needed. Silkworm gut is the material usually used, except for the face, where horsehair is preferable.

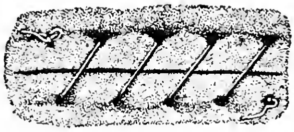


FIG. 119.—CONTINUED OR GLOVER'S SUTURE. (Bernard and Huette.)

Types of Stitch.—The skin may be closed with one of four types of stitch, namely: the *continuous* or over-and-over; the *interrupted;* the *intracuticular;* and the *subcuticular.*

CONTINUOUS SUTURE.—The continuous suture is the quickest but not necessarily the best. Accurate approximation is more difficult and a distorted scar usually results. Further it presents decided disadvantages in the cases where the wound becomes infected. If an interrupted suture has been used and the wound becomes septic, all that is necessary is to remove a stitch or two and put in a small rubber tissue drain. Whereas if a continuous suture has been used, the only stitch present must be removed, and the wound gapes open. This is just another example of the folly of putting all of one's eggs in one basket.

Intracuticular and Subcuticular Stitches.—The intracuticular stitch is continuous, and is open to the same criticism. It is accomplished by taking the "bites" within the true skin on its cut margin. No perforations are made on the surface and as a result the suture is entirely buried except at the points of entrance and exit. The subcuticular stitch is accomplished in the same way except that the "bites" are in the subcutaneous tissue.

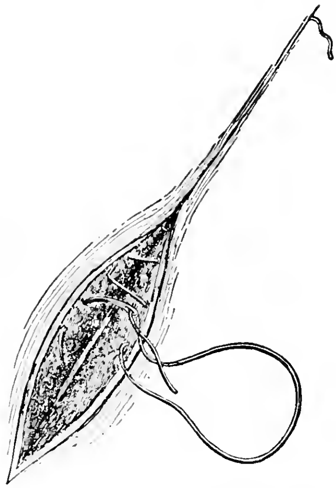


Fig. 120.—The Intracutaneous or Subcuticular Suture. (Halsted.)

Interrupted Sutures.—For general work, the interrupted is superior to all the others and is the one which should be used. The needle should enter the skin in a plane at right angles to the plane of the skin; only enough tissue should be included in the "bite" to insure a firm grip; the suture should be drawn only taut enough to hold the skin edges in approximation. If more tissue is included on one side than on the other, one skin edge will rise above the other and the result will be delayed union and an irregular scar. If too much tissue is included in the bite or if the suture is drawn too tightly, the nutrition of the part is impaired and necrosis, infection and delayed healing result.

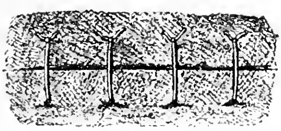


Fig. 121.—Interrupted Suture. (Bernard and Huette.)

DRESSING

The way in which the wound shall be dressed depends upon the character of the wound, its size, location and whether it is to be drained or not. Small, clean wounds which have been sewed up without drainage, require only a few layers of dry sterile gauze held in place by a bandage, by adhesive plaster, or by a collodion cocoon. Wounds from which there is considerable discharge must be protected by a more voluminous dressing. Septic wounds may be treated either with dry or wet sterile dressings.

Wet Dressing.—By a wet dressing is meant a gauze dressing saturated with an antiseptic solution, such as bichlorid of mercury, alcohol, chlorinated soda, etc. In this way the discharge is kept moist, and does not get a chance to coagulate and so impede the drainage. The great conflict now going on in Europe is responsible for the development of the most effective solution yet devised for the treatment of septic wounds, that is *Dakin's solution.*

Dakin's Solution.—When using this solution by means of the Carrel technic, by which every part of the wound is kept continuously irrigated, a septic wound quickly becomes sterile so that it may be sutured just as though it were a fresh clean wound. The personal experience of the writer has been limited to ambulatory out-patient cases, in which the elaborate Carrel technic could not be carried out, but the results obtained by using the solution simply in the form of a wet dressing have been such as to give it preference to all others.

BANDAGES

Application.—A roller bandage is a strip of material rolled upon itself in such a way as to form a compact body. Its free end is called the initial extremity; its other end, that is, the end which is in the center of the roller, is known as the terminal extremity. The surface of the bandage which is in sight when it is entirely rolled is called the external surface; the other is the internal. In applying a bandage, the terminal extremity should be grasped in the left hand and the roller in the right, the external surface always being applied toward the skin. As the bandage is then carried about the part, it unwinds itself into the hand and does not tend to be jerked onto the floor.

Material.—Bandages may be made of any flexible material, such as gauze, flannel, elastic webbing, rubber, and so forth. Gauze is the material in common use except for some special purpose. The functions of a bandage are to retain dressings in place, to render support to a part, or to make compression. A bandage should be applied firmly enough so that it does not tend to slip off. Only enough pressure should be applied to accomplish this, since excessive pressure might interfere seriously with the blood supply of the part and result in destruction of the tissues.

Bandages of the Head

Horizontal Circular.—This is the simplest type of bandage and means that the bandage is carried around the head in a horizontal plane. It has very limited use and is apt to become loose.

Figure-of-Eight.—This bandage is useful for holding dressings or maintaining compression on the vertex of the head. It is applied as follows: the initial extremity of the bandage is placed on the vertex; the roller is carried downward in front of the right ear, under the chin and upward in front of the left ear to the starting point; next it passes behind the right ear, under the occiput, behind the left ear to the vertex again. This completes one turn of the bandage and as many may be applied as is necessary.

Recurrent or Melon Bandage.—This bandage is started in the middle of the forehead and the first layer is carried back to a point below the external occipital protuberance. Then the bandage is reversed and carried back to the forehead. overlapping the first layer by one half its width. These turns are continued, overlapping first on one side and then on the other, until the whole scalp is covered. Two or three circular turns about the head then will anchor the whole and hold it in place.

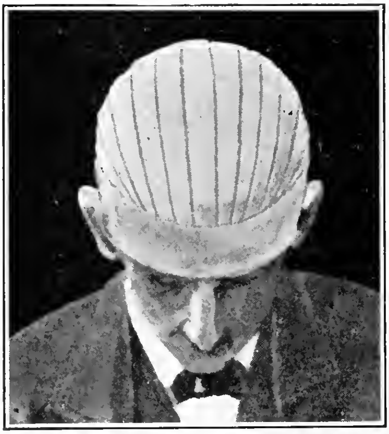


Fig. 122.—Recurrent Bandage of the Head.

Figure-of-Eight of One Eye or Monocular Bandage.—This starts with a horizontal circular turn about the forehead, above the ears, and across the occiput. The next turn passes across the occiput and under the ear; then upward over the eye to the forehead again. These turns are continued until the part is sufficiently protected.

The Binocular Bandage or Figure-of-Eight of Both Eyes.—This is applied in the same way, covering first one eye and then the other.

Four-Tailed Bandage.—This is the simplest form of bandage applicable to the lower jaw. It is useful for retaining dressings or for temporarily maintaining fractures of the mandible. It may be made of any kind of cloth that is at hand. A strip of material three inches wide by one yard long is necessary. This is split up to within four or five inches of the center, making the so-called tails. The *central* or unsplit part of the bandage is now placed under the chin. The two tails which represent the lower half of the bandage are brought upward, one on each side, and tied at the top of the head. The other two tails are tied under the occiput. The ends remaining after tying these two knots are then tied together. The amount of force applied can be varied at will. By tying the knot at the vertex more tightly, a greater upward pull is given to the mandible; a greater backward pull is obtained by tightening up on the knot under the occiput. The two ends tied across the top of the head hold the dressing in place.

Fig. 123.—Crossed Figure-of-eight Bandage of Both Eyes.

Barton's Bandage.—This is the most useful bandage there is for injuries and diseases of the lower jaw. It is applied as follows: the initial extremity is placed on the top of the head, the bandage is carried downward behind the left ear, then directly across the neck under the external occipital protuberance, then forward under the right ear, across the cheek, in front of the chin, and backward, under the left ear to the occiput. From there it is carried upward behind the right ear to the starting point. So far, then, one has applied a figure-of-eight bandage one loop of which encircles the head and the other chin and neck. Continuing, the bandage is carried downward in front of the right ear, under the chin, up-

Fig. 124.—Barton's Bandage, or Figure-of-eight of the Jaw.

ward in front of the left ear to the starting point. This completes one turn of the bandage and must be reinforced by several others. This dressing can be further strengthened by applying safety pins at the intersecting points.

Fig. 125.—The Four-tailed Bandage. Tying the final knot exerts pressure upon the chin, both upward and backward. (Foote's "Minor Surgery.")

Gibson's Bandage.—This is also intended for injuries of the lower jaw, but is neither as effective nor as easy of application as either the four-tailed or the Barton bandage. It consists of three series of loops: one horizontal, about the brow and occiput; one vertical, about the chin and the top of the head; one oblique, passing in front of the chin and around the back of the neck.

CHAPTER XI

GENERAL ANESTHESIA, ITS PHARMACOLOGY AND ADMINISTRATION

FREEMAN ALLEN, M.D.

HISTORY OF ANESTHESIA

Gas.—In December, 1844, Dr. Horace Wells, a dentist of Hartford, Conn., discovered the use of nitrous oxid gas as an anesthetic in the extraction of teeth. He allowed one of his colleagues to administer gas to him while he had a tooth pulled and found the process entirely painless. In the same year Wells attempted to administer gas at the Harvard Medical School, but probably selected a difficult subject. He selected a full-blooded patient who was difficult to control; in consequence his administration proved a fiasco, and he became an object of public ridicule. This experience, no doubt, tended to affect his mind. Both Wells and Morton, the pioneers in anesthesia, died showing symptoms of mental aberration. It is highly probable that this result was brought about by their repeated use of anesthetics in the course of their experiments.

Ether.—On September 20th, 1846, Dr. W. T. G. Morton, a dentist of Boston, employed the vapor of ether to produce general anesthesia in a patient at the Massachusetts General Hospital and thereafter administered it in cases requiring surgical operation, with complete success. This great achievement marked a new era in surgery. Operations were performed in America in numerous instances under ether inhalation, the result being only to establish more firmly its value as a successful anesthetic.

Chloroform.—The anesthetic properties of chloroform were discovered in 1847 by Simpson of Edinburgh. This was at first supposed to be a better anesthetic than ether, because it was more agreeable to use and it was employed freely; but finally, when patients began to die from its use, it became evident that it was not a safe anesthetic. The use of chloroform was thought so unsafe and it was so difficult to administer that the English medical profession began to devote more time to the search for something that might take its place. As a consequence, anesthetics came to be used more in England than in this country. Chloroform used to kill patients, therefore they set about devising apparatus for increasing the safety of chloroform, and a great many kinds of these devices came over from England; but, of course, as usual, when this country finally did take up the administration of anesthetics, we far outstripped anything that England had done in that line. So much of that for a brief historical mention of the anesthetics, gas, ether and chloroform.

PREPARATION OF PATIENTS FOR ANESTHESIA

Emptying of Viscera.—A word will be said here about the preparation of patients for inhaling anesthetics. Except in the brief administrations of dentistry, patients should come to an operation with an empty stomach, an empty rectum and an empty bladder. No prolonged and profound administration of any anesthetic should take place in a patient who has not been previously prepared.

The degrees of starving and purging which a patient should undergo vary with the patient. A weak patient in being prepared should not be starved or heavily purged. An athletic, strong, full-blooded man should be thoroughly purged or given very little food for a day or two before the operation, in order to bring him more easily under the influence of the anesthetic.

Morphin as a Preliminary.—For prolonged administrations the patients do much better from every point of view by having a preliminary injection of morphin, and the dose should vary in proportion to the bodily weight and general conformation of the patient. Suppose that one is dealing with a big, heavy, two hundred pound man, whom it is wished to place under profound anesthesia. That man must be quieted with morphin to lessen the amount of ether necessary to control him. Now a man weighing 200 lbs. could easily take half a grain of morphin, especially if he uses alcohol or tobacco. Therefore, for a big man, the dose of morphin would vary from a quarter to half a grain, and the dose of atropin from one one-hundredth to one one-hundred-and-fiftieth grain; for a patient of average size, weighing 150 lbs., a sixth to a quarter grain of morphin, and one two-hundredth to one one-hundred-and-fiftieth grain of atropin; for a patient weighing 100 to 125 lbs., a tenth of a grain of morphin to a sixth and one two-hundredth grain of atropin.

There are several reasons for giving the morphin. In the first place, it calms the patient and lessens any sense of fear. It also lessens the amount of ether, gas or chloroform necessary to control the patient. Atropin dries up mucus and saliva, and this with the morphin acts as a safeguard against pneumonia.

PHYSIOLOGY OF ANESTHESIA

The physiology of anesthesia is now considered. The ether, in order to be effective in the patient, must enter the blood stream in some way. There are various ways of introducing ether vapor into the blood stream. One can open a vein and inject the salt solution of ether and thus induce anesthesia, or one can carefully clean the rectum and inject an emulsion of oil of ether into the rectum and the patient will become unconscious; one can introduce a solution of ether into the stomach—make the patient drink ether—and get anesthesia that way; but, of course, to administer ether in that way injures the mucous membrane of the stomach or of the rectum. Ether can be given by the rectum, but it is difficult to control. It has been found that the lungs are the most convenient channel for the administration of ether. The principal thing is the effect of the ether on the respiration. The effect of all anesthetics is first to stimulate, then to depress, and finally to paralyze the respiration. If a patient is given gas, the respiration increases. If after a while he is given more gas, the respiration tends to decrease; and if he is still given gas, the organs of respiration will finally become paralyzed. The same is true with ether, and with chloroform, although the use of chloroform is much more dangerous.

Comparative Safety of Anesthetics.—That leads to the subject of the safety of these different anesthetics. It must be asked "What are the death rates resulting from the use of gas, ether and chloroform?" Gas, as ordinarily administered, is the safest known anesthetic. The death rate is so small that no actual estimate has been made.

Death Rates from Gas, Ether and Chloroform.—The death rate from gas (N_2O) is about one in two hundred and fifty thousand; that from ether $(C_2H_5)_2O$ is about one in sixteen thousand; that from chloroform ($CHCl_3$) is about one in every three thousand. Gas is safest when limited to dental administration. This statement is not true of the prolonged administration of gas. For surgical purposes it is a very dangerous anesthetic. Next comes ether. Last comes chloroform. Chloroform is five times more dangerous than ether and a great deal more dangerous than gas. Somnoform and ethyl chlorid are about the same as ether. Of course, chloroform is unsafe anyway, notably unsafe in dentistry, because the danger in chloroform comes in the light degree of chloroform anesthesia. When a patient is lightly under the influence of chloroform, that is the time when he is most in danger. Therefore chloroform is notably dangerous in any operation about the mouth or throat.

PRACTICAL ADMINISTRATION OF ANESTHETICS

Exclusion of Air.—In regard to the practical administration of these anesthetics, it must be stated that all are volatile except chloroform. Being volatile, they are difficult to keep in the lungs. The difficulty is to control the patient. Air limitation is a most important principle in the administration of a volatile anesthetic. A cylinder of nitrous oxid gas in liquid form and under pressure becomes gaseous when liberated. One might hold that gas in front of his face all day and he would get no effect because of the air. On the other hand, if he put the container into his mouth, he would be inhaling gas, because the air would be cut off. The air must be excluded in order to make the gas effective.

The simplest way of excluding air is to close the mouth and close the nose. Unfortunately, there are other exigencies which require different methods. In a great many cases a big tube goes into the mouth, the patient inhales fully and the surgeon operates in the period of available anesthesia. That period of available anesthesia varies in different cases. It may last only from twenty-five to forty seconds. That is a very short available anesthesia. If a full dose of nitrous oxid gas is given, the operator has about twenty-five to forty-five seconds to operate in. On the other hand, the effect of somnoform lasts much longer. Somnoform lasts after its withdrawal, from fifty seconds to a minute and a half.

Metal Face-Piece.—An apparatus for giving gas is necessary if one wishes to administer gas with a face-piece. This is surmounted by a gas chamber. This gas chamber contains an inspiratory valve and an expiratory valve, fitted with a pneumatic rubber face-piece, of which there are several sizes to fit various sized faces. If a patient has a small face, it would be absurd to use a big face-piece, because everything depends on the size of the face-piece. The face-piece should fit the patient's face up to the bridge of his nose and come down to the chin. The object of the face-piece is to exclude air and everything depends upon the correct limitation of air. If one tries to administer gas with a face-piece that does not fit, he will get a failure. It takes a great deal of experience to get it properly.

Gas Inhaling.—In gas inhaling the patient breathes gas from a bag through the inspiratory valve down into his lungs, and gas plus air goes out through the expiratory valve. The practical result is that in from one minute to a minute and a half or two minutes, according to the degree of air limitation, the patient will show signs of gas anesthesia. If the face-piece does not fit or if air is let in, the administration is delayed, and the result is imperfect anesthesia, and the patient becomes exhausted because he is only partially under the influence of the anesthetic.

Simple Administration of Gas.—A description of the simple administration of gas is here given. The patient is placed on the operating table and gas administered in a cylinder. The patient breathes through valves for two or three minutes, after which symptoms of gas anesthesia will appear. The first symptom is a change, an increase in the rate and depth of respiration, which finally becomes stertorous, and this is a sure sign that the patient is under the anesthetic. If the anesthesia is pushed beyond that stage, cyanosis results; if still further, the respiration will increase in rate and depth; if still further, the patient will stop breathing, as a result of paralysis of the respiratory center. If, when the patient is under the anesthetic, air is pumped in that brightens the patient up; he will show signs of recovery and the respiration will return to normal. If respiration is stimulated by gas or by ether, when the stimulus is removed the respiration will return to normal.

Ether Administration.—In the administration of ether the same idea holds good. Ether, of course, is volatile, but it is not so volatile but that it can be administered by the open method, a method which allows large amounts of air to gain access to the patient's lungs.

Methods of Administering Ether.—The following are the different methods of administering ether: (*a*) *1,* open, *2,* semi-open, *3,* closed (according to the limitation of air); (*b*) rectal; (*c*) intravenous; (*d*) intertracheal. The latter are simply fancy methods.

Open.—Ether by the open method would be administered by the chloroform mask. The ether is dropped gradually until anesthesia is obtained. Another form of administration under the open method is the use of an open inhaler, of which the simple cone is the best known. That is, a cone is made to fit the face.

Semi-open.—The semi-open method is so called because some attempt is made to limit air.

Closed.—The closed method of giving ether is a method which provides for the maximum limitation of air. One can suppose that an inhaler is fitted for the inhalation of ether. It may be stuffed with gauze and the patient breathes to and fro into a rubber bag. In that way, the patient gets no air or just as much air as is allowed occasionally. This is another illustration of the all-important principle of limiting air. Volatile anesthetics cannot be given successfully in the presence of air.

Of the foregoing, the open method is more liable to produce pneumonia for this reason. In the open method of administering ether there is free access of air, and this is administered on a gauze at the entrance of the lungs. After the administration, frost appears on the gauze. That cold chills the lungs. Of the three methods it is the most liable to be accompanied by bronchitis and pneumonia. For this reason the open method seems utterly impracticable. It does not control the patient at all.

Dangerous Symptoms in Ether Administration.—These are failure of the respiration, characterized by short, jerky inspiration and prolonged expiration which indicates an over-dose of ether, associated with wide dilatation of the patient's pupils which do not react to light; the corneal reflex is absent. The most important eye reflex to go by is the corneal; the pupillary reflex is only useful taken in conjunction with other signs. With the corneal reflex present the patient is not too deeply under; if absent, the patient is too deeply under anesthesia. If the patient winks when the cornea is touched the corneal reflex is present.

Chloroform.—To return to the practical administration of these anesthetics: volatile anesthetics must be given with limitation of air, but that is not true of chloroform, which is not volatile. Chloroform is a heavy, bulky vapor which tends to lurk down in the lower part of the lungs. Chloroform must always be given by the open method. Limitation of air with chloroform will kill the patient. It must always be administered with a great dilution of air.

Apnea

Apnea means the stoppage of breathing, and the causes and treatment of it are numerous. The causes of it vary with the anesthetic. If a patient stops breathing under nitrous oxid, the cause is probably paralysis of the respiratory center; if under ether, it is also paralysis; if under chloroform, it is probably partly paralysis, but with a distinct *cardiac* element in it. In other words, the heart stops simultaneously with the respiration. The treatment is the same in all cases, namely, artificial respiration.

Sylvester's Method of Artificial Respiration.—If the patient has stopped breathing the first thing to do is to make sure that the mouth is open, that the tongue is forward, and that the air can enter the lungs if it gets a chance. It is necessary to always open the mouth and draw forward the tongue. Then respiration is imitated. The gas, ether or chloroform is forced out of the lungs. Simple pressure of the thorax will expel the gas or other anesthetic from the lungs and start respiration. Then inspiration is slowly instituted by drawing the arms above the head, and expiration by drawing them down. This method of artificial respiration is known as Sylvester's method and is, in the writer's opinion, the best known method of restoring respiration. Pulmotors and other mechanical devices for promoting respiration are not so efficient as the Sylvester method. That was pointed out very clearly by Professor Henderson of Yale in a recent paper. This method should be tried even if the patient looks absolutely dead. To hurry does no good, and may even do the greatest harm. The method must be done deliberately and quietly, not more than sixteen times a minute. Ribs have been broken, and other trauma has been caused by students who have thumped patients on the stomach and nearly killed them. In the proper procedure the elbows are grasped and the thorax pressed, and that, more often than not, may be sufficient to initiate automatic respiration; but in some cases it will not. If not, the arms are brought up, then gently down again, pressing the thorax and raising the arms above the head slowly. This is most important. Hurry accomplishes nothing.

Causes of Apnea.—In the case of ether the patient stops breathing from paralysis of the respiratory center from over-dose of the ether. In chloroform anesthesia the patient stops breathing from dilatation of the heart combined with paralysis of the respiratory center. The treatment is the same in all cases, namely, properly performed artificial respiration, which was spoken of above.

Origin of Symptoms.—As has been said, ether is not dangerous, relatively speaking; if there is a danger, it is from an over-dose causing a paralysis of the respiratory center. Chloroform, on the other hand, is dangerous, because it is a dilater of muscle tissue; it dilates the heart and the muscular coat of the arteries. The dangers of nitrous oxid are comparatively few; indeed when used in dentistry it is perfectly safe; when used in surgery, prolonged inhalations are exceedingly dangerous, and the death rate of nitrous oxid and oxygen used in surgery would surpass that of chloroform. The dangers of cocain are very well known. It is a very toxic drug and easily brings trouble. Novocain, on the other hand, is absolutely non-toxic, and large quantities can be used without danger.

Symptoms of Hemorrhage and Shock

Hemorrhage.—This subject may be considered here in relation to anesthesia. The symptoms of hemorrhage are of course, first, blanching. A patient, previously of good color, will become white; then the pulse increases, from 80 to 150 or 160, and becomes thready. The patient will have a sighing respiration; that is air hunger, indicating a desire for oxygen. He will be cold to the touch instead of warm. The principal symptom of hemorrhage is the marked increase in the *rate* and diminution in *volume* of the pulse.

Shock.—In differentiating shock from hemorrhage the previous course of the operation should be considered. The symptoms are a gradual failing of the pulse not suddenly but slowly. It becomes not necessarily rapid as in hemorrhage, but very feeble and poor, from lowering of the blood pressure. The patient becomes pale, sweats and feels cold and clammy. In other respects symptoms of shock occur during operations. In traumatic injuries the patient comes to the operating room a pale gray in color, cold and with a feeble pulse, feeble voice and obviously in a condition of shock.

Acapnea

Rebreathing.—This condition is a deprivation of carbondioxid from the system and is seen in certain administrations of gas and oxygen where very rapid breathing is induced without rebreathing, and the patient exhausts the supply of carbondioxid necessary to maintain respiration. That is the reason why rebreathing is desirable; that is to say, if the patient rebreathes into a bag he conserves carbondioxid which is a respiratory stimulant and is necessary for the proper performance of respiration. Acapnea, then, is the body's necessity for a restoration of a normal supply of carbondioxid.

The above are the important points to be remembered in the discussion of anesthesia. There is no need of accidents if the properly educated anesthetist observes the proper caution; but if accidents do occur, as they sometimes do, correct artificial respiration, etc., will usually prevent fatality. The foregoing facts are clearly stated and if thoroughly mastered should enable the dentist to put them into successful practice.

CHAPTER XII

MILITARY ROENTGENOLOGY FOR DENTISTS

FREDERICK WILLIAM O'BRIEN, M.D.

DENTAL WORK AND ROENTGENOLOGY IN WAR

Despite the innate dread of war and all that is carried in its train one must recognize that this war by the United States has, among other good things, obliged proper recognition of the dental profession and of the science of roentgenology by the Medical Department of the United States of America. The need has always been felt by the Surgeon General, but authority and money were lacking until now to adequately expand these two intimately associated branches of medicine. The Surgeon General has now established schools of military roentgenology throughout the country at which are being trained picked medical officers, of both sea and land forces, who will act as roentgenologists at the various base hospitals of the army and navy, whether these are located in the field or at training camps. These specialists will be available for consultation by the now much enlarged dental corps of the Medical Department.

During Mexican border service of the writer for six months at El Paso, there was an X-ray apparatus at the Base Hospital in charge of an enlisted man. There were approximately 50,000 troops dependent upon this service at all times. The situation was such that when a difficult case came up for diagnosis the roentgen conclusions were not dependable.

In the present war, while some members of the dental corps will be in the advanced zone to care for emergencies, the major portion of the work will be done by the dental corps out of the zone of danger, where there will be adequate apparatus and competent roentgenologists.

It has not been possible for the government to supply a specific type of apparatus and accessories for use by its roentgenologists, but generically all are the same. Some form of interrupterless transformer of standard manufacture will be used. While switchboards and unessential matters may differ, basically all are built and operated upon the same principles and the government roentgenologists are being instructed accordingly.

DISCOVERY OF ROENTGEN RAYS

Professor William Conrad Roentgen of Würzburg, Bavaria, rather accidentally discovered in the autumn of 1895 the rays which now bear his name. He was experimenting with what had been up to that time practically nothing more than a plaything of scientists, the so-called Crookes' Tube, called variously in different countries the Geisler, Hittorf or Plucker vacuum tube. When making a search for invisible light rays, he noticed that a fluorescent screen lying nearby shone brightly when his vacuum tube was excited, although it was covered with heavy black paper. He reasoned that the black paper offset the probability that the effect was due to ultraviolet rays and that the phenomenon must be due to some unknown radiation emitted by the tube. He found that if obstacles were interposed they cast shadows on the screen and in this way traced back the unknown or X-rays to their source.

Sir James Mackenzie Davidson has written down his recollections of an interview with Professor Roentgen not very long after the discovery of the X-rays, in which he speaks of the cordial reception extended him and of how he urged Roentgen to preserve in a glass case the historical screen (which was simply a piece of cardboard with some crystals of platinobarium cyanid deposited on it) and not keep it lying about his laboratory.

Terminology

It is informing to contrast the good fellowship, as indicated in the account of this interview between two great scientists—one English, the other German—with what exists today. Feeling has run so high even among scientific men that after the start of the war the name of the official organ of the English X-ray specialists was changed from the *Archives of the Roentgen Ray* to the *Archives of Radiology and Electrotherapeutics.* In this country the prefix Roentgen is used because as yet a satisfactory etymological equivalent has not been found. Radiology, for instance, need not refer to the science of X-ray.

Radiology, actinology and similar terms it is felt are not specific. The American Roentgen Ray Society adopted the following terminology until something better shall appear:

Roentgen: To be pronounced rent'gen.

Roentgen Ray: A ray discovered and described by William Konrad Roentgen.

Roentgenology: The study and practice of the Roentgen Ray as applied to medical science.

Roentgenologist: One skilled in Roentgenology.

Roentgenogram: The shadow picture produced by the Roentgen Ray on a sensitive plate or film.

Roentgenograph (verb): To make a Roentgenogram.

Roentgenoscope: An apparatus for examination with the fluorescent screen excited by the Roentgen Ray.

Roentgenoscopy: Examination by means of the Roentgenoscope.

Roentgenography: The art of making Roentgenograms.

Roentgenize: To apply the Roentgen Ray.

ROENTGENIZATION: Application of the Roentgen Ray.

ROENTGENISM: Outward effect of the Roentgen Ray.

ROENTGEN DIAGNOSIS, ROENTGEN THERAPY, ROENTGEN: These terms are self-explanatory.

SOURCE AND PROPERTIES OF X-RAYS

Roentgen traced back the source of the unknown or X-rays to their source, which proved to be the region of impact of the cathode rays on the glass wall of the tube. Further investigation revealed the fundamental fact that Roentgen- or X-rays are produced whenever and wherever cathode rays encounter matter.

It was imagined by many that X-rays were present in the original cathode ray beam and were obtainable by mere subtraction. But this was soon disproved by the discovery that when cathode rays were magnetically deflected the source of the X-rays also moved. The experiment also put out of court the notion that X-rays were due to impact of particles of metal from the cathode.

Penetration.—But the fascinating feature of the new rays was their extraordinary ability to penetrate any substance opaque to light. The degree of penetration was found to depend on the density of the substance. For example, bone is more absorbent than flesh, and if the hand is placed in the path of the X-rays the bones stand out against the flesh in the shadow on a fluorescent screen. It has been also ascertained that X-rays affected a photographic plate and could not apparently be refracted or reflected and unlike cathode rays were not bent by a magnetic or electric field.

The X-ray differs from ordinary light in regard to its penetrating power. In the first place it is not influenced by molecular arrangement, but probably depends entirely upon the atomic composition of the substance. Generally the greater the specific gravity, the more opaque the substance is to the X-ray. Books, vulcanized hard rubber and aluminum are very transparent to the X-ray. Glass is transparent also if it does not contain too large a percentage of lead. Copper, gold, aluminum and lead are transparent in thin plates, although a quantity of 1.5 mm. of lead is quite opaque.

The salts of different metals act similarly to the metals themselves whether in solid or solution. This fact is made use of in gastro-intestinal and urological examinations, the hollow viscera being filled with a solution of some metallic salt opaque to the ray, thus visualizing the parts under examination.

Invisibility.—The X-ray is invisible yet passes readily through solids to produce an image upon a photographic plate. It does not produce the sensations of heat, light or sound and when it encounters a solid substance it gives rise to secondary X-rays; this is an important factor to remember both for the protection of one's self, when doing much X-ray work, and in a photographic way when considering the lack of delineation of an image when raying large parts.

Production.—X-rays are produced whenever a current of high potential is passed through a glass bulb exhausted to a proper degree of vacuum, having two wires entering it that serve as the positive and negative terminals of an electric circuit. When such a current is introduced to such a tube a stream of molecules is repelled from every surface of the cathode or negative terminal and normally perpendicularly to this surface. When this cathode stream encounters any solid substance, as even the glass wall of the tube, it gives rise to the form of motion called the X-ray.

The vacuum tube with which Roentgen made his famous discovery was pear-shaped with a flat disc for the cathode, which was mounted in the body of the bulb at its narrow end; the anode was in a small side tube. This pattern of tube was widely copied, but it was found that it did not survive many of the prolonged exposures which were necessary to secure roentgenograms of any value.

Improvement in Tubes.—The greatest improvement in

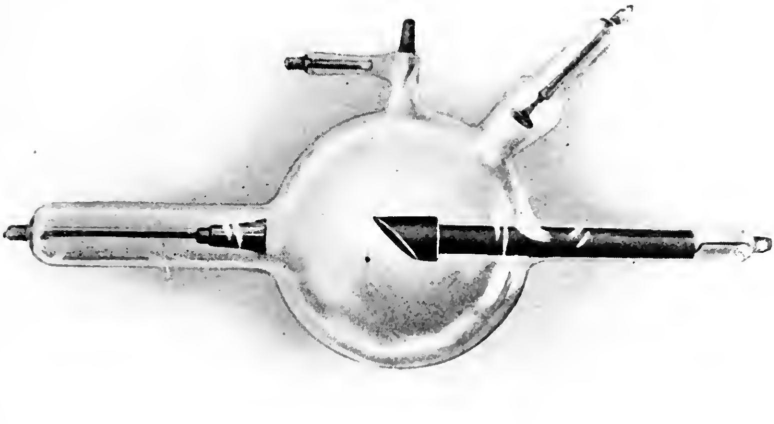


FIG. 126.—TYPE OF GAS TUBE IN COMMON USE.

the construction of X-ray tubes since the original discovery was in giving the cathode a concave surface and focusing the cathode stream upon a platinum disc called

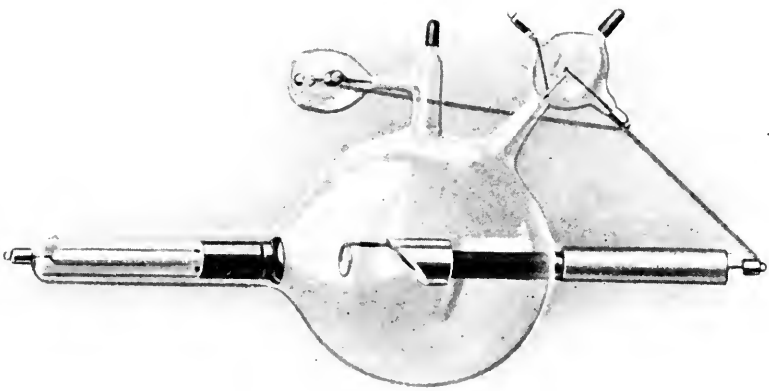


FIG. 127.—THE VICTOR HYDROGEN TUBE.

the target or anticathode. This causes the X-ray to radiate from a very small point and permits of much heavier currents being used.

This type is known as the gas tube (*see* Fig. 126) because its vacuum is controlled by the release of oxygen within it. The hydrogen tube (*see* Fig. 127) is now preferred to the old type of gas tube. In this hydrogen is

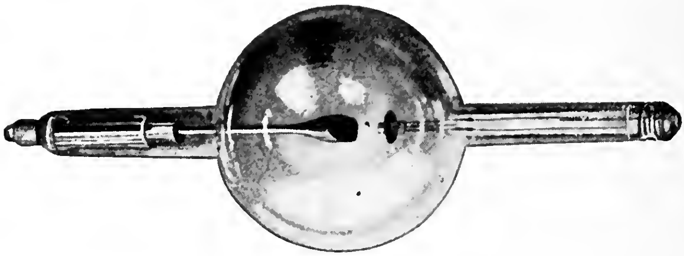


FIG. 128.—COOLIDGE TUBE.

used to control the vacuum, because it is claimed the vacuum can be controlled more readily and constantly.

COOLIDGE TUBE.—The greatest advance in tubes was made by Dr. W. L. Coolidge, who in 1913 gave to the profession his tube (*see* Fig. 128). Its possibilities in roent-

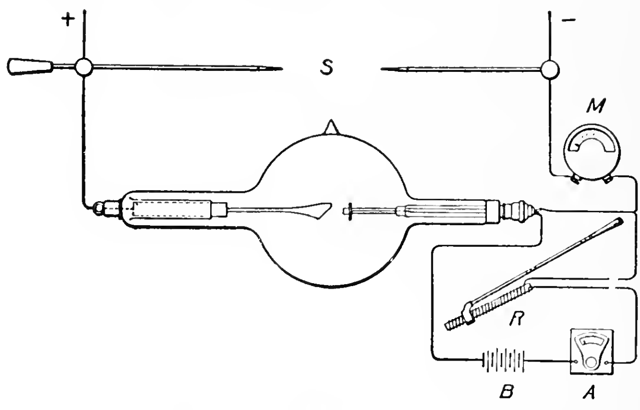


FIG. 128A.—DIAGRAM SHOWING WIRING CIRCUIT OF COOLIDGE TUBE.

genography and therapy are tremendous. The chief novelty lies in the cathode, which consists of a small flat spiral of tungsten wire surrounding which is a molybdenum tube, the two being electrically connected. The tungsten spiral is heated by a subsidiary electrical current and so becomes a source of cathode rays. The molybdenum serves to focus the stream of cathode rays on the anticathode, which is of tungsten and extremely heavy. The vacuum of the tube is extremely high, about 1000 times that of an ordinary tube. The intensity of the X-rays is precisely and readily controlled by adjusting the temperature of the cathode. The tube shows no fluorescence as does the ordinary X-ray tube.

APPARATUS

Suitable current for driving an X-ray bulb may be generated by any apparatus that will transform a low potential current into a high potential current that is unidirectional.

The so-called influence machine (*see* Fig. 129), which consisted of ebonite or glass plates driven at high speed about a vertical axis, was merely an elaboration on a large scale of the old experiment in physics by means of which electricity is generated by a glass wand and a silk handkerchief. A current is produced with relatively high voltage and a very small amperage. When working properly such a machine produces a current unidirectional with a beautifully ready X-ray discharge. Such types of apparatus have been abandoned because of their unreliability and now obvious limitations.

The induction coil (*see* Fig. 130) has been much used for the production of a suitable current to excite an X-ray tube. Essentially it is merely a device for transforming a low potential current, such as is yielded by a battery of a few cells, into a high potential current of a kind suitable for X-ray. It consists of a cylindrical iron core around which is wound a coil of stout insulated wire; this coil, which is known as the primary, consists of a relatively few turns. Outside this is a secondary coil, consisting of many thousands of turns of finer wire carefully insulated. Some form of interrupter is used in the primary circuit and a condenser offers an alternative path to the break. The primary circuit is joined to a suitable battery or street current and the object of the interrupter is to make and break the current in rapid

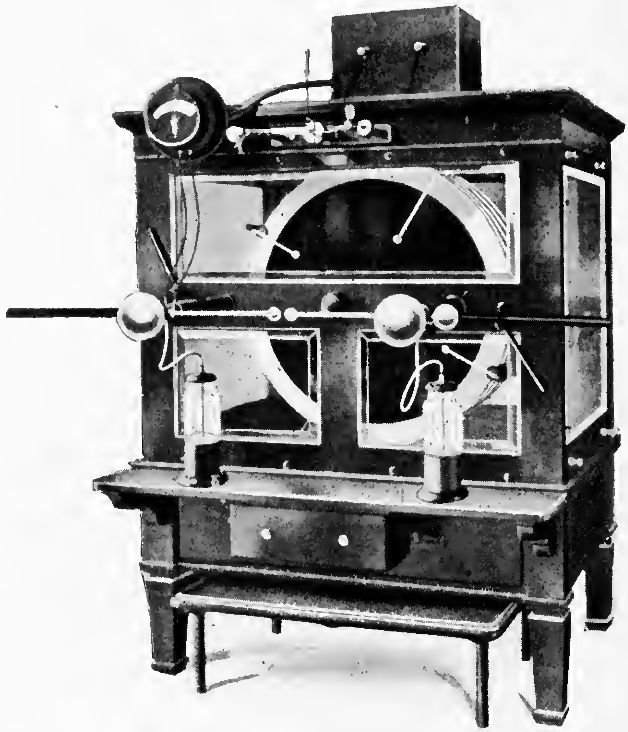


FIG. 129.—THE STATIC OR SO-CALLED INFLUENCE MACHINE.

succession. Since in X-ray work it is important that the current through the tube should be all in one direction, the condenser assumed this function.

The high tension interrupterless transformer (*see* Fig. 131) has now very generally replaced the induction coil where continuous work must be done, calling for an apparatus with a wide range of flexibility. Snook in 1908 first introduced this type of apparatus. It is essentially an oil-immersed, step-up transformer supplied with alternating current, with a pole-changing switch to rectify the high potential alternating current from the second-

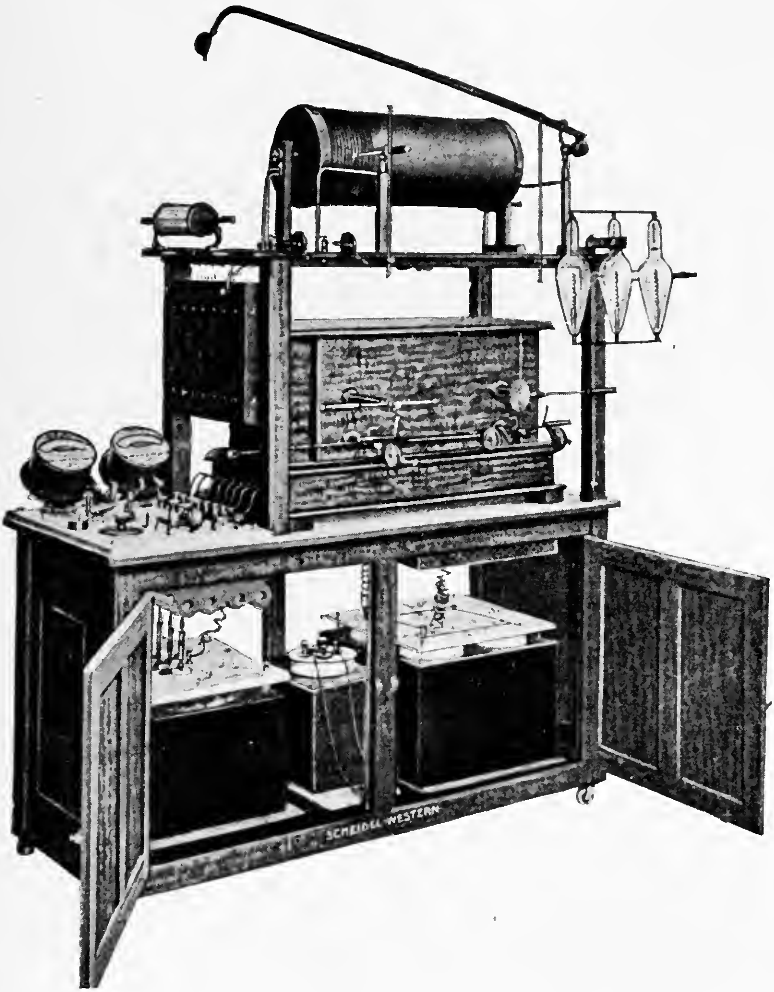


Fig. 130.—Induction Coil Type of Apparatus for Producing X-Rays.

ary of the transformer, and a commutator mounted on the same shaft as the alternator to secure the perfect synchronism essential for rectification. Some form of high tension transformer will be found installed by the government at its many base hospitals.

Having an apparatus capable of generating the kind of current necessary to excite an X-ray bulb, one then may use the X-ray so generated either to register a desired

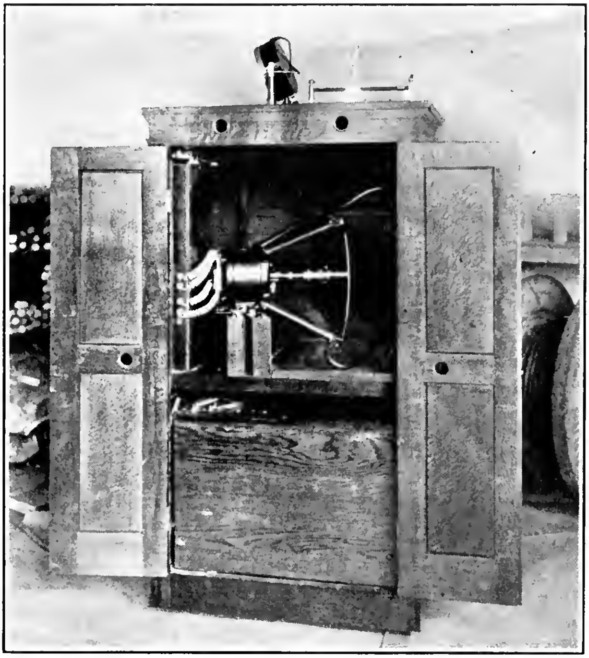


Fig. 131.—Interior View of Interrupterless Transformer Type of Apparatus Supplied the U. S. Government. (*Courtesy Campbell Electric Co., Lynn, Mass.*)

part upon a photographic plate, or else have the same registered in silhouette upon a fluorescent screen.

At all times when using the X-ray the operator must carefully protect himself from the action of the ray, which is now well known to be destructive of human tissue and function when produced in sufficient dosage.

PROTECTION FROM RAYS

In office practice and permanent hospitals one can be assured of sufficient protection. The X-ray tube itself usually rests in a suitable lead-glass container which if honestly manufactured should cut out about 95 per cent of the X-ray. The operator himself should work from behind a sheet-lead or lead-glass protecting device.

FIG. 132.—TYPE OF ROENTGENOSCOPIC TABLE SUPPLIED THE U. S. GOVERNMENT, SO CONSTRUCTED THAT INJURED SOLDIER MAY BE EXAMINED FROM HEAD TO FEET WITHOUT BEING MOVED. (*Courtesy of Campbell Electric Company, Lynn, Mass.*)

In field practice such as one may encounter in wartime there will be a tendency to put aside proper protective devices to attain speed, but this should be strongly warned against. In doing roentgenoscopy one should habitually wear the lead impregnated apron and gloves and lead-glass spectacles. While the X-ray bulb is generally contained in a lead-protected box it is to be remembered that secondary X-rays are given off from any substance impinged upon by the primary X-ray.

The United States government is supplying its base hospitals with a so-called trochoscope, a device some eight feet in length (Fig. 132), so that a patient can be examined rapidly from head to foot. The X-ray tube, which rests in a properly lead-protected box beneath the table top, can be operated in any section of the table, thus combining to aid both the patient's comfort and that of the operator.

DENTAL ROENTGENOLOGY

Dental Films.—The roentgenoscopic method will not be generally employed about the head and jaw because of the density of these parts. Usually one would employ dental films or plates when dealing with these regions. The dental films are sections of celluloid coated with a proper photographic emulsion protected by a black paper covering, outside of which is a second paper covering red or orange in color. The outside wrapper is waxed to make it moisture proof. These films are placed within the oral cavity itself, in proximity to the tooth or teeth one desires taken. These films vary in size, the one most commonly used being one inch by one and one-half inches, oblong in shape with rounded corners. An oval-shaped film is manufactured especially for use at the angle of the jaw. Most patients bear these films within the oral cavity well, but there are some who will gag and fret whenever anything but food is placed in the mouth. In such cases some form of dental film holder may be employed successfully, although in extreme cases it may be necessary to use a local anesthetic to overcome the patient's difficulty.

Application.—The essential fact to be remembered in using dental X-ray films or doing X-ray work at all is that the film or plate must be so placed that the central ray from the target will be perpendicular to it. Otherwise there will be distortion of the image, and perhaps nowhere more than in the mouth is it as necessary to observe this fundamental matter of technic. All sorts of curious looking teeth will result unless this dictum is followed rigidly.

McCoy, in the *American Journal of Orthodontia*, Vol. I, No. 1, illustrates this desirability (*see* Fig. 133).

Plates.—Where there is question of disease of the maxilla or mandible it is far safer to use plates in examining these parts. This is also true where there is question of disease of the antrum. In the latter case a plate taken in the classical position (*see* Fig. 134) both antra are registered upon it, and there exists at once a basis for genuine comparison, since one knows that the densities registered were so under identical technic. In fractures of the jaw it is rarely possible to get such upon a dental film, and if it were, the relations are lost because of the limited size of the films.

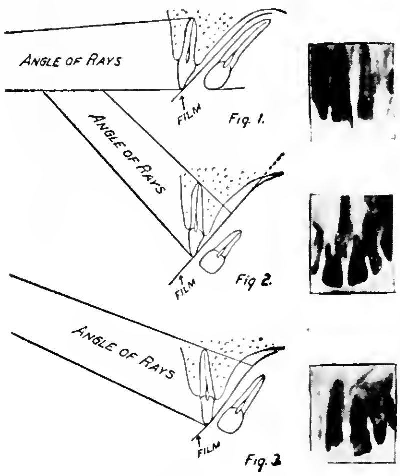


Fig. 133.—Diagram Showing the Results of Correct and Incorrect Technic. From McCoy, *American Journal Orthodontia*, Vol. I, No. 1.

Position.—Quite as necessary as a proper angle is that the patient should be immobile. Whether one examines one's cases sitting or reclining is a matter of choice. Some form of headrest is at times desirable to make certain immobilization of the head, although for most dental work using an apparatus with sufficient output one can make exposures so quickly that it is sufficient to ask the patient to remain quiet and not move.

It is to be remembered that in general a plate or film registers an image in one plane only. If one desires perspective, then the so-called stereoscopic method of examination is adopted. In this case one uses a specially constructed tube stand and some form of plate changing device. The central ray being directed over the part to be taken, the tube is then shifted 3 mm. to the right and left of center and an exposure made. These plates are then developed and viewed either in a specially constructed stereoscopic viewing device as the Wheatstone (Fig. 135) or are viewed by means of a hand stereoscope

Fig. 134.—Showing Normal Antra and Position Preferred by Author.

and in this way perspective is obtained and a better idea of distance and relationship of structures. The stereoscopic method is also of value in the localization of foreign bodies because of the fact that one gets an idea of perspective.

Triangulation Method.—The United States government instructors in military roentgenology have adopted the triangulation method for localization because it is more accurate using either a screen or plate and also the so-called Sutton method. The triangulation method depends upon three factors, a known distance from the plate or screen to the center of the tube target, two exposures and a known distance through which the tube is displaced, and two shadows of the foreign body on the screen or plate the distance between them being measured. Many modifications of this have been developed, but all essen-

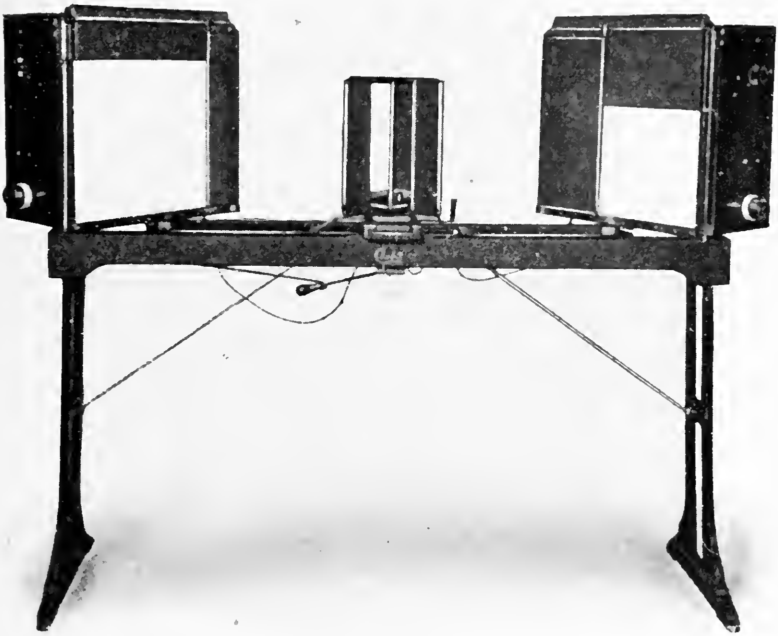


FIG. 135.—WHEATSTONE STEREOSCOPIC ILLUMINATOR.

tially go back to the cross-thread method of localization described by Sir James Mackenzie Davidson.

Sutton Method.—Dr. Walter S. Sutton of Kansas City, while in charge of the American Hospital No. 2 at Juilly, France, in 1915, developed the method which bears his name. It consists of the introduction of a canula directly into the flesh after surgical cleanliness is assured, under the guidance of the roentgenoscope (*see* Fig. 136). When the foreign body has been encountered the trochar is withdrawn and a piece of piano-wire introduced, the canula withdrawn, the piano-wire cut off to almost the skin surface, and left there as a permanent marker until the case comes to operation.

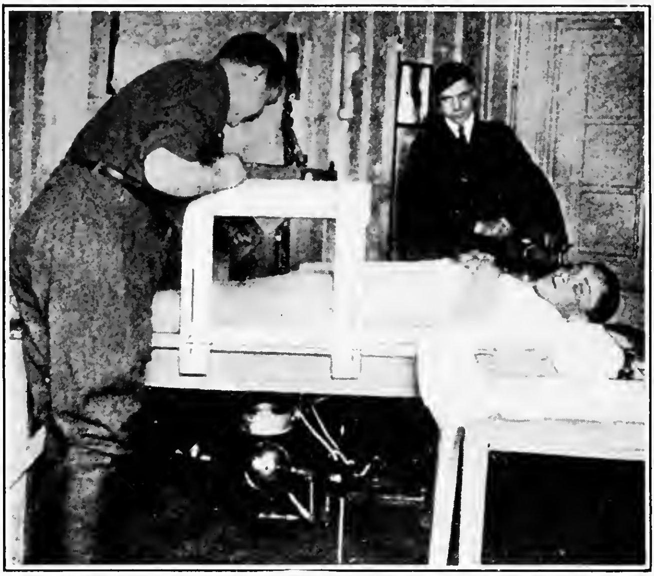


Fig. 136.—Illustrating Method of Introducing Sutton Localizing Canula. (From *American Journal of Roentgenology*, Vol. IV, No. 7, by Ed. H. Skinner, Capt., M.O.R.C.)

These are mentioned here as matter of educational interest. If one desires to follow these operations in detail, a full description of them may be obtained by consulting the bibliography.

CYSTIC ODONTOMATA

Dental Root Cysts.—Wartime dentistry will have its just share of all the familiar lesions of peace times. Some form of the cystic odontomata will call for attention daily. The so-called dental root cyst (*see* Fig. 137) is seen more frequently than any of the other types and occurs in connection with the necrotic apices of devitalized teeth. This type is always found beneath the periosteum, hence Magitot termed it a periosteal cyst.

Incidence.—The majority of writers declare the dental root cyst is found most commonly in the upper jaw in connection with the incisors and bicuspid teeth. Scudder makes it a point of differentiation from the small follicular odontoma that the latter is situated in the lower jaw usually in connection with the molar teeth. Of the twelve cysts in the series reported by New, six occurred in the upper jaw and six in the lower. Of those

Fig. 137.—Simple Cysts.

in the upper jaw, four occurred in the incisor regions, one in the bicuspid and in one case the location was not noted. In the lower jaw three occurred in the incisor region, two in the bicuspid and one in the molar region. New suggests that owing to the coincidence of location of this type of cyst and supernumerary teeth these cysts may be derived from supernumerary anlagen.

There seems to be no particular age incidence for this type of cyst. Of the twelve cases reported by New the youngest patient was 12 and the oldest 70. They may assume the size of a walnut, or indeed be so small as to pass through the alveolus and be found attached to the apex upon extraction of the offending tooth *Marshall*). (*See* Fig. 138.)

Follicular Cysts.—The follicular cyst (see Fig. 139) is not uncommon, says Scudder, though Partsch in two

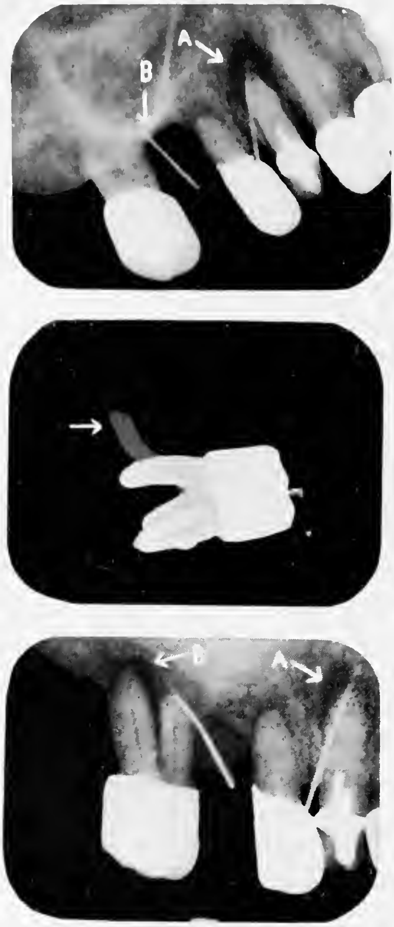


Fig. 138.—Upper view shows probe inserted into fistula at second molar. No abscess seen because taken at wrong angle. Lower view, abscess of distal root of second molar revealed by proper technic. Middle view demonstrates extracted tooth with attached cyst as recorded by Marshall. (Courtesy of J. J. Lowe.)

years saw 200 cases of dental cyst and only 6 follicular cysts. The term *dentigerous cyst* applied by many writers to this form of cystic tumor is inaccurate, for literally dermoids are tooth-bearing cysts. On the other hand, New believes the designation *follicular* to be misleading, in that one takes it for granted without knowing definitely that this type is developed from the follicles of a tooth.

These cysts, according to New, occur in either jaw with about equal frequency and usually in the bicuspid and molar regions. They are seen during or shortly after the second dentition, except those in connection with the third molar, which develops later in life. They rarely occur in connection with deciduous teeth. These cysts are slow-growing and may reach enormous size. It is to be noted that in the follicular cyst, the cyst wall is partly a new growth of bone and not a mere expansion of a previously existing capsule.

Some tooth, most commonly a molar or canine, is missing in connection with the development of these cysts and a partially developed unerupted one found in the cavity of the cyst. The crown of the tooth is usually complete and the root partially formed. The cyst lies over the

FIG. 139.—FOLLICULAR OR DENTIGEROUS CYST.

crown of the tooth which lies at the base of the cyst. On the other hand there may not be any tooth present in the cyst if the cyst has begun to develop at an early period in the development of the tooth. Professor Harbitz of Christiania has reported such a case in detail. Numerous denticles or toothlike bodies may be found embedded in the walls of these cysts or be found free in the cyst itself. The most important clinical sign is the history of a tooth missing in the region of the swelling. Pain usually is not present until the cyst has expanded to a fair size or has involved the inferior dental nerve.

Multilocular Cysts.—The multilocular type of cyst (*see* Fig. 140) variously called *adamantine epithelioma,*

Fig. 140.—Adamantinoma or Multilocular Cyst.

epithelial odontoma, proliferative follicular cystoma, is considered locally malignant. It is made up of a collection of cysts varying in size, separated by a thin fibrous septa and in some cases by osseous tissue. It usually involves the mandible. It is an insidious growth usually involving the angle of the jaw.

The exciting cause of these growths Marshall believes to be some form of trauma. The injury may be in the form of irritation from an erupting tooth. The lower third molar is notoriously difficult to erupt and is more frequently impacted than any tooth in the mouth. "It is interesting to note," says New, "that it is in this region, and at the average age of 33 years, during or just at the time of eruption of the lower third molar, that these cysts occur, but it is difficult to obtain conclusive evidence of the association of the eruption and impaction of teeth to adamantinomata."

While a diagnosis of these tumors can be made clinically it is far more scientific to submit prospective cases to Roentgen examination. The roentgenogram in the simple variety of dental cyst will show a unilocular cyst in connection with a devitalized tooth. In the follicular cyst the X-ray will demonstrate the presence of an undeveloped tooth within the cyst wall and in the adamantinomata multiple cysts and their dividing septa will be made out. The differentiation between a giant cell sarcoma and adamantinoma may be difficult and may have to be made at the time of operation microscopically.

ROENTGENOLOGY IN ARMY CASES

It will now be quite as convenient in army practice as at home to employ Roentgen examination before and during orthodontic procedures. Proper Roentgen examination will reveal unerupted and impacted teeth, giving the story of impaction and why and laying the foundation for proper surgical interference when indicated (*see* Fig. 141).

Roentgen examination will reveal improperly filled root canals, perforations, foreign bodies such as dental broaches in the root canals, unextracted roots and other pathological conditions that may account for septic processes and disease in the jaws.

Fractures.—Fractures of the upper and lower jaws will fall to the lot of the army dentist, however, far more frequently than would be the case in civil practice. It

Fig. 141.—Impacted Lower Third Molar.

will be necessary to know the position of the fragments for the correct fashioning of the dental splints, and here again one will find Roentgen examination often essential.

Of the Upper Jaw.—Fractures of the upper jaw (*see* Fig. 142) always occur from direct violence. The direction of the line of fracture is very varied according to the direction and character of the force. A blow upon the cheek may crush the malar bone into the antrum. By a blow on the upper lip a fracture of the alveolar border can be produced. Severe degrees of violence may separate the superior maxillary bones one from the other. Gunshot fractures may produce any possible degree of destruction of the bone. The diagnosis of fracture in such cases is entirely easy, Roentgen examination being

Fig. 142.—Fracture of Ramus of Mandible and Superior Maxilla.

made to give one the degree of fracture and relationship.

Of the Lower Jaw.—The lower jaw (*see* Fig. 143) is broken more often than any other bone of the face. A frequent cause is a blow upon the chin, less often a blow from the side. The fracture is rarely comminuted except in case of gunshot wounds. The coronoid process is rarely broken, the condyloid process more frequently, and its fracture is often associated with fractures of other bones. Fracture of the alveolar border is common, as are also fractures through the body of the jaw. Fractures of the body behind the teeth are rare. In the fractures in the horizontal portions of the body the line of fracture is usually vertical. Fractures through the angle or ascending ramus are oblique and transverse. Owing to the proximity of the mucous membrane of the mouth many fractures of the lower jaw are compound.

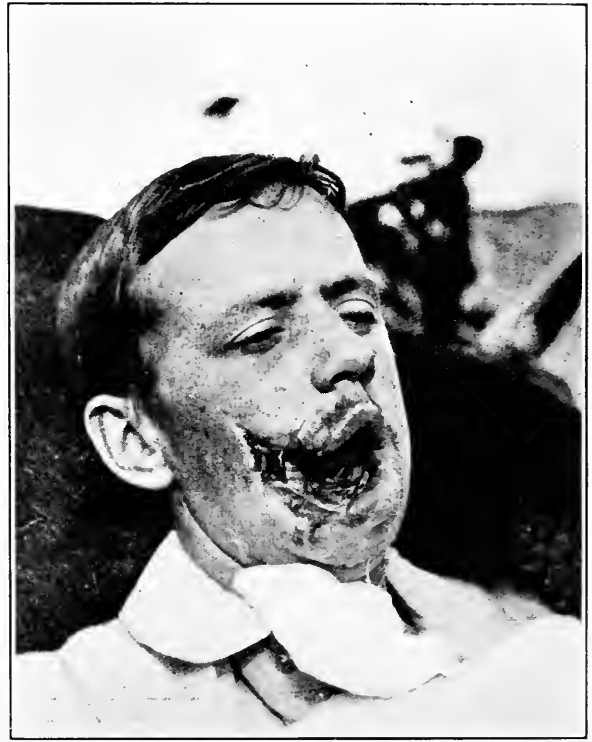
Fig. 143.—Fracture of Lower Jaw from Gunshot.

It is to be remembered that roentgenograms of the lower jaw made in a lateral or oblique position may fail to demonstrate a fracture at or near the symphysis. In a case of suspected fracture at this point the patient's chin should be placed upon the plate and the ray passed from above downward (Fig. 144).

Dislocation.—Dislocation of the lower jaw can be diagnosed clinically with ease from its clinical signs, the jaw projecting forward and incapable of movement. The condyle can be felt anterior to its normal place and a corresponding depression can be felt at the site of the glenoid cavity.

Fig. 144.—Fracture of Lower Jaw near Symphysis not Easily Demonstrated in Lateral View.

Gunshot Wounds.—Gunshot wounds of the jaws (Figs. 145, 146) mean frequently great loss of bone substance either by direct injury or necrosis, so that the oral surgeon has had a tremendous field of endeavor opened up during this war in all kinds of plastic and orthopedic procedures (Fig. 147). Here, too, Roentgen examination will be of value in checking up the post-operative and end results of bone transplants and the like.



FIGS. 145 AND 146.—OBJECTIVE APPEARANCE OF WOUNDS RECEIVED IN WARFARE AS ILLUSTRATED BY FIG. 143. These represent actual cases as seen and treated at an American dental clinic in France. (*Courtesy of Miss Winona Durant, who served as dental nurse at this clinic.*)

This is not by any means the story of dental roentgenology but is meant to be suggestive of its possibilities

FIG. 147.—TREATMENT OF GUNSHOT WOUNDS. Same cases as seen in Figs. 145, 146, seven weeks after treatment by American dental surgeons behind the firing line.

as far as the limitations of the present work would permit.

CHAPTER XIII

VENEREAL DISEASES (SYPHILIS) AND DISEASES OF MOUTH AND NOSE

William Chenery, M.D.

The efficiency of the soldier depends largely on his health. He must be ablebodied to start with; in fact, the flower of the land is picked. These men, untrained and used to entirely different surroundings, food, clothing and habits, are the material of which soldiers are made. The country must do its utmost towards promoting and preserving their health. Sickness means handicap. The cause and prevention of disease must be found out as far as possible. Prevention is far better than cure.

Metabolic and Infective Disease.—There are two classes of diseases: *first,* those arising within the body, due to disturbances of nutrition, assimilation and elimination. There is a lack of harmony in waste and repair. This is seen in gout, diabetes, nervous conditions, arteriosclerosis and rheumatism; *second,* those diseases due to causes without the body and depending on invasion and multiplication of special germs or bacteria in the body. These are called infective diseases. For the production of infective diseases two factors are necessary: the germs must get into the body in sufficient numbers; they must find a suitable soil and propagate. The entrance of the bacteria is through the respiratory or digestive tracts or inoculation through the skin. A lowered vitality means a chance for invasion of bacteria.

INFECTIVE DISEASES

Diseases Prevalent in the Army.—Relaxed discipline, ill-ventilated camps, neglect of hygienic rules, also lack of care of teeth, result in the dissemination of infective germs producing disease and death. The most prevalent diseases in the army in their order are—venereal diseases, tonsillitis, suppurative skin diseases, acute and chronic bronchitis, enteritis, influenza, alcoholism, malaria, rheumatism, measles, mumps, tuberculosis. Tonsillitis is second and bronchitis a close follower. Barracks overcrowded, overheated and with poor ventilation, mean air infection, then, tonsillitis and diseases of the respiratory tract easily develop.

The order of deaths for the entire population in 1910 was tuberculosis, heart disease, diarrhea, enteritis, pneumonia, nephritis. In war times morbidity and mortality necessarily increase. The highest rate of sickness and death is in the younger soldiers under twenty years, in the first year of service, and in those over forty years of age.

From these remarks just made it would appear that the most important diseases that impair the health of the soldiers are the infective group. Since there are at all times in the nose, throat and mouth a large variety of bacteria, whose activity depends on a lowered vitality, it is necessary to look carefully after the hygiene of the nose, the nasopharynx and the mouth.

Inasmuch as venereal diseases head the list of illnesses of soldiers, syphilis or lues will be first spoken of because of its increasing importance.

Syphilis

Alcoholic intemperance and sexual debauchery are always closely associated. The abolition of the canteen, at least in times of war, is a very necessary precaution to keep up the high efficiency of the soldier. During active war times venereal diseases are said to be less prevalent because the soldier is more occupied and has less leisure and less temptation for immorality. While preventives have a certain amount of value, they are by no means sure. The education of the soldier is necessary. He must be taught proper appreciation of the prevalence and gravity of venereal diseases.

Results of Syphilis.—According to Lesser, a third of all syphilitics eventually die of tuberculosis, paralysis, or aortic aneurism. The predilection of tertiary syphilis for the nervous system is also well known. All deaths from general paralysis, locomotor ataxia, as well as one-half of those from paraplegia and softening of the brain, are attributed to syphilis. It is supposed by some that the cure of syphilis by salvarsan is sure and quick and that indiscretion can be easily corrected. Such is not the case. It should be also remembered that syphilis uncured may be transmitted to the newborn.

Prevention.—How to control the social evil has been a subject of much discussion and various attempts have been made with varying success. The moral standard should be upheld. Camp life should be made as pleasant as possible and Bishop Lawrence's idea of furnishing each camp with a picture machine with the latest reels is certainly one way of entertaining and lessening the temptations of the soldiers off duty. Games of all sorts, reading rooms and Y. M. C. A. quarters should be established to take up the time and attention during off hours.

Diagnosis and Early Treatment.—The discovery of the cause of syphilis and the Wassermann reaction have rendered an early diagnosis of the disease possible, and treatment and cure much more certain. Early and persistent treatment means much less damage to the general system. The Wassermann reaction also helps to recognize latent syphilis when manifest symptoms are absent, and also materially aids in determining when the patient is cured. A positive Wassermann is of great value. On the appearance of the primary sore a positive diagnosis can be made by finding the specific germ in the exudate, and in nearly all cases a positive Wassermann can be obtained by the fourth week. The chief trouble with the Wassermann test is laying too much stress on a single negative result. The early detection of syphilis and isolation of the patient, during the active symptoms, is important because of the possible danger to others in camp. The syphilitic is a menace in any community.

Location of Primary Sore.—It should be remembered that syphilis is not purely a *venereal* disease, and that it may be transferred from one to another innocently. While the primary lesion is found most frequently on the genitalia, it is often found in the mouth. The sources of extragenital syphilis have received much attention from Dr. Buckley and his findings emphasize the frequency of nonvenereal infection. It carries its own warning and the great need of care, especially to dentists, who are constantly examining the mouth. The sources, according to Buckley, are: lip 1819 cases; breast (from suckling infants) 1148 cases; buccal cavity 734 cases; fingers 467 cases; tonsils 308 cases; throat 267 cases; tongue 157 cases; chin 146 cases; cheek 145 cases; gums 42 cases; arms 2 cases; hand 1 case; nostril 1 case; hard palate 1 case; eyelid 1 case. In all he reports 9071 cases of extragenital syphilis and fifty per cent of these were produced by some form of oral syphilis.

Course of Disease.—Syphilis does not always follow a typical course. It may omit certain stages. One may not see the early manifestations, or, if seen, they are of such a mild form as not to be recognized, only to break out violently in a tertiary form at a later day. The disease may be acquired or congenital. The vast majority of infections are acquired after birth. It is a constitutional disease, contagious in character, chronic in course and affects all parts of the body. It may be transmitted by heredity or inoculation on any portion of the body by the syphilitic virus. To acquire the disease two factors are necessary: first, the virus containing the Spirochaeta pallida (Trepone a pallidum), and second, the abraded surface of skin or mucous membrane through which the microörganisms may enter the system.

Treponema Pallidum.—The Spirocheta pallida is a spiral organism having six to eight coils or rings; it may

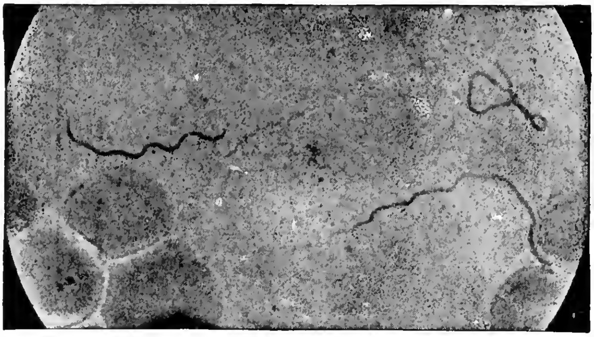


Fig. 148.—Spirochaeta Pallida (two in center) and Refringens (three, more deeply stained). (Hoffmann).

have as many as twenty-four, regular and close together. It moves along its own axis by rotation, whereas the Spirochaeta refringens, which is often found in the mouth, moves by flagellation or snakelike motion.

Sources.—Of the extragenital cases of syphilis seventy-five per cent begin around the head. The infected pipe, drinking cups, musical instruments, kissing, infected household implements are the common sources of this disease.

Stages of Syphilis

For the sake of convenience syphilis is divided into three periods: the primary, the secondary and the tertiary manifestations. Contact of the virus with an abraded surface in any portion of the body having occurred, absorption takes place through the blood vessels and lymphatic circulation. This is inoculation.

Primary Stage.—There is a period of primary incubation following infection, which lasts about three weeks and then appears what is called the primary lesion or chancre. This occurs at the point of inoculation. A true chancre is hard or indurated at its base and is quite different from a soft chancre or chancroid whose infection is local and limited to enlargement or suppuration of the nearest glands. A hard chancre, at first, is an elevated spot which slowly enlarges and becomes firm, indurated or button-like in feeling in contrast to the surrounding tissue. The softer the tissue in which it is situated, the more marked is the induration. In certain situations, as for example the finger, the induration may be slight and so, scarcely noticed until later symptoms make known the diagnosis. This primary sore increases in dimension, has an ulcerated surface and shows no tendency to heal. It rarely is larger than a ten-cent piece. It is usually single but may be double providing inoculation has taken place at the same time.

Secondary Stage.—Following this is a second period of incubation, during which the glands nearest the point of invasion or chancre become enlarged; then follows a general glandular enlargement. This second period of incubation lasts about six weeks, then occur what are called the secondary symptoms, which last from one to three years and have a predilection for mucous membranes and skin. After the formation of the primary sore and during the period of incubation to the development of the constitutional manifestations, evidences of lymphatic absorption of the disease can be found in the glands nearest to the primary sore; if the genitals, those of the groin are first affected; if the fingers, the epitrochlear; if the lips, the submaxillary. From about the tenth to the fourteenth day these enlargements are quite noticeable and are hard, non-painful kernels under the skin.

Secondary Symptoms.—The secondary stage is ushered in with feverishness, slight sore throat, pains in the limbs, headache and a feeling of malaise, and soon after there appears on the body an eruption of rose colored blotches or spots not unlike the appearance of measles. This may cover a part or the whole of the body. It is often transitory in its appearance; it lasts about

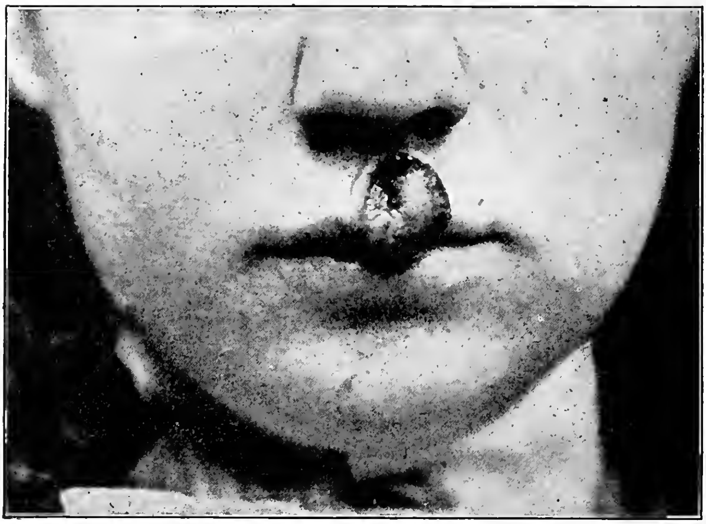


Fig. 149.—Chancre of the Upper Lip (Porter).

three weeks and disappears with a very slight scaling of the skin. The sore throat may subside; the headache may diminish; the initial sore may even heal, thus giving a feeling of false security to the patient. After a short time usually a papular eruption appears on the body and the scalp becomes involved; the hair, the eyebrows and lashes fall in patches, giving a moth-eaten appearance. Then occur the lesions of the mouth which are the most important of the whole body.

Lesions of the Mouth.—These lesions are among the early symptoms and are the most destructive and rebellious to treatment and the most apt to recur. They are also very contagious, and there is no doubt but that more cases of extragenital syphilis are acquired from these mouth lesions than all the local lesions elsewhere in the body. It must be remembered that the secretions from the mucous patches of the mouth as well as the blood and lymph during the second stage of the disease are highly contagious.

Syphilis of the Mouth

As seen in the mouth and throat there are five forms in which syphilis may occur. First there may be a primary lesion; usually this is seen on the lips, the tongue, the fauces, the tonsils. Then the second form or erythema, a congestion that occurs at the beginning of the secondary rash and consists of a diffuse redness of the posterior parts of the mouth, confined chiefly to the soft palate and uvula. After a time there occurs the so-called butterfly manifestation, which is quite characteristic. This area of redness is sharply defined from normal mucous membrane at the juncture of the hard and soft palate. This soon disappears and next is developed the third and most important form of oral syphilis, the *mucous patch*.

Fig. 150.—Mucous Patches.

Mucous Patches.—In number these patches may be one or multiple. They are grayish white spots varying in size and shape, but more or less round, and not unlike the ordinary canker spot so often seen. They are not elevated but have a reddish hyperemic zone around them. They are situated usually on the inside of the lip and cheek, tongue and gums, the soft palate and tonsils. When occurring at the angle of the mouth they are troublesome and hard to heal. These patches appear eight to twelve weeks after the primary sore and tend to recur again and again. The simple canker sore is more painful, develops quickly and gets well in a few days. Mucous patches look not unlike the mucous membrane when touched with a strong solution of nitrate of silver, with the addition of a red zone around the whitish opalescent patch. These mucous patches are extremely contagious and infect saliva which often conveys the disease. Contact with a sharp or ragged tooth prolongs or causes a local outbreak.

Infection from Saliva.—Here might be quoted an interesting example of the contagiousness of saliva. Two teamsters, one of whom had the habit of chewing the lash of his whip, one day were driving in opposite directions. The one who chewed the lash playfully snapped his whip in the direction of his friend, hitting him on the tip of the nose and causing an abrasion of the skin. The saliva carried the spirocheta and a primary sore developed in due time.

Another interesting case is that of a young man who, like many others, used to smoke cigarettes. (After puffing a little one allows the cigarette to rest listlessly on the lower lip; the rice paper adheres to the mucous membrane and on removing the cigarette quickly, a slight abrasion of the mucous membrane results.) In the case spoken of (one in actual practice) a young man met a young lady who liked to smoke cigarettes. She did not happen to have one and was not averse to a second-hand smoke. She snatched the one from the mouth of the young man, took a few whiffs, then passed it back. In three weeks he developed a primary sore on his lower lip caused by inoculation through an abrasion. Therefore if a man has a pipe, he should keep it in his pocket. It doesn't pay to let his neighbor have it.

In mouth infection there must be an abraded surface to come in contact with the active virus. The spirochete lives in the open air perhaps five minutes and if well taken care of may be active for an hour or two, but the drying process of the air seems to make it inert and protects people from having syphilis. Moisture and heat tend to prolong its activity. The period of primary incubation is about three weeks. The secondary period lasts from one to three years, which is followed by a period of two to four years of quiescence, after which the tertiary period, which lasts indefinitely, commences.

Fig. 151.—Gumma of Tongue.

Tertiary Stage.—The tertiary period is characterized by gummata, deep ulceration and destruction of bone and tissue. Irregular nodules or gummata form in any portion of the body. They may be very small like millet seed or large like marbles. They are hard and firm at first and later become soft. Necrosis is followed by absorption and breaking down of tissue associated with more or less pain. Then follows a deep punched ulcer or a necrosis of bone with sequestra formation accompanied with more or less odor. Tissues and bone are alike affected. If these ulcers heal under treatment they leave a stellate scar, which is quite characteristic.

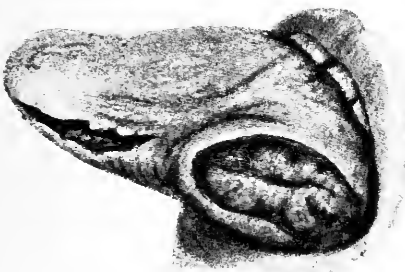


Fig. 152.—Gumma of Tongue.

Briefly, then, there are: (*a*) a period of primary incubation following inoculation, lasting about three weeks; (*b*) a period of primary symptoms, chancre and beginning adenopathy; (*c*) a period of secondary incubation, lasting about six weeks; (*d*) a period of secondary symptoms, lasting from one to three years; (*e*) an intermediate period, of two to four years; and (*f*) a tertiary period, lasting indefinitely.

Parasyphilitic Symptoms.—These manifestations are tabes, dementia, paralysis, arteriosclerosis, aneurism, aortitis, amyloid degeneration.

Hereditary Syphilis.—In hereditary cases there is no primary lesion. There are only the secondary and tertiary manifestations. One class of symptoms may not be seen or they may be so slight as not to be noticed, only to show up later in the tertiary form of the disease. Instead of waiting two to four years for the tertiary symptoms, they may appear in perhaps six or nine months or the secondary symptoms may be delayed and not show up until later than usual. The course of the disease is by no means regular; often symptoms recur when the disease is thought to be cured.

SYPHILIS OF THE MOUTH ILLUSTRATED

These points are especially important to dentists. The primary sore may appear anywhere on the body. In order to have inoculation there must be an abrasion and then the active spirochete must be rubbed in just like ordinary vaccination.

Dark Field.—The pallida seen in the dark stage microscope is just like a piece of fine spiral wire with perfect coils. There may be six, eight or any number of coils up to twenty-four. They differ decidedly from the Spirocheta refringens which is constantly in the mouth. The latter is thickened in its center and has tapering ends and moves by flagellating or whipping from side to side in a wriggling motion. The pallida always moves with a spiral motion. The spirals are perfect in the picture and differ from the refringens variety. The Spirocheta pallida can be found in the serum from a primary sore very early and an absolute diagnosis result. The figure shows the primary sore beginning as a pimple, gradually enlarging to the size of a ten-cent piece. It appears any-

Fig. 153.—Late Secondary Lesion.

where on the body where inoculation has taken place—the genitals, mouth or finger, etc. The surface is slightly ulcerated with only very little secretion. The edges are slightly raised and if it is felt between the thumb and forefinger it has an indurated or button-like feeling. Sometimes it is only parchment-like in feeling but usually hard, and especially in soft tissue has a decided thick indurated base. This sore has no tendency to heal and does not get larger than a ten-cent piece. This is followed by enlargement first of the glands nearest to the sore; in this case the submaxillary glands are first enlarged. One may have a double chancre but both inoculations must take place at the same time.

Figure 154 shows a very early stage of the secondary lesion of syphilis with skin eruption. The whitish mu-

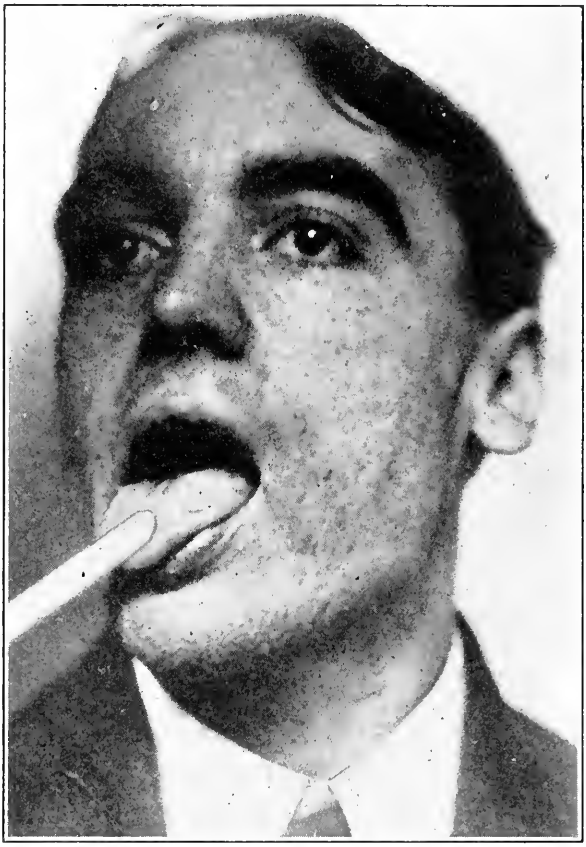


FIG. 154.—A VERY EARLY STAGE OF THE SECONDARY LESION OF SYPHILIS, WITH SKIN ERUPTION. (Photograph by Dr. C. M. Whitney.)

cous patch on the edge of the tongue, more or less rounded, with a red zone around it will be noted. When the disease is active this tends to enlarge with serpiginous edges. This is quite characteristic.

When examining the mouth, if there is a suspicious sore around the lips, the dentist must not handle it himself.

The patient must do it. He should roll down the lower lip so that the mucous membrane can be seen; then roll up the upper lip and protrude the tongue in the median line, moving it to the right and to the left. In this way one may get a very fair view of the mucous membrane of the lips and tongue and the anterior portion of the mouth. Opalescent patches in the mouth associated with a rash on the body and a general enlargement of the cervical glands, and falling hair or eyebrows should arouse suspicion and lead one to seek expert advice. A persistent ulcer or sore at the angle of the mouth is always suspicious.

Salvarsan does not eliminate syphilis; it is only another weapon with which to fight the disease. Early diagnosis by microscope or by the Wassermann serological test helps to fight the disease earlier and with better results. Mercury and iodid still have an important place in the treatment of this disease. Alcoholism and neglect of cleanliness of the mouth tend to make mouth lesions more common. The use of tobacco also prolongs the disease.

Care of Mouth.—In the earlier treatment of lues the patient was frequently salivated from the mercurial rubs. The teeth became loosened; the gums tender, swollen and bleeding; the patient unable to bite, with saliva drooling and breath offensive. This condition is seldom seen with modern treatment. Sharp or ragged teeth are very apt to cause excoriations and keep up mucous patches. Well cared for teeth and mouth hygiene are very necessary during the treatment of syphilis.

Frequently there is an ulceration of the tonsil, destructive and simulating syphilis. It is not syphilis but Vincent's angina, a destructive process with a predilection for the tonsil. The microscope easily reveals its true character. It is caused by the Bacillus fusiformis and the Spirocheta refringens. This is very common in the

Army. It must be remembered that the patient may have syphilis as well as tuberculosis at the same time.

History is very important in tracing out old ulcers, gummata and scars. A gumma (*see* Figures 151, 152) may appear anywhere in the body and may be small or large. It gradually breaks down with destruction of tissue and is followed by a stellate cicatrix. Frequently the roof of the mouth is affected so that the hard palate is destroyed and speech interfered with.

The primary sore occurs exactly at the point of inoculation wherever that may be. Mucous membranes and skin are where the secondary forms of the disease are manifested. The upper and lower lips, the angles of the mouth, the sides of the tongue and the fauces must be examined. Gummata may appear anywhere but are frequently found involving the roof of the mouth, the nasal septum, the tongue, the frontal bone and the anterior part of the tibia. Destruction of bone and tissue are characteristic of this stage.

Perforated Palate.—A hard swelling in the roof of the mouth, gradually growing larger, becoming deep red and then softening in its center is the usual course. Gummata break down soon if treatment is not started. Perforation of the hard palate into the nose is common and this decidedly interferes with speech. The writer has frequently seen such an opening filled up by the patient with gum or gauze or some other contrivance so as to make speech intelligible. Where perforation of the hard palate occurs an artificial denture restores speech at once. Ulcerations and swelling are always suspicious. Other symptoms may be found. The result of a broken-down gumma is a deep punched out ulcer with sloughing in its center.

Perforated Nasal Septum.—The septum of the nose is frequently involved and the junction of the vomer and the cartilage is where gumma and perforation occur. When at this point is found an irregular perforation of the septum involving bone and cartilage, one may be pretty sure it is syphilis unless there has been an operation on the septum. If the perforation is due to caustics or picking the nose, the opening is more apt to be at the center of the cartilage and be round and not irregular. That is an important differentiation.

Uvula Involved.—The soft palate and uvula are frequently ulcerated. The effect on the voice is the same as that of cleft palate if the palate is destroyed. If the uvula and also a portion of the soft palate are destroyed there result a permanent deformity and cicatrix which interfere considerably with the functions of the soft palate and the clearness of the voice.

FIG. 155.—SADDLEBACK NOSE.

Typical Scar.—Stellate and puckered scars often indicate the loss of tissue from syphilitic ulcers. This is quite characteristic. It is surprising how much destruction of soft or bony tissue can take place in a very short time.

Saddleback Nose.—Figure 155 shows a typical deformity of the nose. A man may get this condition as the result of hereditary or contracted syphilis. The bones and tissues are so destroyed that support for the bridge of the nose is lost and a contraction occurs. The nasal bones may not be injured but a slumping of the nose may result from destruction of the tissues at the junction of the cartilage and the vertical plate of the ethmoid. It is well to remember that one may find a similar condition as the result of an improper submucous resection operation. Slumping or sagging of the tip of the nose from this operation is quite common. There may also be a saddleback nose due to injury of the nose with abscess formation; this may be unrecognized and go on to destruction of the cartilage and bone with a resulting depression of the bridge.

The dentist should always be suspicious of a slumping nose. He must find out if operation on the septum has taken place or if the patient has had a severe nasal injury with abscess formation.

The patient shown in Figure 156 came to the writer's attention with the whole interior of the nose destroyed, the septum completely eaten out, the turbinates largely

Fig. 156.—Syphilis of Nose.

destroyed, even the frenum gone. Just one great cavity remained. The sides of the nose had begun to show a slight contraction. This was the result of improper treatment, or neglect of treatment. With good treatment syphilitic manifestations usually readily yield. Destroyed tissue cannot be replaced. Ulcerations may be made to heal but scars remain as telltales.

Syphilis is frequently manifested in the nasal sinuses, especially the antrum and the ethmoidal cells. The frontal bone (*see* Fig. 157) just above the frontal sinuses is sometimes the situation of gummata which look like little horns. At first they are indurated, if allowed to break down and discharge, a disagreeable ulcer is formed, hard to heal and with a deforming scar. They should not be incised, for they yield readily to iodid of potash or mercury.

Necessary Evidence.—The frequent testing of blood is now very important in clearing up doubtful diagnoses. One negative Wassermann, especially if mercury has been used, is not always satisfactory evidence. Lips with slow healing ulcers at the angle of the mouth are suspicious. They are not always cold sores. Corroborative evidence must be sought. A diagnosis cannot be made from one symptom. Mucous patches, general adenopathy, headaches, more or less falling of the hair, pains in the bones or head late in the afternoon and skin lesions are the corroborative evidence to look for.

Fig. 157.—Syphilitic Nodes of the Skull.

One would not like to be the father of a youngster like the one in the illustration. Figure 158 shows a typical hereditary-syphilitic child. The condition of the eyes, the old-man look and wrinkled skin are noticeable.

Hutchinsonian Teeth.—Hutchinsonian teeth are quite characteristic of hereditary syphilis. These teeth ought to be well known to the profession. The cupping of the central incisors and the laterals, also the pegged shape of the teeth are quite diagnostic.

The patient shown in Figure 159 came into the author's office one afternoon. The diagnosis was plain because of the cupping and pegging of the teeth, also the slumping nose. The mother had syphilis and the child was syphilitic by heredity. The Hutchinsonian teeth, the slumping nose, the general glandular enlargement, and the lack of proper development are some of the evidences in this case.

FIG. 158.—HEREDITARY SYPHILIS.

This leads the writer to say that treatment for syphilis should not be begun until an absolute diagnosis has been made. The therapeutic test, while it may relieve the patient, hides, and sometimes leaves a doubt whether a correct diagnosis has been made, so that neglect of treatment results. In the absence of absolutely characteristic symptoms, the demonstration of the Spirocheta pallida

FIG. 159.—HUTCHINSONIAN TEETH.

or the positive serological test is very desirable. Syphilis simulates many other diseases, therefore it is wise to have in mind the more common diseases having manifestations around the mouth.

DISEASES OF THE MOUTH SIMULATING SYPHILIS

Herpes Labialis.—This lesion is quite different from syphilis. Vesicles appear on the lips, with more or less pain; these coalesce and in a few days disappear, leaving no scars. Syphilitic lesions are slow in origin, usually without pain, and tend to advance and destroy tissue unless constitutional treatment has been instituted.

Stomatitis.—This condition is also rapid in its course. There is a vesicle which enlarges and bursts, leaving a cup-shaped ulcer with a red zone of inflammation around it. The ulcer is often very painful. This usually lasts but a few days.

Vincent's Angina.—This disease is apt to be mistaken for syphilis; a sloughing irregular ulcer of one or both tonsils, tending to deepen in the tissues, sometimes causing foul breath and pain and local glandular enlargement. The low-power microscope shows the Bacillus fusiformis and the Spirocheta refringens. The Wassermann test is negative.

Fig. 160.—Geographic Tongue.

A positive Wassermann is here of great importance. A negative Wassermann is interesting but not always to be relied on.

Geographic Tongue or Wandering Rash.—This is a superficial denudation of the epithelium, leaving a red base surrounded by white edges, serpiginous in form. This is not syphilis.

Leukoplakia.—Sometimes there is a tongue that looks as if it had been coated with white paint. This symptom also sometimes appears on the inner side of the cheek near the angle of the mouth. This is leukoplakia. It is often seen in excessive smokers, sometimes associated with syphilis, sometimes a precursor of cancer.

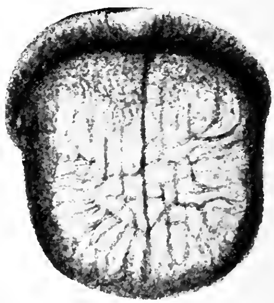


Fig. 161.—Leukoplakia.

Tubercular Ulcers.—These ulcers may invade the mouth, lips or larynx. The process is slow; tubercles forming and breaking down into superficial ulcerations, producing a more or less moth-eaten appearance. These ulcers are indolent, hard to heal and slow to advance.

Carcinoma of Tongue or Mouth.—Cancer has always to be considered when making a diagnosis of syphilis. It presents a sloughy surface, deep red or purple, bleeding easily, usually associated with lancinating pain. It progresses slowly, involves all tissues and produces cachexia in the advanced stages. It is rarely seen under the fortieth year. Swelling, fetid breath, and enlargement of the neighboring cervical glands are other symptoms. Cancer and syphilis may coexist in the same person.

Tonsillitis.—This condition is one of the most frequent diseases which the soldier contracts. Close quarters, ill ventilation, dampness, fatigue and exposure favor it. It sometimes seems epidemic in character. There has been a recent example in its prevalence at the Ship at Marblehead. It is very common in young adult life. It begins with swelling of one or both tonsils, malaise and headache, high temperature and rapid pulse. With the swelling occur fever and difficulty in swallowing; the tonsils have a white exudate usually coming from the crypts. The attack lasts from three to ten days, leaving the patient weak and exhausted. Rheumatism, nephritis and heart complications frequently follow an attack of this kind. The patient may apparently start to get well in a few days, when the symptoms return and become localized in one side of the throat.

Fig. 162.—Carcinoma of Tongue.

Quinsy or Peritonsillar Abscess.—This condition is a result of tonsillitis. It is an inflammation of the tissues around the tonsils which forms an abscess in the supratonsillar fossa. As soon as fluctuation can be determined, an incision should be made to let out the pus. The patient should not be allowed to suffer until the pus, trying to get out, breaks into the throat. Pus always burrows in the line of least resistance. Opiates are contra-indicated, for, if the abscess ruptures, there is great danger of suffocation or septic pneumonia resulting. If the patient has one quinsy, he is very likely to have another attack. It is best to have the tonsils removed to save further trouble.

Diphtheria.—In some of the camps diphtheria has broken out. A distinct membrane appears on the tonsil, in the nose or larynx—somewhere in the upper air passages. It is attended with slight fever at first. The membrane rapidly spreads over the tonsils or adjoining tissue; it is not confined to the tonsils as in tonsillitis. The membrane is adherent, bleeds easily; if removed it soon returns. Cultures should be taken whenever a doubtful exudate is seen in the nose or throat, for antitoxin, which has proven of wonderful value in curbing this disease, must be used early to obtain the best results. Every day lessens its chance of curing. With a mortality reduced from forty or fifty per cent down to one or two per cent, the great dread of this disease is lessened. Early diagnosis is all-essential.

Hypertrophied Tonsils.—There can be no doubt that tonsils are enlarged, which extend into the throat, almost meeting in the median line. But sometimes tonsils which do not appear large are held back into the tonsillar space by a little fold of membrane called the plica triangularis. These tonsils are frequently more dangerous than the obviously very large ones. If an individual has a red or sore throat, especially if the crypts of the tonsils are filled with little cheesy masses; if he has had quinsy or enlarged or painful cervical glands, the writer believes the tonsils should be removed by careful enucleation. He has never seen harm resulting, but has frequently known of great improvement in general bodily health and relief of so-called rheumatic or neuritic pains. Inflammation of the tonsils is many times followed by cardiac and nephritic complications, therefore one seldom errs in removal, providing it is done completely.

Tonsillectomy.—This and not tonsillotomy, should be the operation of choice. The latter operation is often the cause of serious complications because of its incompleteness. Asepsis, as in all operations, should be the rule. If the patient has adenoids, they should be removed at the same time as the tonsils. While the operation can be done with local anesthetics, the writer believes it should always be done under general anesthesia and ether is the best agent. It is safe and gives plenty of time to go slowly, split the capsule and not injure the pillars of the fauces. Fatal or serious hemorrhage has resulted from this operation, but in careful, skilled hands such an accident is rare.

The capsule-splitting operation is practically bloodless. When a case has been operated on before, it is more difficult to do a good tonsillectomy because of adhesions. The writer believes it helps healing to paint the cut surface, which is left, with iodin or iodin and tincture of benzoin. A week to ten days is the time it takes the throat to heal after tonsillectomy. Rest and soft food for a few days, catharsis with castor oil or cascara sagrada (not salts) is the after treatment. After tonsillectomy the soreness is more severe than following tonsillotomy. A white exudate forms over the cut surface; this is normal and gradually disappears as the throat heals.

THE NOSE

Injuries and Diseases of Nose

The nose is the most prominent portion of the face and is made up of cartilage, bone and integument. It is frequently injured because of its prominence. If the tissues are injured or torn, as much must be saved as possible. Thus cleaned and restored an ugly deformity may be prevented. When the bones of the nose are fractured, a dislocation is very apt also to occur. If not replaced at once and held in position until union takes place, considerable deformity may result, often unsightly and annoying to the victim.

Fracture of Nasal Bones.—A face mask was used in recent work in the orthodontia school of the Forsyth Infirmary. The patient, a young man, received a crushing blow on the bridge of the nose, fracturing and dislocating the nasal bones and septum, causing a spreading and separation of the bridge as well as a slumping and marked interference with nasal breathing. He was quite unhappy because of the ill-shaped nose. The writer proposed then to refracture the nasal bones along their base and set up the nose, holding it in place by intranasal plugs and an external splint or plaster cast. The time to have best fixed this was immediately after the injury. Then the parts were pliable and easy to hold in proper position. Physicians too often stop the nose-bleed and say the swelling will go down, without even trying to determine whether the bones are fractured or if the interior of the nose has been damaged. That becomes evident later when it is too late to be easily remedied. If one does not get proper support for the slumping condition, one must later insert a piece of rib or edge of the tibia to restore the fallen bridge. If the deformity is slight paraffin may be used.

Epistaxis.—Nose-bleed is so very common that everyone should know how to stop it. The bleeding point usually is on the septum, it may be the turbinates. About one-half to one inch from the vestibule there is a plexus of veins on the septum near the surface and easily ruptured by trauma or picking. Usually a firm plug of gauze or cotton placed well within the bleeding nostril and held there for a short time will stop the hemorrhage. One must not keep pulling the plug out to see if the bleeding has stopped. A chance for a firm clot to form is necessary. Sometimes one must moisten the cotton with adrenalin chlorid, hydrogen peroxid or Monsel solution. Irrigation of the nose with hot normal salt solution (110°-115°) is very helpful in stopping hemorrhage. Only rarely is it necessary to insert a postnasal plug.

Control of Hemorrhage from Nose.—If the bleeding point cannot be found and hemorrhage is profuse, refusing to stop by the milder methods suggested, then one may use a Bellocq sound or catheter with stylette, carrying a string through the nostril to the nasopharynx and into the back part of the mouth. A piece of gauze about the size of the thumb is then tied on to the string on the mouth end. The nasal end of the string is then gently pulled and the gauze, guided by the finger, is carried into the postnasal space and tight into the nares from which the blood is escaping. The anterior nares may then be plugged. In this way both ends of the nasal passage may be securely closed. Coagulo-plastin or rabbit serum may be used in severe hemorrhages. Sometimes tannic acid or gallic acid may be used on the gauze. It is rare, however, that a nasal hemorrhage may not be stopped by careful packing, using a nasal speculum and gauze one inch wide and thirty-six inches long. This may be packed into the nose, in the posterior portion first and gradually forward. Properly done, usually no other medication but the even pressure of the gauze is all that is required. The nasal packing should not be left in the nares more than forty-eight hours. It is better less. If there is high blood pressure, it must be reduced by bromid or morphia. Recurrent epistaxis is best treated by cauterizing the bleeding point with chronic acid, nitrate of silver or the actual cautery.

Bumps on the nose are not simple affairs. After stopping the hemorrhage which usually takes place, it must be noted whether the thin nasal bones are fractured or dislocated.

Hematoma and Abscess of the Septum.—Sometimes as the result of injury the nose is found blocked with a dark red fluctuating swelling on one or both sides of the septum. There has been an extravasation of blood into the tissues and a blood tumor or hematoma results. A free incision at the most dependent portion, on one side only, must be made early and the clot of blood turned out. Otherwise the blood breaks down, forming an abscess, and very soon both cartilage and bone are destroyed. A fluctuating swelling is seen involving both nares, pale in color, with or without pain and interfering with nasal breathing. Unless this abscess is incised, the pus burrows in the line of least resistance, finally breaks through and discharges. Considerable damage to bone or cartilage takes place with deformity as the result of contraction and scar formation. The abscess should be opened at once at the lowest point and drainage kept up until well. In this way one may avoid ugly deformities of the nose.

Acute Rhinitis.—Of the diseases of the upper respiratory tract, acute rhinitis or coryza is the most common. From a variety of causes and infections one gets what is sometimes called a *cold*. Sneezing, stuffiness of the nose, headache, slight fever, profuse watery discharge which lasts three to ten days, follow. Then the patient gets well, that is, the mucous flow becomes thicker and less, nasal breathing improves, headaches stop and the discharge ceases. The patient is apparently all right again. After a succession of these attacks chronic changes in the tissues of the nose are produced and a constant thick, more or less yellowish discharge is noticed, requiring frequent and persistent use of the handkerchief or hawking and spitting. This is the ordinary chronic rhinitis or chronic catarrh. When this persists there is a third form of catarrh which is called *atrophic rhinitis*, characterized by roomy nostrils filled with crusty secretion, hard to blow out or remove and often with offensive odor. This condition is associated with the loss of the sense of smell and taste. It requires persistent washings to relieve the odor and crusts. Atrophic rhinitis is seldom cured when at all advanced.

The Nasal Sinuses

Connected with each nasal cavity are four sets of sinuses or bony cavities, (*a*) the frontal; (*b*) the ethmoidal cells; (*c*) the sphenoidal; and (*d*) the maxillary sinuses. These are very important and one, the maxillary sinus or antrum of Highmore, is especially so to dentists. They all have openings connecting directly with the nasal chambers and they are lined with mucous membrane continuous with the nasal cavities. Any pathological condition in the nose proper is likely to invade the sinuses; thus there is, by extension from the nose, sinus disease, which may be acute or chronic. As the acute inflammation in the nose subsides, so it does in the sinuses, and normal ventilation and drainage of the sinuses is restored. In other words, usually the acute cases get well as the nasal symptoms subside. Sometimes pain and discharge of pus continues from one or both nares. It is important to find where it comes from. Retention of pus always means pain—the situation of the pain is often a guide to the sinus involved, or if the openings of the sinuses are large enough to allow vent, then the position of the pus in the nasal chamber directs to the sinus affected.

X-ray Diagnosis.—The X-ray is an important aid in diagnosis, as is also transillumination. The latter is of greatest value in disease of the maxillary sinuses, which are the largest and perhaps most often affected because they may be diseased from nasal infections or from bad teeth. The upper second bicuspid and the first and second molars it must be remembered are the teeth nearest to the floor of the antrum and most likely to be the cause of antral disease. An X-ray is important in showing the condition of the apices of these teeth and their relation to the antrum. A unilateral discharge of pus from the nose in an adult means sinus disease. A discharge of offensive pus from the nose is most likely to be from the antrum and of tooth origin. If there is a carious and ten-

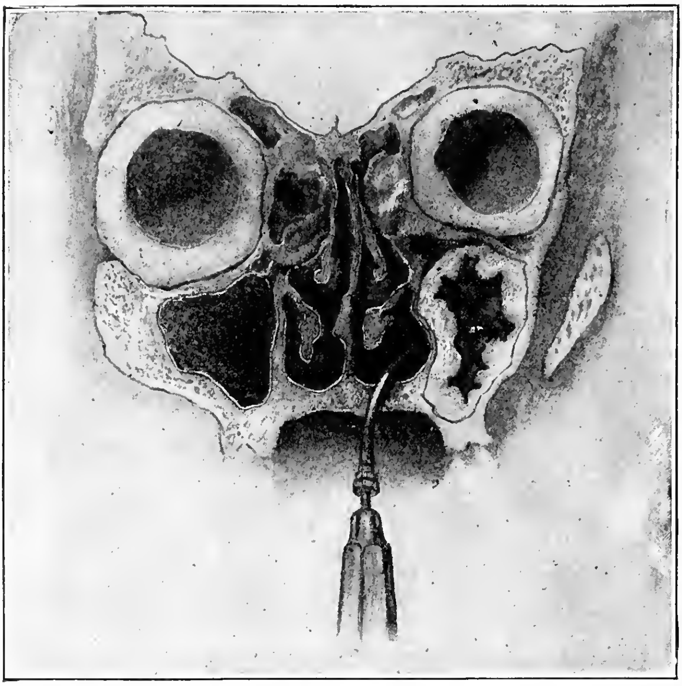
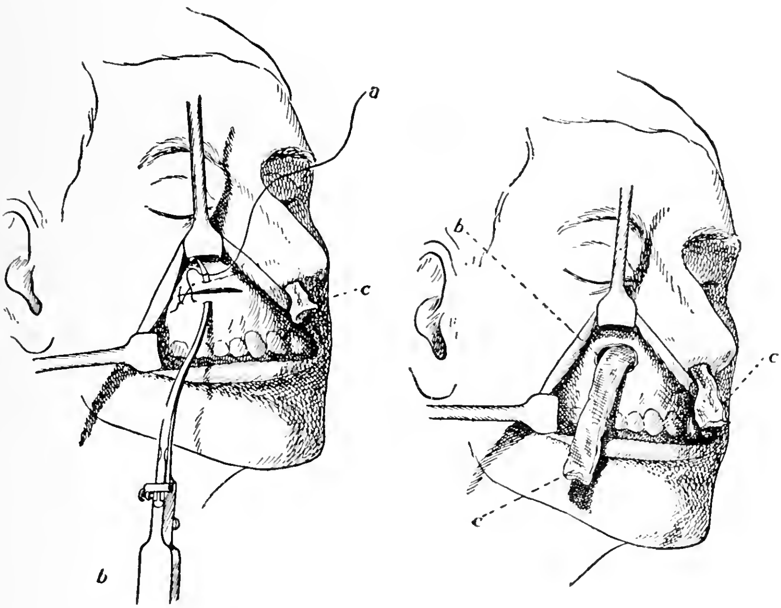


Fig. 163.—Operation on Antrum. (Coakley.)

der second bicuspid or first or second molar associated with a unilateral pus discharge from the nose, it is probable there is an involvement of the antrum. Transillumination is very helpful in making the diagnosis. If a tooth is the cause extract it; then the socket may be enlarged and the antrum washed out through the tooth socket with normal salt solution. If an offensive pus is found in the washings, they may be continued daily for a few days. The condition will probably get well soon.

It is well never to be rough with the mucous membrane lining the antral wall.

Operation on Antrum.—If the cavity has been washed many times without improvement, a radical operation is usually indicated. Sometimes the removal of the anterior end of the middle turbinated bone will allow the necessary ventilation and drainage of the nares and the pa-



Figs. 164 and 165.—Luc Caldwell Operation.

tient may get well without a more extensive operation. If the antrum is a reservoir for collection of pus from the frontal and ethmoidal cells, these must be cured before one can expect the antrum to get well. If the teeth are apparently in good condition and the antrum is diseased, it is not advisable to sacrifice the teeth, but open into the antrum through the lower meatus of the nose. A large opening can be made without doing any permanent damage and frequent washings may easily be accomplished. This is done by pushing a large trochar directly through the nasal wall under the inferior turbinate as shown in Figure 163. Sometimes the antral lining is so diseased that a radical operation at the gingivolabial margin above the teeth is the only method of cure. The antrum may be completely explored in this way, enough of the antral wall being taken away to insert the finger and curette throughout the whole of the sinus. It is better to make at the same time an opening through into the nose and after cleansing the cavity pack the antrum with gauze, leaving an end hanging from the nostril. The original incision may be closed up by interrupted sutures and the treatment thereafter is through the nose. The packing is removed in forty-eight hours. Usually results are very satisfactory (*see* Figures 164 and 165). It is called the *Luc Caldwell antrum operation.*

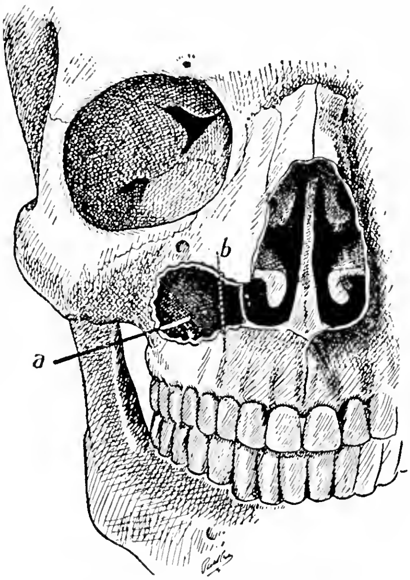


Fig. 166.—Denker Operation.

Figure 166 shows the more radical or *Denker operation* on the antrum of Highmore which is sometimes necessary. There is occasionally a little pocket at the anterior portion of the sinus which keeps up discharge, and removal of this portion of the maxillary bone is necessary. The antral and nasal cavity are here made into one. There may be a slight deformity from this operation. There is none from the Luc Caldwell.

A unilateral pus discharge from the nose of a child means a foreign body in the nares, in an adult usually some sinus involvement. If the patient with discharge from the nose is conscious of odor, it is probably from one of the sinuses, but if those around him perceive the odor, it is probably from a chronic or atrophic rhinitis.

MEASLES AND MUMPS

A recent visit to the naval hospital in Chelsea disclosed the fact that there were two diseases quite prevalent: measles and mumps. These two conditions have been quite common in other sections. The danger from measles is in its secondary involvements: ears, eyes, or lungs. Acute middle ear inflammation is frequent and demands an early paracentesis, or else rupture of the drum membrane will result with considerable damage to the hearing, besides leaving a chronic running ear. In adults mumps or parotitis amounts to very little if the patient is kept warm and quiet for a few days. Sometimes it descends into the testicles, causing orchitis. This is painful and may result in sterility.

Parotid and Submaxillary Glands

Inflammation of Wharton's Duct.—Sometimes the submaxillary outlet or Wharton's duct, which lies close under the tongue and empties at the frenum under the tip of the tongue, becomes blocked. The duct seems hard like a pipestem and the gland is swollen and tender. There is an interference with the flow of salivary fluid through the affected duct. This condition is found many times, and is due to a salivary calculus forming somewhere in the duct near the exit or well down toward the gland; it may be very small or quite long and large. One removed a short time ago is one and one-half inches in length. Sometimes inflammation of the duct is produced and pus may be seen coming from the opening near the frenum. Incision along the duct until the calculus is reached and freed is the treatment.

Sometimes the tongue is pushed up and speech interfered with by a painless swelling. There may be considerable drooling of saliva but no inflammation. The tumor is bluish white and translucent. This is a ranula or a blocking of one of the ducts of Rivinus, with cyst formation. The contents are just like the white of an egg and the sac wall is very thin. Dissection of the sac is therefore not easy, it usually ruptures before completely exposed and immediately collapses. However, as much of the sac as possible must be removed and the cavity packed so as to stimulate granulation, otherwise it returns. Evacuation of the contents does no permanent good.

PROPER BREATHING

Good nasal breathing is a necessity for good health and for physical and mental development; this is now well recognized. Nature has equipped the nasal passages so that air may be properly prepared, while passing through the nose, for its reception into the delicate lungs. The air is here strained of dust and germs, warmed to body heat and saturated with moisture. If a man is a mouth-breather, the body suffers because the air cannot be properly warmed, moistened and strained. One has only to breathe through the mouth a few times to see how dry the mucous membrane becomes. The secretion of the mouth is different from that of the nose. Its function is to start digestion and to make a bolus of food which may be easily pushed on into the esophagus. Anything in the nose which prevents a free current of air through it also interferes with the sense of smell and taste. Secretion from acute or chronic rhinitis and from sinus affections more or less interferes with the ventilation and drainage of the nose, so do new growths. Especially common are polyps, which probably are the result of a chronic inflammation of the ethmoidal cells.

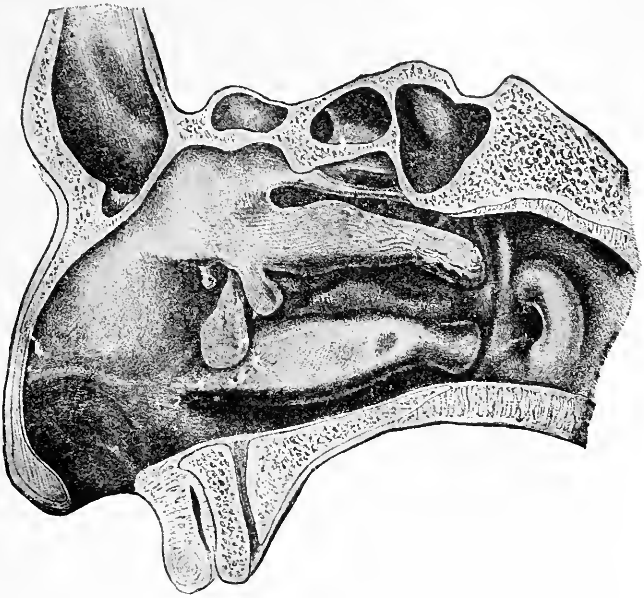


FIG. 167.—NASAL POLYPS. (Coakley.)

Polyps may be removed by the cold wire snare or by forceps. They are apt to return again.

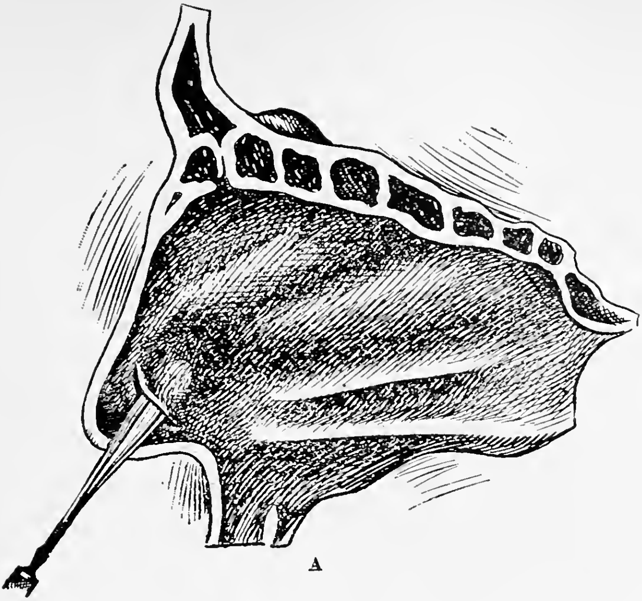
CAUSES OF MOUTH-BREATHING

The common cause of mouth-breathing in the adult is a deviated septum; this is closely associated with irregular development of the teeth and the upper dental arch. In fact, the whole development of the face depends largely on early breathing habits. Mouth-breathing caused by chronic catarrh, adenoids, or habits if these have been removed, is frequent. The balance of muscle forces of the face is upset, resulting in a change in muscle action during early second dentition. It is in this plastic and formative period of development of the face that the bones are molded into a different shape than nature intended, thus making nose-breathing difficult or impossible in later life. The nose, from lack of use, does not broaden; the maxillary arch becomes high and the teeth irregular and the whole dental arch is narrowed and elongated. When the child is twelve or fourteen these deformities become hard to correct, and in adult life cannot be made normal, for the bones are then fixed and unchangeable.

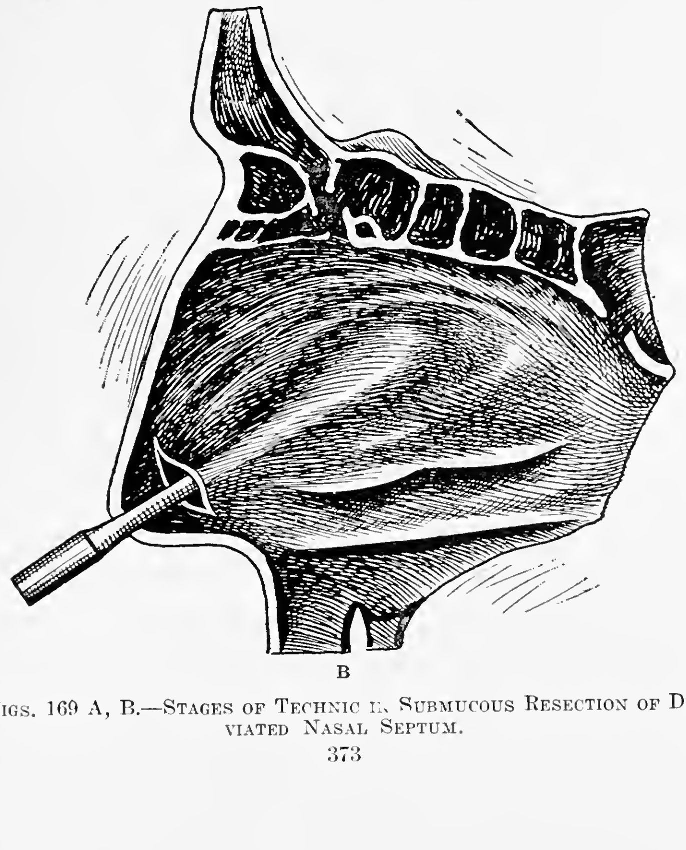
Deviated Nasal Septum.—Trauma and irregular growth are the causes of deviated septal deformities. They are not in evidence before the seventh year as a rule, but with growth become more pronounced or obstructive. They vary much in shape. Sometimes a small deviation causes more marked symptoms of obstruction than a fairly large one. The narrowness of the nostrils and the amount of nasal discharge are important in causing symptoms. Even though all obstructions in the nose may be removed or corrected, the individual may still be a mouth-breather because of malformation and uncorrected habits. A deviated septum makes one short-breathed on exertion. Submucous resection of the septum is the only operation that gives satisfactory results in correcting deviations of the septa, thus restoring the lumen of the nose approaching normal.

Fig. 168.—Deviated Septum.

Submucous Operation.—This may be performed under ether or by means of novocain and adrenalin. The latter is preferable, as it is bloodless; the pain during the operation is entirely bearable and, as soon as it is over, the patient may go home. There is no disagreeable vomit-

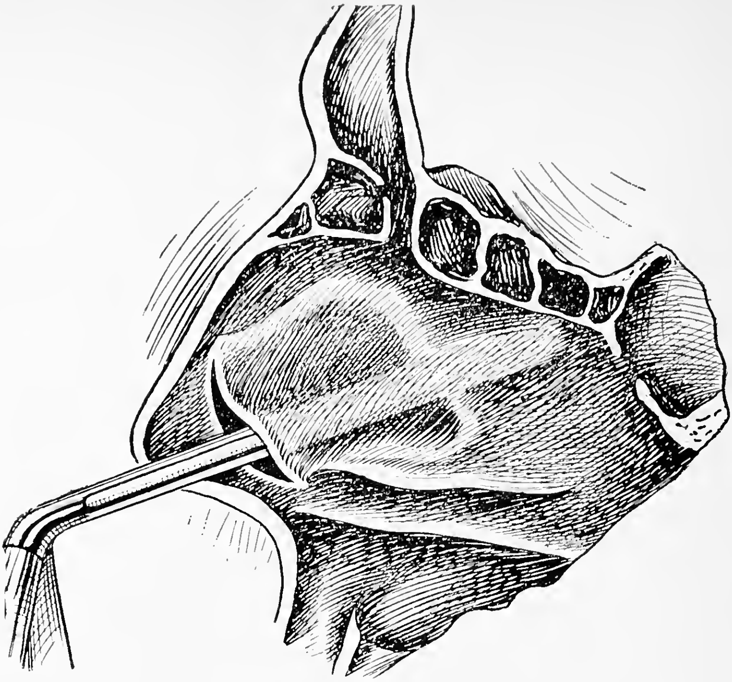


A



B

Figs. 169 A, B.—Stages of Technic in Submucous Resection of Deviated Nasal Septum.



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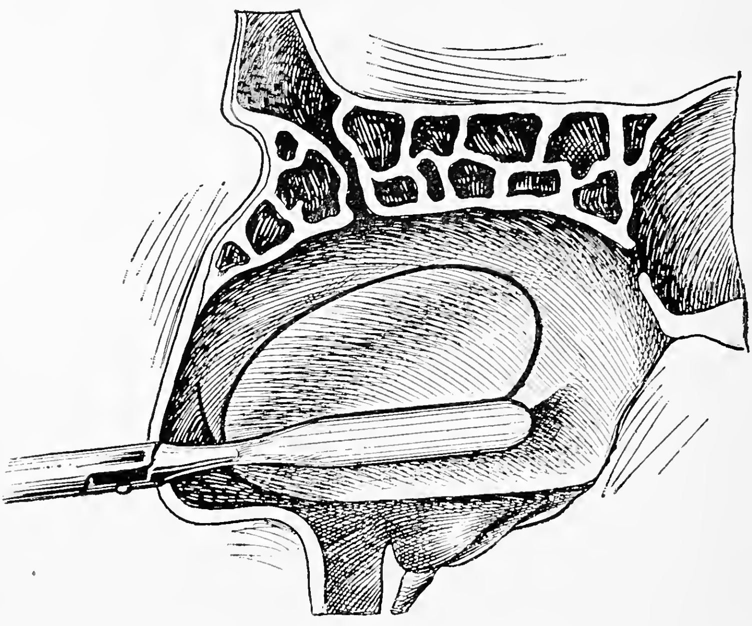

D

Figs. 169 C, D.—Stages of Technic in Submucous Resection (*Continued*).

ing which increases the discomfort of the nasal plugs, which are usually inserted to keep the septal mucous membrane together after the operation for from twelve to twenty-four hours. The patient is able to return to work in a few days and in ten days the nose is well. In most cases nasal respiration is much improved and the comfort in breathing during sleep is very noticeable.

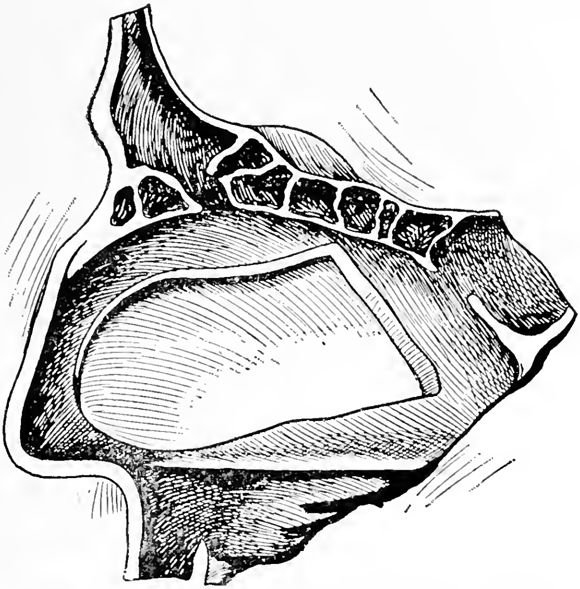

Fig. 170.—Extent of Septal Removal Necessary to Equalize the Nostrils and Promote Normal Ventilation.

Many times patients have said that their mentality has wonderfully improved following operation, because of the freer inspiration.

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CHAPTER XIV

APPEARANCES OF THE MOUTH IN SOME OF THE COMMON INFECTIOUS DISEASES

Howard Smith, M.D.

In speaking of infective diseases it is necessary to presuppose a general knowledge of medical terms. The writer will select three or four of the most important of such diseases and then speak briefly on these. In a book of this kind it would be impracticable to give all the points regarding the treatment, diagnosis, and so forth, of these different troubles. But fortunately for the purpose of this chapter most of these diseases have certain manifestations in the mouth by which they may be diagnosed, and the point in treating of these different conditions is not that the dentist may be expert in treating them or that he expects to treat them, but that he may be on his guard and recognize the early symptoms if they develop.

Danger of Infective Disease.—Wherever a number of men are together, whether in a camp or a hospital, or in any collection of persons, the danger which is dreaded more than anything else is the outbreak of one of these infective diseases. If it starts with a single case, unless prompt measures are taken to head it off, the result will be that everyone susceptible to the disease in the hospital or camp will be infected. Usually the only way to stamp out the disease is to close down temporarily that camp or hospital. Moreover, if these diseases develop on a surgical wound or in a surgical patient, they are a great deal more dangerous. Sepsis very frequently develops in an operative wound. One of the common, infective diseases may develop which is the reason for mentioning these different troubles.

THE MOUTH AND THROAT SYMPTOMS OF THE MORE COMMON DISEASES

Measles

Incidence.—First, the disease known as measles will be considered. Many people think that measles are confined to children, but a great many adults are susceptible to and develop measles. A short time ago in Boston an office was practically closed because most of the stenographers and office help were at home trying to recover from the measles. Unless a person has had measles in childhood, he is very apt to develop it in adult life on the first exposure, and when a collection of men is gathered from all parts of the world, many of them coming from small towns and rural districts where measles has not been incident, it is surprising to find how many of those men or persons will develop measles upon exposure.

Race Susceptibility.—Another point is that if measles is developed by a race of people who have not been subjected to it over a number of years, it is a very severe disease and often fatal. As an illustration of that fact: some years ago the Fiji Islanders who had never been exposed to measles were infected in some way or other, through a visitor or some member of a ship's crew, who went ashore, and the measles was spread. It went like wildfire through the island, and the mortality among those people was something like thirty or thirty-five per cent. Most of the northern races among whom measles is endemic, are developing a certain immunity day by day, so that their offspring are not affected so severely. However, this disease is worth serious consideration, because at the front now races are coming from all parts of the world, and some of them have never been subjected to measles.

Measles, known also as *rubeola* or *morbilli,* is the most contagious of any of the infective diseases. One attack usually confers immunity, although second attacks are not uncommon. The cause of the disease, whether bacterial or not, is not known. It is highly contagious even three or four days before the rash or eruption appears. Only a very short exposure is necessary in order to contract the disease. The incubation period is from eleven to fourteen days. The symptoms of the disease begin three or four days before the eruption appears on the skin. The infection is probably spread by the secretions from the mucous membranes of the nose and throat. It is most commonly spread by means of the cough, which is always present.

Symptoms.—The classical symptoms are as follows: for three or four days preceding the eruption, there is a great deal of inflammation of the conjunctivae, and the mucous membrane of the nose, throat and bronchii. Examination of the mouth shows a congestion of the tonsils extending on to the soft palate and pharynx. On the hard palate there are usually a few red spots about the size of a split pea. These spots represent the first evidence of the eruption, appearing first in this place. The sign of the greatest importance diagnostically is known as Koplik's sign, or Koplik's spots. These are small, bluish-white spots, about the size of the head of a pin, each one being surrounded by a reddened zone. They are exactly the same in adults and children. They first appear on the mucous membrane of the cheek opposite the molar teeth. They may spread to other parts of the mouth or be confined to the original areas. Their number varies. There may be only a few, or a large number may be present. There is always cough present and a good deal of discharge from the nose. The eyes are swollen, or rather the eyelids, with an increased production of tears. These symptoms continue for about three days, after which the rash appears on the skin.

INFECTIVE STAGE.—The rash begins on the face, then spreads, covering the whole body.

It can easily be seen that the most important factor is to recognize measles early before the eruption appears on the skin. If a patient with measles is allowed to remain in contact with other people until the rash appears one might just as well let him stay there the rest of the course, because he has done all the damage and infected everyone who can be infected. Of course, the patient is removed at that time, but there is very little value in doing it, because the infection begins as soon as the catarrhal symptoms develop; the throat and nose get red, the nose beginning to run and the eyelids beginning to swell; and the cough appears. From that point on, the person is infectious to others, so the value of knowing these signs is to enable us to get the suspects isolated before they have done any more damage than is possible, and to protect all the people possible from further infection.

To summarize: Anyone who has a cough should be an object of suspicion. If that person, in addition to having a cough, develops redness of the eyelids, a running nose, and a red throat, he is doubly suspicious. If, in addition to these signs, Koplik's spots are found on the mucous membrane of the mouth, it is absolutely certain that the case is one of measles and nothing else, because these Koplik's spots do not occur in any other condition. Koplik's spots present various definite characteristics in various stages of the disease. In an early stage of measles, two or three days before the rash or eruption appears on the skin, they appear on the inside of the mouth as small, discrete red spots, the center of each having small, bluish-white specks.

The spots become more numerous and coalesce to a certain extent. Then, that appearance on the mucous membrane, speckled all over with the small white spots becomes evident. If there are very many of them, the inside of the mouth looks very much as though the person had been drinking milk and some of the curdled milk had adhered to the mucous membrane.

In a still later stage the spots become larger, coalesce more, and the mucous membrane appears studded with these numerous small white specks. That appearance is absolutely characteristic of measles and nothing else. If it is seen in a person's mouth, plus the catarrhal symptoms, one can say absolutely that he has measles and no other condition. Once in a while there is one symptom that somewhat resembles this Koplik's, that is the so-called canker spots or stomatitis. These spots, however, are very much larger, are ulcerated, they do not run together and they are very much fewer in number. They are the only things that can possibly be confused with the Koplik's spots.

One more point to remember is that the Koplik's spot begins with a few spots and increases in number, finally coalescing in the speckled, whitish appearance. The stomatitis, or canker spots, on the contrary, always remain discrete. They do not coalesce, are much less in number, and the individual spots are larger than the individual Koplik's.

Essential Points.—To reiterate briefly: the points to remember about measles are that the disease is highly infectious long before the eruption comes out, and that in order to prevent infection for other people, the patient having the disease must be removed before the rash appears. Any person under one's care developing a cough should be suspected of having measles until he can prove to the contrary. If that patient has a cough and also develops swollen eyelids and running nose, then the chances of his having measles are very great and he should be isolated until it is proven definitely whether or not he has the disease. If, in addition to the cough, the running nose, and the swollen eyelids, the Koplik's spots appear in the mouth, it is absolutely sure that that patient will show the eruption of measles within three or four days.

German Measles.—Another point should be mentioned in connection with this subject, and that is, "What does one mean by *German measles?* Is German measles the same as ordinary measles, or is it different?" German measles is a distinct disease and has no relation to ordinary measles. It is very mild in its course. It has few or no prodromal symptoms. Usually the first sign is the appearance of the rash. There is no swelling of the eyelids. There is little or no cough and very little, if any, nasal discharge. The rash differs in appearance and in intensity. It lasts two or three days and disappears. The importance of this disease lies not in the treatment but in the recognition of the early signs, so that patients can be put where they will do no further damage.

Scarlet Fever

The next in order of common infective diseases is scarlet fever. A good many people think that scarlatina is a mild form of scarlet fever. The fact is that the two terms mean exactly the same thing, scarlatina, or scarlet fever; those terms are used synonymously. It is an acute, contagious disease, characterized by a sore throat, fever, and a fine red eruption on the skin. The incubation period is very short, varying in length from six hours to one week. The disease is followed by desquamation, which requires from four to seven weeks to be complete. The cause of the disease is probably a minute, short-lived microörganism which has been discovered within the last few months.

Symptoms.—The symptoms of the disease are as follows: first there is a rise in temperature, varying from 100 to 104 degrees. At the same time, a sore throat develops which gradually increases in severity; in about fifty per cent of the cases, vomiting is an early sign; and in from 12 to 48 hours after the appearance of the sore throat, the rash appears on the skin. This rash is deep red in appearance, not raised, and begins first behind the ears or upon the cheeks. It then spreads, covering more or less of the whole body. Examination of the mouth shows the following symptoms: the tonsils are swollen and much reddened, and in the majority of cases there is a varying amount of tonsillar exudate. This exudate may appear as small spots resembling tonsillitis, or it may be in the form of a patch, partly or wholly covering the organ. The pharynx and soft palate are intensely red. On the hard palate there is a large number of very fine, red spots, and this is the first appearance of the rash on the hard palate. Early in the disease the tongue is coated, the edges and tip are reddened, with a marked enlargement of the papillae of the tongue. Within two or three days the tongue desquamates, and is then smooth, deep red in color, with a marked enlargement of the papillae. This forms what is known as the *strawberry tongue* of scarlet fever.

The essential points regarding scarlet fever should be emphasized. Anyone who has a sore throat is suspicious, and should be watched. If, in addition to the sore throat, the patient vomits, he is doubly suspicious. If on examination the throat is found to have a marked congestion of the tonsils, pharynx, and soft palate, and shows a large number of very small, fine red dots on the hard palate, the chances are that that patient is going to have scarlet fever. In cases of this disease, as with the rest of the infective diseases, the earlier they are removed from contact with other people, the less the danger of contagion. The old-time idea was that a person with scarlet fever was not very dangerous until he commenced to "*peel*," as it is called. Then the patient was anointed with different kinds of greases and lotions to keep the dead skin from flying around and infecting other people. It has been found, within a comparatively recent time, that this dead skin is very little, if at all, infectious; that the infection is not in the dead skin, but comes early in the disease, and is contained in the discharge from the nose or mouth of the patient. The time when he is most contagious is during the early stages when the throat is red and the rash is on the skin. It is relatively safe to go where a patient is desquamating. There is very little danger from the desquamating skin—so much so that within the last year or so in Boston, the authorities do not even fumigate after scarlet fever. As soon as patients have done peeling, they are discharged, and the room is merely aired, subjected to sunlight and a good application of soap and water. The point to remember then, is that the desquamating skin is not so infectious as formerly considered, but that the danger comes early in the disease when the throat is sore and from the discharge from the throat and nose.

Infectious Discharges.—Another point that is not generally known is that there is a great deal of liability to complications in this disease; a good many children develop abscess of the ear, and have a running ear for a variable length of time. Others, who are troubled with an enlargement of the adenoid growth, develop a chronic inflammation of the adenoids, which results in more or less of a chronic discharge from the nose. So that as a complication of scarlet fever there may be running ears and running nose; and as long as any patient having had scarlet fever has a running nose or a running ear, he is in a condition to spread the disease. At the hospital for contagious diseases in Boston children were kept sometimes ten or twelve weeks, sometimes three months, until it was thought that the ears were clear, adenoids quieted down, and that there was no discharge from the nose, etc. The patient would be sent home, might develop a little cold, and for some reason or other the ear or nose would start to run again. Inside of a week or ten days there might be anywhere from one to two or three more children in the hospital, from that same family. So it must be remembered that so long as a scarlet fever patient has a running nose, or a running ear, the discharges from those parts of the body are contagious, and are capable of spreading the disease.

Ambulant Cases.—Before concluding a discussion of scarlet fever mention must be made of the much disputed question as to whether or not scarlet fever can occur without the appearance of any eruption or rash upon the body. There is a good deal of difference of opinion as to whether one can have scarlet fever without having any eruption. The question is not yet definitely settled, but the probabilities are that this is possible. The ordinary idea of a patient with scarlet fever is of someone desperately ill. Now, some people certainly are, but it seems safe to say that many persons with scarlet fever are not very sick, and there are a great number of scarlet fever patients who are never sick enough to go to bed. They are up and around and attend school regularly, and those are the ones that spread the disease. A patient who is known to have a very mild case of scarlet fever can infect another person, who may in turn develop one of the most virulent cases of the disease. Many cases of scarlet fever have been seen where the rash only lasted two or three hours and was confined to a small part of the body, possibly the axillae or the groin; it appeared as a small patch of rash possibly six or eight inches in circumference. By the next morning that rash would have practically disappeared. The only thing the patient would complain of was a little sore throat. Now those cases are scarlet fever just as much as the most virulent case, where the rash is so intense that it can be seen across the room. Consequently, if a case of scarlet fever breaks out in a ward, special precaution should be taken against these so-called "*mild*" cases. If scarlet fever has appeared in a ward or in a hospital or in a camp, every person should be isolated who develops a sore throat, irrespective of the fact that he have a rash or not, because many of them may have had mild rashes that could not be seen, or that disappeared before examination was made. If this is done, the epidemic will probably be nipped in the bud.

Diphtheria

Before considering the subject of diphtheria a word should be said about sore throats in general. There is no person who can positively diagnose diphtheria or who can state definitely from the appearance of a throat that a certain case is diphtheria, a certain case tonsillitis, or a certain case some other throat infection. A culture should be taken on every case of sore throat that occurs, especially in hospital practice or where there are a large number of men congregated under one roof. This is the only way of proving the presence or absence of diphtheria. In the majority of cases it is easy to diagnose, but the absolutely safest way is to take a culture.

Klebs-Loeffler Bacillus.—Diphtheria is an acute, communicable disease, due to a specific organism which is known as the Klebs-Loeffler bacillus, Klebs being the name of one man and Loeffler the name of another, who discovered this organism independently, one a year after the other. This disease is usually characterized by the formation of a false membrane on certain mucous membranes, especially those of the tonsil, nose, pharynx and larynx. Those are the four important points involved in diphtheria.

The average person, when speaking of diphtheria, imagines a sore throat, but the diphtheria organism may grow on any mucous membrane, the conjunctiva, for instance. The bacillus can occur on any open or granulating wound, and the patient will be extremely sick and very likely die, when diphtheria of this kind occurs. It is not unusual. Cases have been known where a person was burned and developed diphtheria on the wound. Therefore, although diphtheria is usually confined to the throat, it may occur on any mucous membrane or may occur on any wound.

In the great majority of cases diphtheria is spread by direct infection, that is, by contact with the patient. The breath of the patient probably does not contain the organisms. The bacilli are present in great numbers in the saliva and the mucous discharge from the nose. They are rather long-lived organisms. They have been found virulent on a child's toy five months after the toy was infected. Milk is a very common mode of spreading the disease. It rarely spreads through the water supply. Persons with enlarged tonsils, adenoids or a chronic inflammation of the throat are much more susceptible to this disease than others. The incubation period is from two to five days. One attack does not confer immunity, as a second attack has occurred in some cases within two months after recovery from the first.

Symptoms.—The symptoms of the disease are, first, elevation of the temperature or fever, a certain amount of malaise or discomfort, and sore throat. In the majority of cases the tonsil is the point affected; the nose is frequently involved, either alone or as a part of a tonsillar attack. Examination of the throat shows the tonsils swollen and red. The tissues immediately surrounding the tonsils are also reddened. On the tonsil a varying amount of membrane is seen. In the mild cases only a very small amount may be present. One tonsil may be affected or both. This membrane usually begins as a small spot and gradually increases. Except in severe cases, it is wholly confined to the tonsils. In severe cases it spreads and involves the uvula and the soft palate. The membrane is of a grayish white color, gradually becoming darker. It is rather thick and has a well defined edge. It is difficult to remove from the tonsil, and when removed it leaves a raw, bleeding surface. The temperature in diphtheria is only slightly elevated; 100 degrees to 102 degrees is the average. If there is a mixed infection, the temperature is apt to be very high, 103, 104, or even 105 degrees. The point to be emphasized is that if a patient has a sore throat and any spots of exudate on the tonsil with an accompanying temperature of 104 to 105 degrees, it is more apt to be tonsillitis than it is to be diphtheria. The pure infection of diphtheria has usually a low temperature, 101 to 102 degrees.

With the sore throat and temperature there is always involvement of the glands of the neck. The appearance of the throat is rather characteristic. In most cases the membrane is either confined to or beginning on the tonsil and in severe cases it spreads to the other parts.

Nasal Diphtheria.—One form of diphtheria that is very largely overlooked is diphtheria of the nose or nasal diphtheria. It is a very common condition, especially in children, although adults may have it. It often occurs limited to the nose, the throat not being involved. It is often chronic in its course, continuing a number of weeks. During this time the person is not confined to the bed; he is up and around and feels moderately well. The signs of this disease are, first, a little interference with the nasal breathing due to the swelling in the nose. There is a persistent nasal discharge, which is only slightly purulent. Occasionally this is blood tinged. There is almost always more or less excoriation of the external nares. These nasal cases are the cause of a large percentage of the diphtheria which occurs. The patient feels pretty well, except for the persistent nasal discharge. This is not thick but more or less thin, serous and usually blood tinged. The external nares are almost always raw and sore from this exudate. The culture is the only way to make a diagnosis. The patient should be subjected to cultures from the nasal discharge, and in the majority of cases it will prove positive. Children or adults having this condition spread the infection by mingling with others, but do not necessarily spread nasal diphtheria. One of the most virulent types of diphtheria may be engendered. In the nose some of the organisms seem to be of low grade virulence, but start to grow strongly on fresh soil. That is a very important point to remember.

Diphtheritic Croup.—One condition which does not often occur, but which can be mentioned in passing, is the presence of the diphtheritic membrane in the larynx. It is not very common in adults, but it does happen every once in a while. It usually occurs as a result of failure to treat, or failure to recognize, a case of diphtheria either tonsillar or nasal. The symptoms of this are interference with the breathing. This disease is frequently seen when it is primary in the larynx and there is nothing in the throat or the nose. In those cases it is very difficult to make a diagnosis. The chief symptom is that the patient has the croup. Usually there is very little temperature, oftentimes not more than 100 degrees; sometimes not as much as that; but the croup, instead of acting as the croup usually does, gradually gets worse, so that any person who has been exposed to diphtheria who develops the croup, that is, interference with breathing, with the symptoms gradually increasing in severity for twenty-four hours, usually is a case of diphtheritic croup. Cultures from these cases are often perfectly negative simply because the culture rod cannot be introduced deeply enough. A case of that kind should be given antitoxin and the antitoxin will help to clear up the diagnosis by relieving the symptoms.

Vincent's Angina

A few words should be said here about a disease which is frequently seen. It is the condition known as Vincent's angina. This is an infection of the throat and other parts of the mouth, caused by the combined effect of a spindle-shaped bacillus and a spirochete. Those two organisms work together, causing this disease. It is seen in adults rather than in children. It usually affects the tonsils, where it may remain or it may spread to other parts of the throat and mouth. Often only one tonsil is affected. The symptoms are fever, sore throat, enlarged glands in the neck, and constitutional disturbance, depending upon the severity of the infection. This condition is characterized by the formation of ulcers, which become covered with a membrane. The tonsils and surrounding tissues are red and swollen. The ulcers vary in number, in size and in depth. They are covered with a thick, dark-colored, sometimes almost black, membrane. This membrane is difficult to remove. When taken out, it leaves a deep, bleeding ulcerated surface. On removal it re-forms within a few hours. The interesting feature of this disease is its resemblance to diphtheria. Sometimes it is impossible to differentiate the two. Differentiation can usually be made, however, by the fact that the membrane is much darker in color, sometimes almost black. Then there is the presence of ulcers, which are not present in diphtheria. Diphtheria does not ulcerate, and Vincent's angina does. Dentists are probably better acquainted with these cases than medical men. Some of the cases of inflammation of the gums (gingivitis) seen by dentists are probably due to Vincent's angina organisms. The reason for mentioning it here is that it may attack the throat and may be confounded with diphtheria. These two diseases oftentimes occur together, but the Vincent's angina organisms cover up the diphtheria organisms, so the latter cannot be found until one gets rid of the Vincent's angina. If there is any suspicion of diphtheria, antitoxin should be given, and probably in three or four days later the culture of the diphtheria organism can be obtained.

O'Dwyer Tube.—The illustration shows an interesting apparatus. In diphtheritic croup the symptoms sometimes progress so far that it is impossible for the patient to breathe. In the olden times the only method was to do tracheotomy, and such operations were usually fatal. Out of twenty-six tracheotomies for laryngeal diphtheria the writer had a mortality of twenty-four. That is about the average mortality for tracheotomy for laryngeal

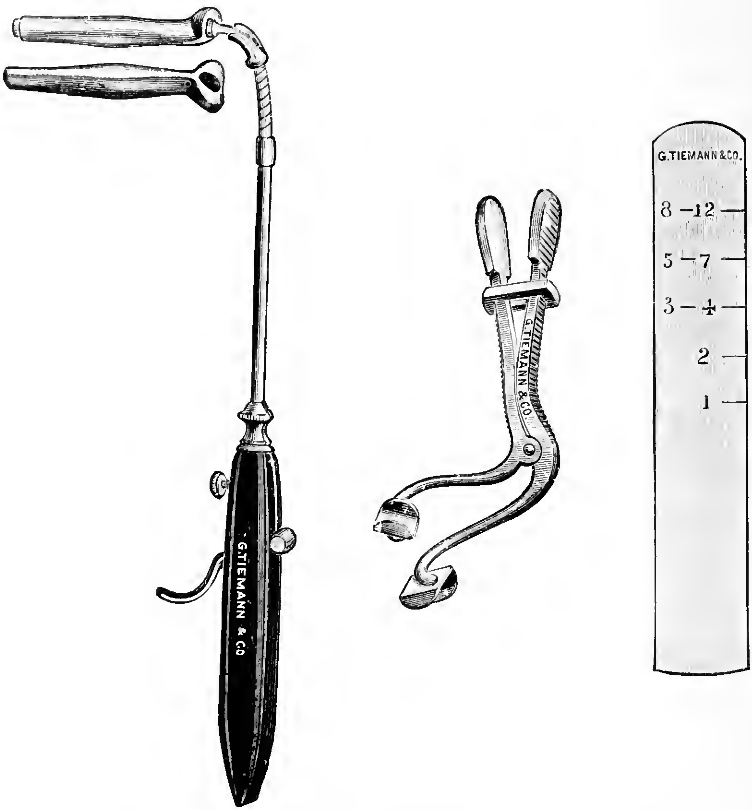

FIG. 171.—O'DWYER'S INTUBATION TUBES. (From Shurley.)

diphtheria. That being the case, a method was devised for allowing these patients to breathe. This is done by what is known as the *O'Dwyer Intubation Tubes.* These tubes are graduated in size and inserted into the larynx. The one shown would be for a child ten or twelve years of age. It is inserted through the mouth. Each one has an obturator and is screwed into the instrument. The tube is put on to the apparatus and held in the right hand. The forefinger of the left hand is put back into the larynx, into which the tube is passed. When the tube is well into the larynx, a little button is pushed, which releases the obturator. This is then drawn out, leaving the tube in the larynx. It is of hard rubber, metal-lined, and the patient breathes through the tube. Out of three hundred cases there was a mortality of about twenty per cent, which, when contrasted with a mortality of practically ninety-eight per cent in tracheotomy, shows a marked difference. These tubes come in all sizes, down to a tube suitable for a child one year of age. This is really one of the greatest life-saving inventions of recent times. It has been out now a number of years and probably most practitioners have heard of it.

It may be said that in families where there is diphtheria the rule is to inject all persons who have been exposed to the disease with a small dose of the antitoxin. This procedure, however, gives immunity for two or three months only.

CHAPTER XV

RECENT ADVANCES IN DENTAL SURGERY AND TECHNIC

Harry B. Shuman, D.M.D.

Under the subject of recent advances in dental surgery and technic some attention will be given to electricity, in other words, ionization, as it is viewed in dentistry.

ELEMENTS OF ELECTROLYSIS

A few A B C's of electrolysis, which covers the whole field of what is called galvanism or direct currents, will be first reviewed. In order to get a comprehensive idea of this subject one must consider for a moment its rudiments. It is necessary to know something about voltage, amperage and resistance; and a few moments spent in studying those three elementals are well worth while.

Voltage.—Voltage is not electricity but only one of the component parts of electrical energy, and though it is itself perfectly harmless it becomes a dangerous factor under certain conditions. Voltage is the pressure at which electricity is used, and can be likened to the pressure in the steam boiler. One would not call the pressure in the boiler *steam,* and it would be evidently as improper to call voltage electricity. It is pressure; in other words, it is electromotive force, and the abbreviation E. M. F. is the one constant abbreviation for electromotive force in any of the books discussing this subject. It always means Voltage.

Amperage.—In most text-books the word amperage is defined as amount or quantity. This is wrong, because one must not look on electricity as an entity but a condition. Amperage is only the rate at which electricity flows, and that rate is governed entirely by the pressure or voltage. If a dentist says, "I am giving a patient 50 milli-amperes of current," he means that the rate of flow of 50 milli-amperes is maintained throughout the entire circuit, and consequently just that much electricity is passing through the patient.

Resistance.—The third element in electrolysis is resistance. This means anything that opposes the passage of electricity. Every force has its resistance; if this were not so one would be able to make something out of nothing, or be able to produce perpetual motion.

It is necessary to understand that there is a definite relationship existing between the factors voltage, amperage and resistance, and that it is impossible to destroy this relationship. If two electrodes of an active galvanic battery be placed on the body, and a certain amount of pressure or voltage be turned into the circuit, a definite rate of flow or amperage will be established. If these electrodes are moved to another part of the body, or the distance increased between these two electrodes, the same amount of voltage will not maintain the same current flow.

That, briefly, is the essence of the whole subject. In other words, by separating the two acting electrodes resistance is increased to the current between the two poles, and in order to maintain original amperage or flow of current, one must either increase the pressure or decrease the resistance. In other words, what is gained in one of these factors must be at the expense of the other. It is very easy to change force or energy from one form to another, and this interchange of energy is the physical life of this world. The chemical energy within a cell begets electrical energy and with this one can in turn break up a chemical compound. So a simple definition of electrolysis is the breaking up by electricity of substances into their elements.

Direction of Ions

In studying this subject the main fact to be kept in mind is that there are certain products of decomposition which were named by Faraday "*ions*." These ions take a definite direction toward one or the other pole of the battery. Some have strong affinity for the positive pole, and others for the negative. Those ions appearing at the positive pole are called electronegative substances; likewise those appearing at the negative side are called electropositive.

The body fluids are composed largely of water, and therefore contain oxygen and hydrogen. In the process of electrolysis the former is electronegative.

Acidity and Alkalinity at the Poles.—If the application of one pole is indicated for a certain condition the other will aggravate it, so it becomes necessary to become thoroughly conversant with this part of the subject. Oxygen is an acid maker; consequently tissues adjacent to the positive pole are rendered acid. The acid condition is one antagonistic to pain, as it means the beginning of death of the tissue. Consequently this pole is called sedative.

Hydrogen is an alkali maker; therefore tissues in the immediate vicinity of this pole are rendered alkaline, and that means a condition of overstimulation or irritation. All inflammations are due to an excessive alkalinity of the part.

The positive pole by its acidity coagulates the albumen of the blood, and therefore hardens and shrinks tissue. The negative pole acts like caustic soda, liquefying or disintegrating the tissue.

CATAPHORESIS

Cataphoresis is the process of introducing medicaments into the tissues and circulation by means of the direct current. That is a definition which will pass muster. Many misleading statements have appeared in the literature regarding this process, the principal one of which is that because the movement of a direct current is from the positive to the negative pole all medicine must be placed on the positive pole so as to be pushed along in the direction of the current. Cataphoresis is an electrolytic process and follows closely the laws of electrolysis, and whenever suitable medicine is placed on either pole of a galvanic battery, that medicine is decomposed or broken up into its elements or ions, which, having an affinity for one or the other pole of the battery, the selection of the active pole would depend on what part of the medicine it is wished to use.

The medicament is carried deeply into the tissues, the depth depending on the amperage and the length of time the current is allowed to flow. It is not hard to formulate a rule to govern these cataphoric operations. If it is kept in mind that all bases, whether metallic or alkaloidal, have an affinity for the negative pole and are repelled by the positive, and that the acid, or that which takes its place, has just as strong an affinity for the positive and is repelled by the negative, the rule would be stated as follows—if one wants to utilize the base, medicine is placed on positive pole; if acid is desired, the negative pole is used.

IONIZATION

Uses.—A combination of the two subjects briefly discussed above is what is termed ionization today. It has a wonderful field in the practice of dentistry. It is used in the treatment of pyorrhea; for sterilizing the root canal, fistulous tracts and old sinuses; for cauterizing purposes; for desensitizing dentin and for pulp removal; and it will no doubt be used in the future for an indefinite additional number of things.

In Pyorrhea.—This treatment is used in the treatment of Riggs' Disease or pyorrhea. Of all the new technics and various fads relative to the treatment of pyorrhea this has been found superior to any. Either three per cent chlorid of zinc is used on the electrode, or a two per cent sulphate of copper solution.

This procedure will be described briefly. After the instrumentation in pyorrhea where there are very deep pockets and the degeneration of the bone is marked, even though the softer tissues have not yet degenerated, the electrode, wrapped with cotton, is placed in the pocket and run for from two to five minutes. This is the most beneficial local therapeutic agent the writer knows in the treatment of pyorrhea. A few applications of this treatment stop the worst possible cases of bleeding gums, and a few more additional ones will stop pus where it can be stopped. If the treatment with zinc ions and copper ions does not stop pus flow, it is doubtful whether anything will.

In treating pyorrhea after thorough instrumentation the writer usually applies this treatment, taking three or four teeth each time, depending on the ease of manipulation. By that is meant that the technic of ionization is extremely difficult, insomuch as it requires critical attention to detail. In other words, the electrode applied to a pocket of a tooth must reach that pocket and not touch another thing on its way. If it touches the clothing or cheek of the patient it is a failure. The patient is usually seen three days a week for two or three weeks, and then once a week on the least reacting pockets in the mouth. More has been accomplished with this method than with any other technic the writer knows of.

Other treatments of the disease, including the intra-muscular and intra-oral, have been tried conscientiously, and have been relegated to the scrap-heap.

The strength of current to be used is in proportion to the point of tolerance or sensation by the patient. It is turned on slowly, and when the patient says he feels the current it is allowed to run there, not any more, and the purpose is accomplished thoroughly. The strength one can use on different patients and different teeth varies according to the resistance, and also on whether one uses the negative pole in close proximity to the positive or far away from it.

The sterilization of root canals will be also briefly considered.

The question is often asked, "What is a definition of an ion?" An ion is the product of decomposition when substances are broken into their elements. It may be further asked, "Why do ions cure pyorrhea?" In the first place these products of decomposition are carried with the electric current, or they are parts of the things which move between the two poles. The medicine goes deeply into the tissue. It does not stay on the surface, and one does not have to depend on absorption locally. There is no reaction afterwards. The writer once had reaction when he first used cocain, because of faulty technic. Great care in technic is necessary. One can cocainize a part so that one can lance an abscess beautifully, but the region anesthetized is only as great as the area of the electrode with which it has contact.

Positive Results in Pyorrhea.—The positive results of this treatment in pyorrhea are very marked. It is the very best medium known of by the writer for bringing about cessation of pus. If, however, the patient does not coöperate with the dentist there is going to be a recurrence. There never will be a cure without the coöperation of the patient. This coöperation consists of cleaning the teeth properly and not leaving pieces of meat there; and of the use of floss silk. Riggs' Disease is largely due to neglect. One hears every day of all the horrors of pyorrhea and that everybody has got it, and undoubtedly many persons have, but proper co-operation and proper instruction on the part of the dental profession directed to their patients will make a wonderful change. One cannot cure this condition, however, without eternal vigilance on the part of the dentist and that of his patient.

Frequency of Treatment.—As regards this point many patients come once in three months, and to all intents and purposes they are cured; they do not accumulate tartar the way they used to, and they do take care of their teeth. The most potent factor in making people take care of their teeth and their mouths, after one has proven treatments beneficial, is to make one's fees large and so increase their appreciation.

Current.—In regard to the current one can use an alternating current, but it must be converted. The writer uses a continuous flowing current, or galvanic current and zinc electrodes. The minute the current starts flowing the electrodes disintegrate; salts develop immediately the current is turned on, and are applied not only to the tissue but into the tissue, and that is how they accomplish the result.

Iodin.—In regard to iodin, it is excellent for applications externally; that is, to mucous membrane. Iodin is used on the negative pole; that is the only thing used in dentistry which is electronegative.

Root Canals.—In the treatment of root canals either zinc chlorid or common salt solution is used; the latter breaks up into sodium and chlorin gas; that is the only thing that will sterilize the root canal structure to any depth and that outweighs all drugs one has ever used in root canal work so far as efficiency is concerned. It is more potent than any of them. A one or a two per cent salt solution is used and broken up with the electric current which is allowed to run up to the point of sensation (anything from one to three or four amperes), and if one is ingenious one can hold that electrode in the canal by mechanical means, but it must not touch any other thing before entrance to the canal. If tried, the strong smell of chlorin gas after two or three minutes' run of that current will be noted. That is a recent method of sterilizing root canals. If one has no board one has to do the best one can with any other method one knows about.

Reinfection.—In regard to reinfection the author has never had any cases that he knows of, but that does not say that some of the cases ionized have not gone to some other dentist. Excellent success has been obtained with other methods, but every root canal is ionized before it is filled in the writer's present practice. Immediately after sterilizing the root is filled. If it is a very putrescent root three treatments of the salt solution are given and then those canals are filled. The canals are sealed with dry sterile points. It is an amazing thing that one can seal that in without any drug on it, and see how soon it becomes sweet. The canal is filled up after the removal of the live pulp, but usually after one dressing, which is left in a couple of days. There is always more or less hemorrhage, and the dry dressing is left in there to sop up what it will. That canal gets only one treatment. With an open foramen the patient will not stand so much as if the foramen is closed up.

Desensitizing Dentin.—In this procedure the writer uses cocain in the form of Schieffelin's neurocain tablets; that is, in places where cervical cavities are accessible and can be isolated and kept dry a matter of two or three minutes. The technic in question is a difficult one, because it is fussy. The cocain is placed in the cavity, and on top of that a small pledget of cotton moistened in water is placed. Upon that a piece of gold or platinum foil larger than the cavity is put, and then the electrode placed on that and run for 30 seconds. If one runs over that time the pulp is cooked and made snow-white, which means pulp removal. This method is used to coagulate the albumin. If one takes a raw egg and puts the positive pole to the egg it coagulates just as though put into boiling water. It is the greatest styptic known for stopping a hemorrhage in a root canal. In ionization, for desensitizing the positive pole is put on until the patient feels it. Sometimes after a tenth of a milli-ampere the patient will feel it. The pole is just left there. The moment the current is started it is felt, but one does not have to hurt the patient with this technic at all.

CHAPTER XVI

MILITARY ADMINISTRATION

MAJOR FREDERICK E. JONES, U.S.A.

This chapter purports to explain some of the customs of the service and to indicate various sources from which the military dentist may obtain necessary information. It is going to be necessary for the future army dentist at some point to receive military instruction, and Dental Reserve Corps Surgeons will be unfortunately so situated that probably no instruction will be given them in a great many things that they ought to know. Military life is very different from civilian life. Things that one has learned in civilian life will have to be changed rather radically. It is therefore a necessity for the aspirant to a commission as army dentist to know something about what is expected of him from a military standpoint. Doubtless there will be many applications for commissions in the Dental Reserve Corps.

Application for U. S. D. R. C.—This entails upon the candidate certain required things before he goes into the service. In the first place, he makes an application for a commission in the Dental Reserve Corps. Later, notice is sent that he is to appear at a certain time and at a certain place to be examined, both physically and mentally, for his commission.

PHYSICAL EXAMINATION AND REQUIREMENTS

The physical examination is easy; it is applied to every soldier or officer entering the Army and has certain requirements which are not absolutely invariable. The personal element in the examiner has a great deal to do with the examination of the officer or recruit. The examination for both is the same. Some of the requirements of the physical examination will be enumerated.

Chest Measure.—In the first place, the minimum requirement for chest measurement is 32 inches. The applicant must have an expansion over that of 2 inches. It makes no difference whether in his effort to show what wonderful bellows he has he gets down to 29 inches or not. His normal range is required, and that in the minimum range is expiration 32 and inspiration 34 inches. If 32 inches is multiplied by 2, one gets 64 inches, which is the minimum required for height.

Height.—The applicant must be 5 feet 4 inches in height. Even the height of 5 feet 4 inches has been waived in some cases by the Adjutant General when the applicant has shown marked ability, and when the height waived was but slightly below 64 inches. A fraction of an inch is counted as a whole inch or no inch at all. For instance, 5 feet $3\frac{5}{8}$ inches would represent 5 feet 4 inches, and 5 feet $3\frac{3}{8}$ inches would represent 5 feet 3 inches in height. That covers the subject of height.

Weight.—If 64 inches is multiplied by 2, 128 inches is obtained, which is the minimum weight in pounds of the applicant, stripped. There are various exceptions to that. A man may be muscular, but thin and slight, and very desirable both as a recruit or as an officer; and a certain variation is therefore allowed. The extreme variation is 8 pounds less than 128 pounds, bringing the minimum weight down to 120.

Vision.—The reasons for which men and officers are most frequently rejected in the physical examination are, beginning at the head, the eyes. The requirement for vision is 20/40 in the right eye and 20/100 in the left, or one-half normal vision in the right eye and one-fifth in the left eye. It is astonishing to find how many men have not even that amount of vision. They are examined at a distance of 20 feet. In the later orders, however, even that requirement is further qualified, in that it is stated:

> Any officer who has not distinctly bad vision and whose vision is corrected to the normal by glasses, may be accepted.

Teeth.—Many men fail on account of their teeth. Orders require that a candidate must have four opposing molars. If he has four opposing molars that is enough. That looks like a mighty small amount of teeth, but that is all that is required. If those molars were in fair shape, he could punch holes through all the hard-tack they gave him. Plates or other artificial teeth are not officially recognized as being teeth. Later, at the end of the examination, when it is found that the only fault is a few teeth missing, the examining officer makes a statement to the effect that the applicant has no other physical disability except the missing teeth, and of course a record of each tooth is kept.

Heart.—When the men's chests are examined one finds that many are rejected on account of heart trouble. It is rare that any difficulty in a man's lungs is found; that is, a man is not rejected for that reason. So many men come with ordinary colds which look so much like tuberculosis of the lungs that men are rarely rejected on account of such symptoms; but in the case of a man's heart, many lesions, particularly valvular, are found. These cases are always rejected. It is rare that one has been able to dodge rejection who has a valvular lesion of the heart. There is a good reason why. Under the hard strain of field service those hearts break down, and then there are cripples to be taken care of. Not only the man afflicted is lost, but also someone has to take care of him.

Hernia.—A man is always rejected if he has hernia, for the reason that in the field those hernias are apt to break down under the physical strain of hard field service and the patient may be in a position where no proper medical aid can reach him to reduce that hernia. Hernias practically always eliminate a man in his physical examination.

There is little else to say in regard to the physical examination except that a man is rejected for such things as extensive varicose veins.

Flat Feet.—A great many men are rejected for flat feet, but not so many as formerly. Flat feet are not a cause for rejection, if they do the work as well as high arches. The thickset type of man often has flat feet. It has been found in the field that those men who have flat feet are likely to get along as well as men with high arches. The high arch might break down as soon as its owner gets into the field. This makes little difference, however, for in a month's time under good care he will have an arch that can hardly be broken down. He makes the best man after he is seasoned and hardened. So much for the physical examination. There are a great many errors to look for, and many are usually present, for the perfect man has never been found.

Mental Examination

The mental examination merits but little attention in these pages. One need have no fear regarding it. A dentist who can go before the examining board and present a diploma from a recognized dental school and a certificate from the state that he is a practicing dentist should pass the board almost invariably. That man has nothing to fear before the board of examiners. He may go before them and have an attack of nerves and not be able to tell his own name, but he is rarely rejected for that reason. The examiner realizes his condition. For that reason the average dentist should have no fear when he goes before the examining board. He should go before them squarely and do the thing that is asked quietly and easily; he need not be excited; excitement destroys a man's judgment so that he cannot do things right. The candidate who has had reputable dental training and who goes before the board willingly and calmly with the purpose of telling what he is asked to tell rarely fails to pass.

Having passed these two examinations, there is nothing for a man to do except to wait for the Government to appoint him as a first lieutenant in the Dental Reserve Corps. When the Government has need of him, he will receive his appointment. Later on a commission will come along, signed by the President of the United States, showing that he is a first lieutenant in the Dental Reserve Corps. He will ask, "When do I go into service?" No one knows when he will go into service. When the Government gets ready, the man will go. Where? Anywhere the Government sees fit to send him. There is no choice in the matter; one goes wherever he is sent. Of course it takes months and even years to make a full fledged military man, but the most essential points may be learned in less time than that.

TYPHOID INOCULATION

After the candidate has passed the mental and physical examinations, he is inoculated against typhoid fever. Those who have been fighting typhoid in the United States Army know the necessity for inoculation. When men are collected together in large numbers, contagious disease flies through them like wildfire. For that reason typhoid fever has been the scourge of armies. The prevalent method of inoculation is to inject half a billion, or a whole billion, of dead typhoid bacteria at weekly intervals, which usually gives the desired immunity against disease. Many people today, going on their summer vacations, take their typhoid prophylaxis for the reason that so many have died from drinking infected water and eating infected food. Most people are vaccinated against smallpox. By inoculating against typhoid and vaccinating against smallpox much has been accomplished to save men. The inoculation against typhoid is not, however, an absolute preventive. Last year there was a case in the hospital where a man had been inoculated perfectly and the doctor said it was a case of typhoid. It did not seem possible, yet in due time a pure culture of typhoid appeared. While in Mexico it is said that General Pershing sent up fifteen cases which were suspicious, all of which had true typhoid fever. Later there were found several cases of paratyphoid, all of which were mild. One should inoculate against paratyphoid in an area where paratyphoid exists. The prophylaxis for many other diseases has not yet been found. A great many cases of typhus fever were observed among the Mexicans, but by good sanitation, cleanliness and willingness to do the right thing, the disease was kept out of the army camp.

UNIFORM AND EQUIPMENT

The Uniform

The next thing to be considered is the equipment that a man should have in going into the field. It is probably well known that orders have been issued that no uniform shall be worn now but the service uniform, except in the White House. This applies to such organizations as the Ancient and Honorable Artillery, who are often seen marching through the streets in their dress uniforms. The dress uniform is slightly different from the field service uniform. The field service uniform consists of a pair of riding breeches and a blouse. It is the so-called O.D. (olive drab) uniform.

Payment for Uniforms.—In the first place, officers pay for everything. The enlisted man has everything given to him. An officer may borrow from the Government on memorandum receipts, so-called, a large list of supplies needed in the field. That means supplies are loaned but one must pay them back or send them back some day. If one does not, he will be charged with the item or items and must pay for them. Loss is no excuse. Any remnants are handed back and are of great value, because the remnant which one may hand back is worth just the same to the accounts as the original article. It is better to buy a good uniform and to always have that feeling that, if one wants to, he can look like a gentleman again. Get clothes that fit. There is a regular issue of clothing which is good enough for the field. After one has rolled around in the dirt, wrapped up in a poncho, he does not need white collars and cuffs. All this goes to show that there is a certain psychology of clothes in the Army. It is therefore advised that all who get their commissions should immediately go to a good tailor and have a first class uniform made. Then the enlisted man's uniform can be bought at cost price, and it can be made over by a tailor.

Horse.—Every officer in the medical and dental department is mounted. Everyone is supposed to get a horse. A horse is issued by the Government on a memorandum receipt. One must be sure to bring him back, because his value is stated in the book as $141.27, or whatever it may be. If one does not bring him back, he is not asked to pay for him; the authorities simply extract it from the man's salary and hand him the remainder.

Field Equipment

Next let us look through the list and see what an officer is to take into the field with him. One must have some sort of equipment whereby he can eat when he goes out into the field.

The official list, issued May 17, 1917, gives a table of things which an officer should have.

Saddle-bags.—Utensils are slipped into the saddle-bag, which is on the left-hand side of the horse. Every horse has a right side and a wrong side. He is not approached on the right side, but on the left side. That may be a way to help remember it. The saddle-bags hang behind the saddle, one on each side. In the nigh-side bag are the rider's equipments, and the horse's are in the one on the off side. The horse has extra shoes, curry-comb, brush, surcingle, watering bridle and a halter. Those are on the off side. One should not make the common mistake of approaching the horse on the off side.

Care of Horse.—If a horse has been brought up in the army, he has been taught by experience to take care of himself. That means he uses his mouth and his heels and he bucks and does a lot of things like that to take care of himself. If a horse is not acting normally, his rider can be sure that he needs food or water or some of the other essentials. His horse is a man's best friend in the service. One may need him for only half an hour, but when he does, it may be very badly. He must be approached on the nigh side; never riled; and it is necessary to see that he is fed and watered properly; that he is properly cleaned; and that the saddle fits correctly. A man must make a good friend out of his horse; for if he overlooks any of these details, he is pretty sure to be reminded some day, because the horse knows after a while that his rider is responsible for him. If the horse is not treated well, the rider is the only one he can notify, and he has only one or two ways in which he can do this.

Eating Utensils.—First there is a small can, costing twenty cents, in which to keep bacon. That can be put into the saddle-bag; next a condiment can, costing thirteen cents; then the canteen, price sixty-one cents. There is an aluminum canteen with screw cap top. It is a very good one. It is provided with an outside covering of felted canvas which protects the canteen in much the same way as a thermos bottle. To cool the canteen, the outside is wetted and the evaporation through the felt and canvas will cool the water. The canteen will not stand being rolled on by the horse. If rolled upon, it will bend, in which case, one must get a new one. One can always get a new for an old canteen, no matter how badly damaged it may be. An aluminum cup fits over the base of the canteen. That cup sells for thirty-five cents.

One has also to have a knife, fork and spoon similar to those used at home, but it must be said that they are similar only in shape and not quality or comfort. The knife costs twelve cents; the fork, seven cents; spoon, seven cents. They are a very efficient knife, fork and spoon, and for a while a man has a lot of exercise with them, more exercise than riding a horse. They are provided with a container in which they may be rolled quite tightly together and carried inside the saddle-bag.

Dismounted officers carry a haversack, which hangs by the side from a strap over the shoulder. As a mounted officer, one does not have the privilege of carrying that over the shoulder. The articles ordinarily contained in a haversack by a dismounted officer will be kept by a mounted officer in his saddle-bag.

First-aid Packet.—One thing that every officer and man must have is his first-aid packet. This is a little metal case, containing two compressed sterilized bandages with gauze streamers attached, safety pins, and a printed sheet of directions. This little package is carried on the left-hand side, slipped into a pouch. The matter of carrying this packet is watched by the Government very carefully. The inspecting officers look over each man's equipment, and make a very definite report, on four separate copies, of everything a man has not that he should have. Later he will hear from the authorities about it.

Pistol, etc.—The pistol holster and pistol are not necessary unless one is in the region where the rules of the Geneva Convention are not observed. There are portions of Mexico where one would probably have to have a pistol. It is a very desirable adjunct to the equipment.

Obtained from Ordnance Department.—All this property of which mention has been made is called ordnance property. And here the writer must begin to touch on something in regard to the part which the Departments play in army life. A dental officer is affected by the Ordnance Department, the Medical Department, and the Quartermaster's Department, and he may have accounts with all three. There is hardly any one subject in this whole course that is going to be so necessary for officers to observe as the subject of Departments. Just the moment an article leaves their hands, it is charged to the recipient. The onus of obtaining it is on him. From that time he is held responsible for this article until he gets a receipt for it. If he does not turn it back or does not find the proper way of avoiding loss, the value is subtracted from his pay. The articles before enumerated are entirely equipment from the Ordnance Department which each officer will need. Practically all of them can be obtained on memorandum receipt. Most men, however, prefer to buy them for cash at whatever supply depot happens to be nearest, and think no more about it. They then belong to the buyer. The Government price is so low that it costs but a moderate amount to buy them.

From Quartermaster's Department.—From the Quartermaster's Department one may obtain on memorandum receipt certain other articles which are more or less essential.

Mosquito Bar.—The first of these is the mosquito bar, price $2.29. It is said by one officer of the Medical Department that he never was among men of such high rank as on one trip in the Philippines when he went with a division with its headquarters on an excursion through one of the islands. He was the only officer who had a mosquito bar. They met a lot of mosquitoes of the malaria breeding kind. The result was that he lay at night under his mosquito bar with the head of a lieutenant general here and the head of a major general there; in fact, he was lined with the heads of officers. They only asked to be allowed to put their heads under the netting and they could let the rest of their bodies take care of themselves. The mosquito bar is very essential. It is nothing but mosquito netting which is suspended when one wishes to go to sleep. The top of the bar is spread about two feet above and the sides fall around the cot bed, if one has one. The mosquito bar is always ready for use. Generally in the summer time one will meet mosquitoes to which he will have to pay some attention.

Bedding Roll.—The bedding roll is some sort of canvas container in which one carries bedding and on which or in which he sleeps. There are a number of different kinds. The writer uses a piece of good heavy khaki canvas 9 ft. by 9 ft., and of course fellows who have been out a good many times have pretty definite ideas about what they ought to have. Nine ft. by 9 ft. is just the size of the floor of a wall tent. When the quarters are first made the bedding is all rolled up in this canvas inside the tent. The ropes are untied and a kick spreads it out to stay there for a tent floor. An officer gets a low cot bed. The cot is set up on one side of the tent, and the bedding is taken out of the roll. One first takes out the poncho, which is a rubber blanket, then the army blankets and usually nice white sheets and a pillow case when possible. A pillow should always be brought. There is nothing in the regulations about pillows. Oftentimes a martinet will decide that pillows are not a part of an officer's equipment, but they can be hidden. It is a good deal of comfort to get between sheets, so that when the bed is spread there is a very respectable looking tent. Generally the bedding roll is so made that a man may make a sleeping bag out of it. At the top and bottom are flaps which can be used as clothing containers. They keep the clothing flat and dry. These clothing rolls usually have a very thin mattress in them, and they are very comfortable indeed. When one breaks camp, he throws the clothing into the bags at each end, folds them in and rolls up the bedding all ready for the quartermaster's wagon to load it when it comes along. In the field an officer is allowed only 50 lbs. of bedding. When a man appreciates how small an amount 50 lbs. is, he will find it quite a problem to keep the bedding to the required weight. Eliminating the cot bed, the bedding roll will weigh 10 or 12 lbs. When it is considered that every single thing has to go into that roll, it is apparent that one has to figure pretty closely. For cold weather, a down puff weighs almost nothing, and it is twice as warm as any blanket. In the field one sees all sorts of officer's equipment. It is surprising to see how many makeshifts there are. An officer knows how to be comfortable through long experience, and does not always follow the idea of the Government. The Government bedding roll costs $6.52. The blankets one can borrow on memorandum receipt or buy from the supply depots for $3.08.

Basin and Bathing.—A canvas basin is necessary, which is much like a canvas bucket. That gives something to wash in. Speaking of bathing, it is a fact that the army officers often bathe of necessity in other liquids than water. There are places in Texas where there is no water within one hundred miles. There are places there where there is no record of rain ever having fallen. When water is found there is sometimes nothing but a hole with alkali standing in it, like snow, perhaps three or four inches thick. It is undrinkable, and there is nothing to do but start off for the next hole. Water is sure to be scarce in any campaign. City water cannot be piped to each tent. A division contains about 20,000 men on the march and a great number of animals. All these men and animals must be watered at least twice a day. The writer has seen a division watered when twenty-two cocks were running continuously for two hours, and even then the troops were not sufficiently watered. What is to be done with an army of 150,000 men? Where is the water coming from? In New England there are streams running everywhere. But in service, water *of any kind* is all one expects to get, in many places, so one carries water as best he can. The time to keep water is while on the march; when the march is over is the time to drink it. The writer has heard a horse with water thrashing around in his stomach; that is just what happens to a man if he drinks early in the march. When starting out on a long march in warm weather, water should be saved until the march is over.

It is well not to bathe too carefully in the morning, for the reason that one may wash off that oily secretion of the skin which saves from sunburn. It is not necessary to rub the hide off, but just to rub lightly with water, leaving on the oily secretion of the skin. When one finishes the march at night it does not take much to get a bath. The writer is known as the fellow who can shave, treat a sunburn, and bathe out of a bottle of beer and have half the bottle left to drink when he gets through. This seems like a fairy story, but if you think it over for a minute you will remember that though one cannot get any water, a bottle of beer can almost invariably be obtained. The writer has been on half a dozen campaigns where there was no water, but there was always a bottle of beer. No one knows how it got in, but it was always there. It can easily be seen that it does not take very much to wash in in the afternoon after coming in hot, dirty and tired, nursing that one bottle of beer and thinking what a good time was coming. A man can get out his toothbrush, put a little beer on the brush and clean his teeth thoroughly; he can then shave carefully; perhaps he finds he is somewhat sunburned; some of the beer can be very carefully rubbed into the face; then it is rubbed off with a towel; next he can strip off, and take a little of the beer in the hand and go over the body; then he can take a towel and rub down. There is half a bottle left ready to finish the job; and no idea can be formed as to how finely it tastes! That story has a moral. One can do a thousand and one things in military life that in civilian life he would think were impossible. The writer has been on the march when he thought he was going to fall the next minute. The thermometer stood at 120°; his head was spinning around, heat waves coming up before his eyes, but he survived. One must not be discouraged, then, at mere absence of water.

Sometimes it is necessary to eliminate much of the equipment. If not, the horse is liable to have saddle galls which are going to fester. A man must throw away practically everything to save his horse and himself. In hot climates, why should one need this stuff? Many officers have gone for weeks in the same clothes, washed them in some stream and then sat around on the bank and waited for them to dry and felt just as well afterwards. One learns to conserve a great many things on the march, and a great many situations will arise that are unforeseen.

Bed Sacks.—There are some other things which come from the quartermaster's department; for example, bed sacks. These are sacks filled with straw to make mattresses. These are not satisfactory, but are all that is provided for by the government.

Canvas Bucket.—A canvas bucket is very essential, and also a striker to furnish water. A striker is an enlisted man to whom an officer pays a certain amount of money to take care of him; to see that his clothes are in shape, clean his horse, and so on. The officer always pays that striker; he is not a servant furnished by the Government. He is a man with whom an agreement is made. That is a very important point. No enlisted man is a servant of an officer, but he may make arrangements with a man to do certain things. No servants are provided by the Government.

Lantern.—It is necessary to have a lantern, and one should by all means get one. If a man does not do so, about the time a light is needed he will find he cannot borrow his neighbor's, because the neighbor has only one. So unless one has a lantern, he will sit in the dark. The cost of a lantern is seventy-five cents.

Identification Tag.—The *identification tag* is a little piece of aluminum about the size of a quarter of a dollar with a hole punched through it. On it is stamped the name, rank, and the organization to which a man belongs. This hangs around his neck and comes down under the clothing. When the inspecting officer comes around, it must be shown to him. It is essential to have the tag on all the time.

Shelter Tent.—The shelter tent, complete with poles and pins, which rolls up into a very small package, costs $1.43.

Poncho.—Next one should have either a poncho or a slicker. A slicker is an oilskin coat; the poncho, a rubber blanket with a hole in the center, which can be used as a raincoat by sticking the head through the middle. For a mounted officer the poncho flaps too much. A mounted man should therefore wear a slicker, which buttons around in front, and the dismounted man a poncho. The saddles are always wet in the rain; a way has never been found to protect them.

Leggings.—A good pair of puttee leggings can be bought in any well-regulated shoe store. A good pair is of English pigskin. This type just wraps around the leg; there is nothing but a slit at the bottom where they slide together and then the strap holds them at the top. The writer advises getting the best pair to be found. They will be needed. No officer should wear enlisted man's leggings.

Underwear.—For underclothing, one can buy from the quartermaster: undershirts, price twenty-three cents; drawers, twenty-two cents; stockings, seven cents a pair.

Hat.—In regard to a hat, the service hat can be bought from the army for $1.04, and is just as good a cover in the field as any other. For a dress hat one can buy a Stetson for $5, in which the quality of felt is a little better. Officers have the habit of doing this. The coat (O. D.) similar to this costs $3.95; and a cotton coat costs $1.31. This completes the necessary equipment for an officer.

Leaving now the qualifications and equipment of the dentist as officer in the United States Army, let us next give our attention to the rules which govern him. The following are a few extracts from "Army Regulations" which is the Bible of the Service. They will show clearly what the dentist may expect and also what is expected of him.

ARMY REGULATIONS PERTAINING TO THE DENTIST AS AN OFFICER OF THE ARMY

There are two kinds of officers, commissioned and non-commissioned. A commissioned officer has his commission given him by the President, and that commission constitutes his authority to act. A non-commissioned officer is given a warrant.

Articles of War

The word "officer," as used in the Articles of War, shall be understood to designate commissioned officers; the word "soldier" shall be understood to include non-commissioned officers. The convictions mentioned thereunder shall be understood to be convictions by court-martial.

Courts.—There are three kinds of courts: general or special courts-martial and summary courts. For minor offenses men are taken before a summary court and for more serious offenses they go before a general or special court-martial.

ARTICLE 1. Every officer now in the Army of the United States shall within six months from the passing of this act, and every officer hereafter appointed shall before he enters upon the duties of his office, subscribe to these rules and articles.

ARTICLE 2. These rules and articles shall be read to every enlisted man at the time of, or within six days after, his enlistment, and he shall thereupon take an oath or affirmation, in the following form:

"I, *A. B.*, do solemnly swear (or affirm) that I will bear true faith and allegiance to the United States of America; that I will serve them honestly and faithfully against all their enemies whomsoever, and that I will obey the orders of the President of the United States and the orders of the officers appointed over me, according to the Rules and Articles of War."

This oath may be taken before any commissioned officer of the Army.

ARTICLE 3. Every officer who knowingly enlists or musters into the military service any minor over the age of sixteen years without the written consent of his parents or guardian, or any minor under the age of sixteen years, or any insane or intoxicated person, or any deserter from the military or naval service of the United States, or any person who has been convicted of any infamous criminal offense shall, upon conviction, be dismissed from the service or suffer such other punishment as a court-martial may direct.

ARTICLE 4. No enlisted man, duly sworn, shall be discharged from the service without a discharge in writing, signed by a field officer of the regiment to which he belongs, or by the commanding officer, when no field officer is present;

Field officers are officers of the rank of major or above, and that is a distinction one will frequently come across in the literature which will be read in regard to army life.

. . . no discharge shall be given to an enlisted man before his term of service has expired except by order of the President, the Secretary of War, the commanding officer of a department or by sentence of a general court-martial.

It is understood of course that the United States is divided into various districts. New England is in the Northeastern District.

ARTICLE 5. Any officer who knowingly musters as a soldier a person who is not a soldier shall be deemed guilty of knowingly making a false muster and shall be punished accordingly.

There is a list of the various men in the officer's hands which is called the muster roll. Mustering men means simply to see that they are all accounted for, that they have answered their names at roll call. The purpose of this article is to punish a man who puts a man's name on the muster roll when the man himself is not present, for the purpose of trying to cover up cases of desertion, etc.

ARTICLE 6. Any officer who takes money, or other things, by way of gratification, on mustering any regiment, troop, battery, or company, or on signing muster rolls, shall be dismissed from the service, and shall thereby be disabled to hold any office or employment in the service of the United States.

ARTICLE 7. Every officer commanding a regiment, and independent troop, battery, or company, or a garrison, shall, in the beginning of every month, transmit through the proper channel, to the Department of War an exact return of the same, specifying the names of the officers then absent from their posts, with the reasons for and the time of their absence. And any officer who, through neglect or design, omits to send such returns, shall, on conviction thereof, be punished as a court-martial shall direct.

All these various articles represent the charges which are put just above a man's name in conducting the court-martial. If he has violated one of these Articles, that is the charge brought against him.

ARTICLE 8. Every officer who knowingly makes a false return to the Department of War, or to any of his superior officers authorized to call for such return, of the state of the regiment, troop or company, or garrison under his command, or of the arms, ammunition, clothing, or other stores thereunto belonging, shall, on conviction thereof before a court-martial, be cashiered.

ARTICLE 9. All public stores taken from the enemy shall be secured for the service of the United States; and for neglect thereof the commanding officer shall be answerable.

ARTICLE 10. Every officer commanding a troop, battery, or company, is charged with the arms, accouterments, ammunition, clothing or other military stores belonging to this command, and is accountable to his Colonel in case of their being lost, spoiled, or damaged otherwise than by unavoidable accident, or on actual service.

ARTICLE 11. Every officer commanding a regiment or an independent troop, battery, or company, not in the field, may, when actually quartered with such command, grant furloughs to the enlisted men in such numbers and for such time as he shall deem consistent with the good of the service. Every officer commanding a regiment, or an independent troop, battery, or company, in the field, may grant furloughs not exceeding thirty days at one time, to five per centum of the enlisted men for good conduct in the line of duty, but subject to the approval of the commander of the forces of which said enlisted men form a part.

Those furloughs are given to men particularly for good work.

Every company officer of the regiment, commanding any troop, battery, or company not in the field, or commanding in any garrison, fort, post, or barrack, may, in the absence of his field officer, grant furloughs to the enlisted men for a time not exceeding twenty days in six months, and not to more than two persons to be absent at the same time.

ARTICLE 21. Any officer or soldier who, on any pretense whatsoever, strikes his superior officer, or directs or lifts up any weapon, or offers any violence against him, being in the execution of his office, or disputes any lawful command of his superior officer, shall suffer death, or such other punishment as a court-martial may direct.

Article twenty-one is very commonly used. That is one that dental officers will most have to watch.

ARTICLE 22. Any officer or soldier who begins, excites, causes, or joins in any mutiny or sedition, in any troop, battery, company, party, post, detachment, or guard, shall suffer death or such other punishment as a court-martial may direct.

ARTICLE 23. Any officer or soldier who, being present at any mutiny or sedition, does not use his utmost endeavor to suppress the same, or having knowledge of any intended mutiny or sedition, does not without delay, give information thereof to his commanding officer, shall suffer death, or such other punishment as a court-martial may direct.

ARTICLE 24. All officers, of what condition soever, have power to part and quell all quarrels, frays, and deserters, whether among persons belonging to his own or to another corps, regiment, troop, battery, or company, and to order officers into arrest, and non-commissioned officers and soldiers into confinement, who take part in the same, until their proper superior officer is acquainted therewith, and whosoever, being so ordered, refuses to obey such officer or non-commissioned officer or draws a weapon upon him shall be punished as a court-martial may direct.

It is one of the duties of an officer to stop any fights, rebellions or anything of that sort; and sometimes one succeeds with this, sometimes, unfortunately, not.

ARTICLE 25. No officer or soldier shall use any reproachful or provoking speeches or gestures to another. Any officer who so offends shall be put in arrest. Any soldier who so offends shall be confined, and required to ask pardon of the party offended, in the presence of his commanding officer.

This is a small thing apparently, but rather common. All these various Articles of War are written to maintain discipline.

ARTICLE 26. No officer or soldier shall send a challenge to another officer or soldier to fight a duel, or accept a challenge so sent. Any officer who so offends shall be dismissed from the service. Any soldier who so offends shall suffer such punishment as a court-martial may direct.

ARTICLE 27. Any officer or non-commissioned officer commanding a guard who knowingly and wilfully suffers any person to go forth to fight a duel shall be punished as a challenger, and all seconds or promoters of duels and carriers of challenges to fight duels shall be deemed principals and punished accordingly. It shall be the duty of any officer commanding an army, regiment, troop, battery, company, post, or detachment, who knows or has reason to believe that a challenge has been given or accepted by any officer or enlisted man under his command, immediately to arrest the offender and bring him to trial.

ARTICLE 28. Any officer or soldier who upbraids another officer or soldier for refusing challenge, shall himself be punished as a challenger; and all officers and soldiers are hereby discharged from any disgrace or opinion of disadvantage which might arise from their having refused to accept challenges, as they will only have acted in obedience to the law, and have done their duty as good soldiers who subjected themselves to discipline.

ARTICLE 29. Any officer who thinks himself wronged by the commanding officer of his regiment, and who, upon due application to such commander, is refused redress, may complain to the general commanding in the state or territory where such regiment is stationed. The general shall examine into such complaint and take proper measures for redressing the wrong complained of; and he shall, as soon as possible, transmit to the Department of War a true statement of such complaint with the proceedings had thereon.

ARTICLE 30. Any soldier who thinks himself wronged by any officer must complain to the commanding officer of his regiment, who shall summon a regimental court-martial for the doing of justice to the complainant. Either party may appeal from such regimental court-martial to a general court-martial; but if, upon such second hearing, the appeal appears to be groundless and vexatious, the party appealing shall be punished at the discretion of said general court-martial.

ARTICLE 31. Any officer or soldier who lies out of his quarters, garrison, or camp, without leave from his superior officer, shall be punished as a court-martial may direct.

The above is another common Article of War. It means that a man who is not in his quarters at night when he should be, is liable to punishment according to the Articles of War.

ARTICLE 32. Any soldier who absents himself from his troop, battery, company, or detachment, without leave from his commanding officer, shall be punished as a court-martial may direct.

ARTICLE 33. Any officer or soldier who fails, except when prevented by sickness or other necessity, to report, at the fixed time, to the place of parade, exercise, or other rendezvous, appointed by his commanding officer, or goes from the same, without leave from his commanding officer, before he is dismissed or relieved, shall be punished as a court-martial may direct.

ARTICLE 34. Any soldier who is found one mile from camp without leave in writing from his commanding officer, shall be punished as a court-martial may direct.

ARTICLE 35. Any soldier who fails to retire to his quarters or tent at the beating of retreat shall be punished according to the nature of his offense.

The beating of retreat is the last call before taps at night.

The above articles are enough to give one an idea of the Articles of War and how they apply to practically every offense. Unfortunately, it is necessary to familiarize oneself with all of these, because one is liable to have to prosecute others. Now it is hopeless, of course, to expect that an officer is going to know absolutely just what his duty is in every case. There are a thousand and one situations and circumstances in which he will not know exactly what to do. But the line of action in all these matters is laid down in the Army Regulations, and, in case of doubt, if possible one should look up the regulations. A man must find out just what his duty is every time.

After an officer is commissioned he will be given a certain set of books. Among these books are the *Army Regulations.* These must be read intelligently. It is a big task, but one must look to the "Bible" and see what there is in it that he ought to know. There is more in it than it is possible to tell of, but the writer hopes to give some idea of it.

All persons in the military service are expected to obey promptly all lawful orders given by their superiors. These orders should be carried out as nearly right as possible. Only lawful orders are obeyed. When a soldier or officer gets competent orders, if they are competent orders so far as he knows, he should carry them out and look up matters of doubt as to their competency afterwards.

Another thing which is very useful to know is that an officer of the Medical Department can exercise command only through his own department, but as a staff officer he can command all enlisted men as his officers may do.

Traveling.—There is some red tape in connection with officers traveling while on duty. If a person is traveling with troops the transportation will be cared for. If traveling alone, he can get from the Quartermaster a transportation request. If traveling on a mileage basis, he will be allowed mileage at the rate of seven cents per mile.

Adjutant.—Now a word will be said about the adjutant. The adjutant is a very good fellow to know. In fact, he is generally picked out because he is a student of military affairs, is a good fellow, a good mixer and has a good deal of tact and knows how to manage things. He always acts for the colonel of the regiment. All routine business is done through him, not through the colonel. One never should go to the colonel first on a matter of business, but to the adjutant, if one has any business to do in the regiment. The adjutant should be courteous and on friendly terms with all. He must show a great deal of discretion and be well informed on all subjects connected with army life. He is a very useful officer.

Senior Medical Officer.—In the medical department, when one first enters the service, he should frequently see the senior medical officer. When assigned to a regiment, a man is under the senior officer of that regiment, and if in trouble he should go to him.

Honors.—Now a word in regard to honors. This is very important, because it must be observed in daily life all the time. One acts up to his rank. Rank has its privileges. To a superior a certain amount of deference is shown at all times, and inferiors show one a certain amount of deference in turn. In the matter of saluting, a junior always salutes his superior. Among men holding the same rank, one always is superior or junior to the other, depending on how long each officer has held his rank. If both men had received their present commissions on the same date, but one had longer previous service, that man would outrank the other. One must always treat officers as gentlemen. It is a question of civility. A person is independent, but he must live up to certain customs; and when he salutes a man, it should be as a soldier, not slouchily.

Etiquette of Dress.—There is often nothing said in orders as to what a man shall wear on different occasions, but there is a little book which may be obtained which deals particularly with dress. This book tells what to wear on each occasion. Suppose a man has just joined his regiment and wishes to call on the Colonel. He does not know what the customs of this regiment are, but he would like to pay his respects to the Colonel as soon as possible. What uniform should he wear? He goes to the adjutant who tells the new officer what to do; that is his business. After being told what to wear, it is not well to call on the Colonel when he is having lunch but during office hours. In several cases an officer reported for duty while the Colonel was at lunch. The Colonel never turned round an inch but left him standing there at attention while he finished his meal at his leisure. It does not take long to teach a fellow in some such manner the right way of doing. If he did not do it in the right way, the Colonel would contrive some way to impress the proper method on his mind. One should make a social call on the Colonel and his family. The Colonel will probably be glad enough to see a new officer.

Salute.—In saluting one should always salute like a soldier, standing on the feet squarely; bringing the hand up promptly; looking serious about it; and waiting until the hand of the superior comes up. The instant his comes up the inferior's goes down. An officer or an enlisted man will judge a man by the manner of saluting about as quickly as in any way. If one salutes carelessly an opinion is formed right away of what kind of fellow he is. Of course he may learn better later. When a man is not on duty he greets fellow officers as gentlemen in civil life would. One thing to remember is that the commanding officer is the man for whom one is working and one is expected to do everything he can to help him. He is not doing it for himself or to help his record. Many times he may differ from his superior. The sanitary officer must inspect the camps afterwards if errors exist, and they usually do; he goes down and talks about it with the adjutant first. He may then have to talk with the commanding officer and begin to criticize his camp, but very diplomatically, and he will always meet with a responsive spirit. The officer must be just as polite about it as can be and very careful to say nothing to hurt the personal feelings of the commanding officer.

It is better not to write letters if one can help it. They are always on file and may come up to disturb a person later. If a man has to write letters he should put in them only the nicest things possible. Any communication to a superior officer is sent through his adjutant. All letters from the commanding officer conclude "*By order of the Commanding Officer,*" and are signed by the adjutant.

THE USE OF BLANKS IN THE PREPARATION OF REPORTS AND RETURNS

The subject of paper work in the Army is dry and yet very important, because what is not done right at first must be done over later. The first thing to do is, of course, to make oneself of permanent value to the service. In the service there are all kinds of men: courteous gentlemen, roughs, people with "swelled heads," and every sort of man that one ordinarily runs across in civil life. One need not be rebuffed by anybody. Things are taken as they come. The *Manual of the Medical Department* and the *Army Regulations* are the only authorities to control a person's actions, and he tries to follow them as closely as possible.

Dental Supplies.—The first thing required is the portable dental outfit, so called. The *Manual* has a chapter on dental supplies, which is indexed. That chapter tells what one should get; how to get it; and, generally, where it comes from; although one fault of the book is that it does not tell from whom to require these articles. A man is pretty safe if attached to an organization, as he can go to the highest medical officer in the organization. Generally a dentist will be in some division of troops, and medical officers are attached to every kind of outfit. Whatever the division, it has what is called a chief surgeon or the division surgeon. He is the person, then, under those circumstances, to whom all requisitions are sent.

Filling Requisitions.—If one knows what forms are used for these things, he gets out a field desk and borrows the first blank requisition forms, called *special requisition for supplies.* There are in three lines the words *Post Medical, Field Medical,* and *Dental.* The two headings that do not apply are crossed out. At the top are the words *Annual, Semi-annual, Emergency.* If one crosses out "Annual" and "Semi-annual" and leaves "Emergency," this implies *Emergency Special Requisition for Dental Supplies Required.* Next is put down the place of writing, the name of the regiment, for instance, *Fifth Regiment, National Guard of Massachusetts,* or whatever outfit one happens to be with. A man may not be with one regiment; he may be in a concentration camp. He is chief dental officer in such a regiment or such a concentration camp, and he puts those facts down. Then there is a place for the year, if the requisition is annual; for the quarter, if quarterly; or for the date, if emergency. This is fairly self-explanatory, if it is read with some intelligence. Forms should be as nearly right as possible; otherwise, they will be sent back. The space for the requisition is left blank. The same procedure is adopted on the front of the form. It must be found out from the adjutant how many officers and enlisted men he has. The hospital corps man goes to the adjutant to find out what the strength of the command is. The adjutant writes back "246 officers, 1,239 men," all of which is then entered on the top of the form.

Portable Outfit.—In securing the portable outfit a complete list will be found in Chapter 854 of the Manual. This covers about four pages and gives the articles required. In that list are a great many items. The requisition for a Portable Outfit must be made out. The necessity for the articles required is set forth under the heading of "Remarks." A statement is made that there is no outfit and that one is required.

Three copies are needed: one to be kept and two to be forwarded. All these requisitions go through medical channels. The senior medical officer asks whether or not the dental officer has required the portable outfit. The requisition is sent to him. He takes it, looks it over, and promptly sends the requisition to the brigade surgeon, who is thus notified that the doctor is commencing work, and the requisition goes along to the division surgeon. The division surgeon knows where the portable outfits are, if there are any in the vicinity, and he forwards the requisition to the supply depot, wherever it may be.

Blanks.—There is also a requisition for blank forms. When a man first goes into the service, he will have no blanks and may have to borrow at first. On a requisition for blank forms are listed all the blanks that an officer will have to have. Of course, one never can get them all, but he can get some or most of them. This is sent to the Surgeon General at Washington. A list is made of the forms wanted with the number of each that are required. In the first part are spaces for *Number Used in Past, Number on Hand,* and *Number Required.* In a month or so the kinds that are in stock are sent.

Receipt of Supplies.—When the supplies come, they will arrive with a check list, which is an ordinary check list of the property sent. It is turned over to an assistant, who will open the cases and sort the goods out. At the same time are received two invoices and two receipts by mail from the supply depot which fills the requisition. The invoices are signed by the depot, the receipts are to be signed by the recipient. The property that comes is checked up. A man must be sure he has it all and be on the alert himself. He has to sign for it and is responsible for every article.

Items.—There are two kinds of items, expendable and non-expendable. It is easy to tell whether an item is expendable or not, because the non-expendable items are in italics. Non-expendable items constitute the articles which must be accounted for, if lost or broken. Expendable items are not in italics, and when used up, are accounted for in reports by writing opposite the item *Expended.* In checking up non-expendable articles care must be used, for one is held accountable for them. A record of each one is kept separately, a monthly inventory is made, and the account is straightened out twice a year.

Invoices.—On the invoices and receipts which accompany supplies there is a list of all the property issued to the dentist by the depot. The form is marked *Return of Dental Property* in the brief, but on the top of the form it is called *Transfer of Dental Supplies,* which is the more proper name. It is a form which can be used for either an invoice or a receipt by simply crossing out *Invoice* in one case or *Receipt* in the other. The man at the depot will cross out the proper word. There is then a voucher or a receipt for dental supplies issued or received.

Transferring Property.—One must also know how to transfer property. On the receipt the name is signed, rank designated, and the post or command stated, whatever it may be. All vouchers are numbered serially, so that they can be referred to in reports as Voucher No. 1, Voucher No. 2, Voucher No. 3, and so on. The word "voucher" means nothing but a list of the goods which are sent. The first lot of goods will be accompanied by Voucher No. 1, the second lot by Voucher No. 2, and so on. These are kept together by means of an elastic band so as not to let the wind blow them away.

Listed Outfit.—In making out requisitions every article is itemized. Fortunately, there is a printed list. In the first part of the list under *Portable Outfit* are found: phenol, sodii carbonas monohydratus, etc.; under *Stationery,* eraser, examination blanks, ruler, etc.; under *Books,* Dental Materia Medica, Therapeutics and Prescription Writing, Dental Pathology, Therapeutics and Pharmacology (Burchard), Dentistry First Aid (Ryan), Handbook for the Hospital Corps, Oral Surgery (Brophy). Those books will come in the field desk, which is part of the outfit. Then there is a long list of *Instruments and Appliances.* In this are found: oak office case, for preparations; 18½-ounce glass-stopper bottles; corkscrews; dental engine with No. 2 slip-joint attachment; cables, etc. The *furniture* consists of a dental chair, which goes into a chest, and there is also a chest for dental engines, a special chest, an instrument chest for extractors, etc; a field desk; portable stands; a table, and a lot of miscellaneous material.

Now when a man has his property, he is supposed to receipt for it within thirty days or he is held responsible for it. Another thing should be noted. If property is invoiced to a man and he fails to receive it, he is still held responsible for that property. So if the property does not come he cannot sit down and wait for it, but must find out where it is. It may have been smashed up. He is responsible for it as soon as it leaves the depot, and it is his business to hunt for it. When one gets the invoices and receipts, and the property as shown on them, he signs the receipts. The invoices are already signed. The two invoices are held until the semi-annual return is sent. One of those invoices is forwarded with the semi-annual return to the Surgeon General, showing that one actually received the property. One of the receipts is sent to the depot or officer from whom the supplies came, and the other is sent to the Surgeon General. When this property is received one must not depend entirely on the invoices to keep an account of them, but the hospital corps man can keep a list, so that an officer has his list as well as the invoices, and if one of them goes astray there is the other. It is very important to pay a good deal of attention to the hospital corps man assigned as dentist's assistant. He must be made to do things right at first because after a while he is going to run the office. That hospital corps man must be carefully handled and must be carefully trained and made responsible.

Returns.—After having checked up the property and having seen that one has everything that belongs to him and having signed the receipts, he is ready to go to work. A return is made to the Surgeon General annually or semi-annually, as the case may be, of every article of property that one possesses. The hospital corps man may do this or one may do it oneself if he desires. It is a good idea to do it oneself. The return is sent in on a folder, which bears on the outside cover *Return of Medical Property*. Inside are a lot of instructions which must be very faithfully followed. Officers include in their medical property returns all property of the Medical Department which comes into their possession, except as otherwise expressly provided for in the regulations. Generally it is comparatively safe to put it all in. All property that comes into one's possession, no matter how, is put down. If one finds he has more property than he is charged with, he notes that fact down in the returns, because that is the property of somebody else who will have to answer for its loss and return of such excess may clear his account.

Each of these forms has its number. Most men in the service can tell the form number immediately. One asks for *Form 22,* or whatever the number may be. These property returns are sent in on *Form 17.* The back cover is called *17c;* the so-called "original return" is called *17a;* and the so-called "retained return," *17b.* The department does not bind these together; it leaves that to the officer. When the form is completed, the back cover goes down first; the blue sheet, *17b,* goes next to that, the white sheet, *17a,* next to that, and then the top cover is laid over the whole thing, binding it together through the perforated holes. If one has but one item, he must enter it both on a white and a blue form, making the blue form with carbon paper. On the returns the different voucher numbers are entered for goods that have been received, that is, one's own voucher numbers and not anybody else's. Opposite the expendable articles which have been used, one simply writes in *Are expended.* In the case of these articles an officer generally waits until the end of the year and then expends them at one time. There is nothing to stop him from doing that. That is generally the way it is done, only it is not wise to expend too much or there will be an inquiry. The department does check up the items but generally one does not bother with expendable articles. In the returns one enters as expended what he thinks he has expended, but it is well not to let one's imagination go too far. It is well to take an inventory of property occasionally. The blue sheets are retained between the covers for one's own files and the white sheets are forwarded to the Surgeon General semi-annually or annually as required. If there are any discrepancies, one will be asked to account for them.

There is also an annual requisition for dental supplies. This is not used in the field. In the field there is never any chance to use it. Only emergency requisitions are in use in the field, and these are practically the same as the invoice.

Appointment Form.—Next there is *Form 65,* which is an appointment form for a dental engagement. It is necessary to have thousands of them. It is a little blank form in which one puts the station and the date, and contains the following invitation:

> It is requested that ———, of ——— company, report to the dentist for examination at ——— o'clock.

Suppose one does not finish with a man in the given hour, and must carry him over to continue the treatment, he then applies to the adjutant of the regiment on the form provided for the purpose to have the man come again, giving him the date and the hour that he must return for treatment. Of course the dental officer retains copies so that he will know when the men are to report.

Dentists work in the army pretty much as they do in civil life. They start in about 8 o'clock and work until lunch time and come back and work in the afternoon. If men were applying for appointments practically all the time, the dentists would give as much time as possible to satisfy the demands of the men. When work slacked up, they would take an afternoon off. The appointment form is self-explanatory, although the request is never answered in writing. The adjutant simply sends the men. If they do not appear on time the dentist writes to the adjutant saying that such and such men did not appear as requested. It is the dentist's business to check the men up. If he did not, some man would soon be saying, "I know a soft way to get away and go down town Tuesday, Thursday and Saturday afternoons. Simply get an appointment with the dentist." There is nobody to check these men but the dental officer, and if they do not report, it is his business to check them up. The adjutant is informed that in response to the invitation the man did not appear. The dentist makes the request, and the adjutant directs the man to return and report. The word "direct" means a command. As a rule, the adjutant will back the dentist up in holding the men strictly to their appointments. When the patient arrives one must keep a register of the work done for him, and that register is called a register card. There is a register card in the medical department. The dental card is a little different.

Dental Cards.—The Manual devotes a chapter to the registry of patients. In this it is stated:

> 465. A register of dental patients will be kept on cards, Form 79, at every post or station attended by a member of the Dental Corps.
>
> 466. The case of every officer and enlisted man of the Army who is treated by the dentist will be entered in the register, a separate card being made for each period of continuous treatment. Upon the conclusion of continuous treatment in any case its card will be closed by appropriate entry in the "Results" column.
>
> Should it become necessary to discontinue the work on a case on account of the dentist's departure from the station the case will be closed on the card, making a record of the status of the work in the "Results" column.

The cards are kept in two separate files, the *current file* and the *permanent file*. The current file contains a record of uncompleted cases and cards are transferred from the current file to the permanent file immediately after their completion. The cards should be legibly written in black ink with pen or typewriter as may be most convenient. If the entry must be extended to the other side, a mark in parentheses (*a*) is placed and the card is turned over on the back; (*a*) is then written and the entry continued across the back of the card. This must be done very carefully. If one cannot get a complete remark in these columns, it is necessary to take plenty of room, to go as far as possible and then turn it over, prefixing with (*a*), (*b*), etc., and continuing the remarks.

Signing.—*The dentist shall sign or initial all dental cards.* That means just what it says. One must sign his name for every man treated. If not, the cards will all come back for correction. Alterations must be authenticated by the dentist's initials. If the typewriter hits the letter *a,* instead of the letter *s,* the change must be authenticated by initials. If a letter is rubbed out, it must be authenticated with the dentist's initials. Thus every change must be authenticated. The writer has had dozens of cards come back where the clerk had struck letters over, and has been asked to authenticate the changes, and he had to go over them and sign his name to every one of them, though the cards had been away perhaps for a month.

In making out the cards the patient's surname and Christian name are used. No middle name is written out; simply the initial is used. Otherwise the card will come back. The rank of each man, whether private, corporal or sergeant, or whatever it may be, is put in and entered under the word Rank. One must find out the company he comes from, what regiment or staff corps he belongs to, and enter that; the man's age is entered, and in writing ages the number of months is usually indicated in the form of a fraction, thus: *22 11/12 years;* his race is stated, whether white, black, yellow or brown; also where he was born and the number of years he has been in the service. All this is necessary to identify the man. At the bottom is the signature of the dental surgeon. When an officer or soldier comes who has been previously on the register, a new card will be made for the new course of treatment. This card is used only to carry the patient through the time the dentist is working on his teeth. When the treatment is finished that card is closed and transferred from the current file to the permanent file. At the end of each month a return is made so that the Government may know what has been done. It may be that a dentist is treating cases from his own regiment or from several regiments. In that case he may enter in his monthly report his own regiment and all detachments from which cases have come. All instructions should be read very carefully and carefully followed. If the form has been filled out improperly it will have to be done over. A record of the dental work required is made on such a form. It will be made and signed by the dentist. If no patients have been treated during the month, the report is made *No patients for treatment,* or, *No treatment was given at this station.* The report is then forwarded through medical channels to the brigade surgeon, then to the department surgeon, thence to the surgeon general, and eventually is sent back. The dentist must make out his report before the fifth day of the next succeeding month. If he does not, one of the chief surgeon's clerks will ask for the monthly return and ask to have it sent immediately. The chances are that the dentist was too busy to make it out or had forgotten it. But that fact cannot be stated in the return to the chief surgeon.

Contagious Disease.—It is necessary to be on the watch for signs of contagious disease. This is very important. The medical department often depends on the dentists when contagious diseases are coming up. Many diseases show themselves in the mouth first. Diagnoses of syphilis are made oftener by dentists than by any other men through the discovery of mucous patches in the mouth. The dentist should always be on the lookout for mucous patches. There may be mighty little syphilis in camp for a time and then there will be a few cases cropping up and those cases will get in before one has any idea where they came from. The writer had a cook sent him once—one of the greatest difficulties was in getting good cooking. The division surgeon was kept hunting all the time for a cook. Of course a lot of men get through and some come in with an efficiency record as a cook; that is, they were cooks in civil life, and may also have attended a school of instruction. This man came with an efficiency record. It was found later that he had been a waiter on one of the Fall River steamers. Two days after he came he had a little cold and he went to the doctor for treatment. The doctor happened to be a specialist on the nose and throat. On asking the man to open his mouth he saw a lot of mucous patches. The doctor was a hawk on mucous patches, so he took that man out of the cook house. He would have been doing the cooking had he not had a little cold and gone to the doctor to be examined. These things must be watched for. Bakers bake for the entire command and do wonderful work. The dentist must keep his eye on the bakers. He is the only man to check them up. At night they will get to town if they can and mucous patches must be watched for. When a case is of sufficient importance, a special report on it is made. The report should be written in black ink with a moderately coarse pen or typewriter. A duplicate of the report will be kept on file.

FIELD SERVICE REGULATIONS

Another book of interest to the army officer is *Field Service Regulations.* It contains facts and directions about field service and about actual warfare. Although it is concise, everything in it is of the greatest value for every soldier to know. If a man is going to take part in the game, to be one of the cogs in the machine, he must know all about it. Although this is not perhaps so necessary to dental surgeons, it is a mighty good book to read. In it is everything connected with warfare in the field, very concisely stated. To army dentists, as members of the Sanitary Service, the most interesting is the little chapter in this book relating to that service. This will be considered now in brief.

In the first place it is realized that every sick man, or a man with any disability, must be cared for; and the care of that man requires the attention of other men whose ability and work might be used to better advantage in helping the fighting forces in the field. So in the beginning when men are examined, those men who are disabled and who may be disabled are eliminated. For that very reason dentists now are becoming part of this great force to enable the army to have those men fit. In the field a man cannot pick out his food, and men need teeth; if they are going to be disabled through digestive disturbances they are going to be a handicap to the forces

One must realize in the fighting forces in the field that everything is mapped out and radiates from a central point, the base; that merely means where the campaign is being conducted from. Branching out from that are various lines called *Lines of Communication,* and the extremities of the line are fighting forces. Now there are various places on that line of communication that must be considered. In regard to the fighting forces, it is immaterial what they are doing; whether they are in the trenches or in open country, advancing or retreating, they have got to be cared for. Everyone knows the expression "An army travels on its belly." The men must live, and live well, and be physically as nearly perfect as they can be made. There are also their arms and accoutrements; that, however, is a matter that does not concern dentists much. The matter that most interests them is the line of Sanitary Service.

Temporary Care and Provisional Treatment of Sick and Wounded

Firing Line.—In the firing line each regiment or company has with it a certain amount of sanitary personnel; if an infantry regiment, it has about forty hospital corps men and four surgeons, and two dental surgeons. Now what do these men do on the firing line? Their business on the firing line is simply to get the wounded under cover and give them first-aid treatment. The present method of caring for wounds is very efficient, and until newer methods are installed, will be retained. No extensive operations are done on the firing line. A fractured jaw is simply supported and held in place with the bandage in the first-aid package; this is a strip of roller bandage gauze about five feet long, in the center of which is sewed a pad of gauze. That bandage is rolled up and enclosed in paraffin paper; in fact, two of those bandages are worn by each man; and in the package as well are safety pins and printed directions how to use it. Both these bandages are enclosed in a thin metallic container and it fits in a pocket in the belt. Every officer and enlisted man carries that first-aid packet; and in only a few years that first-aid packet has almost taken precedence over the revolver or ammunition. Each man must always have his first-aid packet. If a man can get a first-aid dressing on his wounds it will often save his life. The man is taught how to use it; he is supposed to apply it himself, or a neighbor on his left or right will apply it. There is no waste of hospital men going into No Man's Land and putting on dressings. Everyone knows that the great mortality among medical men has been due more to absolute carelessness than to any other cause. Men lose their reason on account of their sympathy and send doctors into a fire-swept zone to bring in wounded. Now one must be hard-hearted enough to leave those wounded men until night comes or until the firing slackens. It is well enough then to have hospital men and medical officers where they can give all the treatment they may in the circumstances where the men are found; it is well enough to give them all the medical assistance one can; the men need that assurance to keep their morale. The dressing station is established as close to the firing line as is consistent with comparative safety from the fire; at best from rifle and machine gun fire and, of course, from heavy artillery fire. At the firing line, then, there is this regimental aid; then another zone of medical assistance is immediately in the rear, covered by the ambulance corps.

Ambulance Line.—It does not make any difference what the shelter is,—a swale in the ground behind some rocks, any shelter where one can collect and bring the wounded; and this is often a hard job. It is a well-known fact that about nineteen out of twenty shots go over the top of the firing line. For that reason immediately in the rear is a poor place to be, and it is difficult many times to find shelters for the wounded; but one does the best he can.

Now, as has been said, the ambulance corps is the second zone of medical attendance. It is composed of a number of ambulances, litter bearers, and a dressing station. The first party to go out is the litter bearer section. It goes out from the rear and comes in contact with the regimental aid station. If in the rear of the firing line the commanding officer of the Ambulance Company finds a place sufficiently sheltered to care for these wounded men in temporary shelter, he establishes a dressing station; his little pack mules come up with the necessary equipment. There he adjusts the dressings that have been put on by the regimental party and stops unnecessary bleeding; but there he does no surgery that he can avoid. There he collects the wounded until later he gets an order to transmit them to the field hospital. In his dressing station he does whatever emergency surgery he must do and gives the wounded hot soup, etc., to get them into shape to be transferred to the field hospital.

Field Hospitals.—Next comes the third line of medical assistance, the field hospitals. These are established outside the zone of firing, in the nearest place where surgeons may with a reasonable degree of coolness and comfort do major surgery and do it well. One cannot do such surgery while shells are exploding around the hospital. So the field hospitals are established outside the zone of artillery fire and as close to the front as they can be safely placed. There one does such major operations as are necessary. There the wounded are held temporarily until they are tabulated.

Evacuation Hospitals.—Then there is another line of sanitary service which consists of evacuation hospitals. They are on the line of a railroad if there is one, or on the line of a river. These naturally are larger than the field hospitals, but are of practically the same type and equipment.

At the base there is another system of hospitals called base hospitals, where those men who are going to get well are held and when entirely recovered are sent back to the trenches; but from the base those who are injured permanently are sent to their homes or hospitals near their homes as soon as it is safe to move them.

At any of these places the dental surgeon may be assigned to assist; it is reasonable that he should. His work in the future will not be so much filling the teeth, but repairing these face and head wounds. Shots are mostly in the head and face. For that reason the dental surgeon is going to be of the greatest assistance.

Sanitary Equipment.—One of the other services of the sanitary department is the supply of sanitary equipment. This means that not only must the army enlist, equip, train and send to the front hospital corps men, but that it also must obtain and send forward the necessary medical, surgical and sanitary supplies that are constantly needed.

Pensions.—Another thing to remember all the time is that in many instances the dental officer is going to be the one man who decides whether a disabled soldier receives a pension or not. As a basis for every claim is this question: "*Was this wound received in line of duty?*" and one must state on each register card that goes through his hands whether the wound was received in line of duty or not. The dentist must generally judge by what he sees of the wound. One is apt always to err in favor of the man; and "in line of duty" not only means that he was hurt in active duty but even perhaps in playing a baseball game. When it is not in line of duty is when it was received in a manner not proper. Many men receive sicknesses from things which they have done which they should not have done; indiscretion is the word that perhaps covers it. That is not in line of duty, but in all other things one can err in favor of the man. That is a proper thing, even though it is in playing ball or stealing a ride on the railroad train.

General Sanitation

Now, again, members of the Medical Department are all disciples of sanitation. Everyone must realize the importance of the most perfect sanitation where men are living together in such close community as in a soldier's life. One reads in the newspapers now of the ravages of disease among these men. There has been much said lately about conditions at Commonwealth Pier and at Newport. We are constantly hearing about conditions at camps, where men are attacked by some transmissible diseases, and it is no small task to stop these diseases. For this reason, as was suggested earlier, one must be on the lookout all the time for transmissible diseases, and if any question at all comes up the case must be reported. A man's duty is done when he reports it. This came home to the writer in recent experiences in Texas, on the border. The camp was in an area filled with typhus fever, with typhoid fever, with dysentery, and with syphilis.

Contagion in Camp.—Among the Mexicans in that region every other person has syphilis. Typhus wipes out whole communities, though it is transmissible only by the body louse. As fast as one of these cases appeared in the hospital the doctors flew at it like dogs and stuck to that case and took all the precautions they could to stop the spread of it. A case of amebic dysentery perhaps appeared in camp; the man had a little diarrhea and was not able to do his duty, just as with any other dysentery. Unless his stools were examined for the amebas, one might never know that he had amebic dysentery, until through the medium of the patient's excreta, through flies, and through the doctor's sins of omission, a general infection of the camp had occurred. In that region one could open a lunch box about five miles away from any habitation, even a mile in the air on top of Mt. Franklin, where there is not a particle of moisture, and in ten minutes that box would be covered with flies; and flies are the greatest transmitters of intestinal diseases, practically the only source. One must all the time be on the watch for these diseases. The dentist is part of the Medical Department, and nothing is so disheartening as feeling that through carelessness something has been allowed to spread, or that a life was lost; in military life a thing like that sticks. Medical officers are constantly under that strain in the field. The writer has heard enlisted men say they would "shoot that doctor in the back" as soon as they had an opportunity; and usually there is some reason for such utterances. Life is not always rosy in the field; it is real, hard work; it requires mental balance and a constantly aggressive spirit to stop these diseases. If a man does not remember the underlying principles all the time, he is going to feel very humiliated when somebody criticizes him for being careless and allowing something to get by that he should have then and there stopped.

Commanding Officers Responsible for the Sanitary Conditions That Exist in Their Command.—That means the commanding officer of the regiment, of the company. The dental officer has no authority to enforce sanitation; he is there only in an advisory capacity, and he advises that certain things be done, otherwise dire results will follow; but he must be able to show the commanding officer that this situation confronts him; and one may be sure that the officer in command is just as afraid of anything breaking out in his regiment as his advisors are and he is going to take every care of those troops if he can. But he does not want to take a lot of unnecessary precautions and must be shown, and always can be shown by a capable medical man. As has been said before, it is unwise to write official communications when one can possibly avoid it; but if it is necessary to do so, the story must be stated absolutely in the body of the letter; not exaggerated or minimized, but put down just as it is. When a medical or dental officer finds a commanding officer who is a little careless about following these recommendations he may have to write him every day. At the first opportunity, instead of going over his head, it is the writer's practice to get him alone where no one can overhear the talk. He may prefer all the charges he wishes with no witnesses, but if he can get the commanding officer out in the middle of the night and do no more than impress upon him the fact that he is absolutely in earnest, it is worth while. The doctor can tell him that if disease comes it will be the commanding officer's fault. The medical officers must be listened to; their word today is law in the Army, and what they recommend the line officer must live up to. There are officers who do not care a rap for the medical men, but they have not the nerve to refuse to do what is suggested, and they will do it. If an epidemic occurs after disregard of the advice of the medical man, the commanding officer's efficiency record, of which each one is proud, immediately goes to smash; on that is stated the fact that in spite of advice from the medical officer he allowed certain conditions. Generally, however, medical officers are the most tactful men; they encourage the best of feeling with their commanding officers; but if it ever comes to an issue they can fight just as hard, and with medical education usually fight much more cleverly than the commanding officer in sanitary matters.

The Sanitary Inspector.—Sanitary inspectors are staff officers attached to a division who check up the work of the medical or other organizations and report the results of their inspections. It is necessary to have a check on everything. Where one medical man is found efficient, another may not be; both may be good fellows, but their work may not be equally efficient. For that reason the sanitary officer checks it.

Service in Camps.—An infirmary is nothing but a tent, maybe two tents, with an ordinary amount of sanitary material and a man in charge of the whole. To this point the medical men may bring their wounded and leave them if necessary, if they are slightly indisposed. The more important cases are transferred, on a transfer card, a copy of the register card, to some more permanent organization in the rear, where they may be properly cared for. If the camp were suddenly flooded with a lot of cases, they would be sent to the field hospitals if no permanent hospitals were available.

The ambulance corps have their ambulances, and not only ambulances but wagons with mules, in which they store their canvas and supplies, and they move along behind the fighting troops in general; behind them are the field hospitals, which are nothing but tents with medical personnel, bedding and equipment. As the forces go ahead the ambulances and field hospitals follow in the sanitary train, in which are certain supplies for the front and all those outfits which are kept packed to be ready for immediate use. If a building is found a field hospital is set up there. The men are put under cover anywhere rather than under canvas; canvas equipment at best is dirty and cold, and tents are never used if better shelter for the sick and wounded can be obtained.

Non-combatants.—Every member of the medical department wears on his arm a red cross, so in the field service dentists will wear that badge all the time. That shows that they are non-combatants and are entitled to all the respect and consideration that the Geneva Convention gives to that class. There have been two great conventions, the Hague Convention and the Geneva Convention. The Hague Convention has to do with the fighting troops, the Geneva with others; and it is well worth while to consider their deliberations. If any army is operating in the vicinity of a neutral state or power, all those wounded may be turned over to this neutral power to be interned until the end of the war. In the Middle Ages they used to sweetly and calmly despatch those who were wounded, and even with the advice of the surgeon who accompanied the army. Today in Mexico much the same thing takes place; and if one can give credence to what one hears of matters in Europe today, the Apache Indian in his palmiest days committed no more excesses than are committed in Europe now.

Red Cross.—If an officer is in the field and puts up a red cross flag and a battery commander puts a battery up and commences to fire, the red cross flag is torn down. One must not by any chance deceive the enemy by the use of that red cross flag; and care must be taken that nobody takes advantage of the sanctity supposed to surround it.

PERSONAL EQUIPMENT

Field Service Uniform.—The field service uniform is chiefly a flannel shirt and breeches, and, depending on the weather, one may add a sweater or jersey. The shirt is made out of very heavy wool and the jersey is sleeveless. It is a very comfortable outfit. The hat is a campaign hat with a stiff brim with a strap and a cord around the crown. This officer's cord is a mixture of gold and black, and is not the general officer's cord, which is a solid gold braid of the same sort. The strap insures its staying on while riding or under almost any condition. The brim, being stiff, is not always flapping up and down. In very hot weather the brim gives good shade and the hat is comparatively cool.

Field Glasses.—There are one or two other things: field glasses and also what is called a map case. These are very essential for the reason that an officer often gets orders to be at a certain place at a certain time, and unless he knows where the place is on the map, he is liable not to get there. He has to have the power of observation developed to a high extent, so he carries field glasses. It makes no difference what kind he carries. There are hundreds of kinds in the market. The high priced ones are generally the ones with large magnifying power and wide fields, but the cheaper ones are most serviceable. If the horse rolls over a cheap pair they can be twisted back into shape again, which could not be done with a better glass. One should never buy a pair of glasses of so high power that the image trembles. It is not essential for a medical officer to buy glasses, but he is supposed to have them; and a fairly cheap pair, with good illumination and with magnifying power, are more or less undistortable.

Map Case.—It becomes necessary, of course, in finding the location of certain places, to orient oneself, that is, find out where one is. For that reason a map case is carried. In this is a military map which is folded to show that portion that one wants to use. The case is provided with a celluloid cover which protects the face of the map. Notes can be made on this celluloid over the map. One picks out the place on the map where he is located and orients himself by use of the compass which is mounted at the top; this is swung around till north points to north. For instance, a man's normal stride is 30 inches, and he takes 120 steps a minute. In this way he can estimate the distance he has traveled and find out where he is by comparing it with the scale at the bottom of the map. If he is on horseback, he knows the pace of the horse, how far he travels at a walk, how far he travels at a trot, and how far he travels at a gallop in a certain space of time. This is the way orders come: "350 yards south T. P. Butte." One turns to the map and finds the spot marked T. P. Butte. All the elevations are marked on the map, so one knows how high he is. He simply watches the compass and draws lines on the map as he goes along. It is a simple matter to orient oneself properly. When one gets to the place where he should be, he consults the map and proves the location to be true. Then he may have to report back that he has reached the place. He may have to make a sketch of the location, so that he can send back word not only that he has reached the spot, but some information as to what sort of place it is. In this information is included anything which he may have seen and which he thinks the commanding officer ought to know. If it is a sanitary situation that a person is to take up, he must make certain notes on the sanitation. Therefore a map is indispensable.

The pistol is strapped against the officer's leg so that it may be drawn easily and will not keep flapping up and down while riding; otherwise it would soon gall the leg. Pistols are not ordinarily carried by Medical Department men, except on such service as the rules of the Geneva Convention do not apply to, where it is necessary for the officer to protect himself. The pistol is a .45 caliber, automatic, very close shooting. One can shoot at 200 yards and make good targets, allowing for elevation. The shells are held in a clip in the breech, that is, an empty clip. The cartridges are sent into place by the recoil. A person can fire very fast and very effectively with such a weapon. The cartridges which are used in the gun are carried in the clip container. Back of the cartridges is a spring which shoots them into place. The clips are kept where one can get hold of them.

The first-aid packet is kept in a little pouch where one can get at it easily and contains two sterilized pads, a roll of gauze, safety pins, etc. On the packet is a little ring. The finger is put in the ring, which is pulled, and the packet opens like a can of sardines.

The flannel shirt is the best one to wear in either winter or summer. In the summertime it protects from the sun's rays and absorbs the perspiration. One should under no circumstances in hot sunlight strip down to the undershirt. Some woolen goods should be kept on to protect the skin. In hot climates it is essential to have sun glasses, no matter what type, otherwise the glare of the sun and the dust will ruin the eyes in no time, so that one cannot see anything. The officer must always carry glasses.

The breeches for use in field service are to be chosen mainly for comfort. Old breeches should be used in the field, a comfortable pair with plenty of looseness around the hip. Ready-made clothes do not fit or feel well. It is better to have them made by a tailor. A comfortable pair of riding boots is the proper thing. No man ever appears without spurs on his boots.

Miscellaneous Information

Saluting.—There are certain exceptions in the matter of saluting. A man eating does not salute or stand at attention. A man working does not salute. A man occupied with his ordinary work never stops to salute anyone. Even soldiers at work do not stand to salute an officer if they are preoccupied with some duty or busy hustling along with a couple of bundles in their arms. The reason is perfectly evident. The man is busy and his arms are occupied. It would almost be analogous to a soldier on the firing line stopping firing on seeing an officer. It would be farcical. The customs of the service enter into every question of that sort, and one often sees jokes in the papers about it. The salute is different from what it was twenty years ago. The right hand is always used, bringing the arm sharply to position, taking the shortest distance the hand can travel from the head to the hip and holding the hand there until the salute is recognized, when the one first saluting brings his hand down.

Books.—There are four important books in connection with army administration: the *Army Regulations,* which covers more than all the others together; a *Manual of the Medical Department,* which controls professional life; the *Field Service Regulations;* and there is still another which deals with general orders, circulars and bulletins of the War Department. This latter is apt to be changed.

In regard to orders, one gets from the War Department general orders, which relate to big things; special orders, which relate to individuals particularly; bulletins and circulars, which relate to opinions particularly, some kind of property that should be issued, or the way in which it should be issued. An officer not only gets orders, circulars and bulletins from the War Department, but he gets some from the Militia; some from the State of Massachusetts and some from the Medical Department. It is difficult therefore for an officer to get the right order or the right circular or the right bulletin to apply to each individual circumstance or case that comes up. Most of the National Guard officers have been complaining against that kind of red tape and are trying to simplify things. It is desired to cut out this mass of red tape that keeps everyone tied up all the time. The officers want to have one set of orders and have only that portion of the order sent that refers to the particular business on hand. An officer wants his own orders concerning his own business with the rest eliminated. However, the War Department is now planning to issue a single set, and to eliminate anything that does not concern particular department work. It cuts out all the bulletins and circulars. The authorities in Washington are beginning to lop off the branches of the great tree of red tape, and it is hoped that they will prune it well.

Getting Settled in Quarters.—The new medical officer reports to the colonel as soon as possible. The colonel will introduce him to the officers of the mess, and to his own family if he has one. Whenever the colonel implies that he wants a certain thing done it is necessary to do it. He rarely will say, "do such and such a thing." The medical officer gets an order stating that "The colonel desires so and so." After having made the regulation call, naturally one thinks about his quarters, because his trunk is somewhere on the road. The quartermaster is the man who has charge of all the transportation. The new officer introduces himself and says, for instance, "Captain Smith, I am Lieutenant ——— of the Medical Corps, assigned to this regiment, and I have a trunk somewhere on the road." He may then mention that he needs a place to sleep in. It is the business of the quartermaster to send somebody after the new officer's trunk, to find quarters and make him comfortable. He may not be able to get the trunk or to find quarters, but he will see that the medical officer is made comfortable until the quarters are ready. The 9 ft. by 9 ft. tent is set up and the person takes possession and proceeds to make it look as homelike as possible. When the bedding roll comes the cot bed is set up, the clothing put on it and after the trunk comes a line is hung up from one pole to another, to hang the clothes on. Or one may have one of these patent combination racks with hooks around the pole. Usually both are necessary, because more or less clothing accumulates after a while. The tent flap is raised to get light and air and a place is found to hang the lantern. It is always inconvenient, when the shades of night are coming on, to have no light.

The new man will then be introduced to the various officers; they will invite him to take a drink or have a cigar, and life will start off properly. There is no drinking now and the cigars are getting poorer every year, but the men are comfortable and happy and like the life. One can soon size up some fellow as being likable and cultivate him. Generally the gruff type are the best hearted and the best soldiers. If some fellow just looks at the new arrival and moves on the latter need not be rebuffed.

After a while he will appreciate good soldiers, not so much for their social as for their soldierly qualities.

One salutes the colonel when approaching him and when leaving. The new man gets up on his feet, throws his chest out, and starts. The colonel will say, "There goes a good soldier." The first impression is important. Whatever a man does, he never comes into camp with an umbrella over his head. If a new man is ordered to report before he has a chance to get his uniform, he reports in civilian clothes, apologizes and explains that he had no opportunity to equip himself. Perhaps he feels he is making a breach of etiquette, but he explains that he is green at the game.

The proper way of terminating a conversation with a senior officer is to leave as soon as convenient. The colonel will ask the new officer to sit down. He will ask where he came from, whether he has any equipment, or something pertaining to his arrival in the regiment. The minute one finds the conversation beginning to flag the least particle, he should stand up promptly and terminate the interview with some sentence like "Well, Colonel, I think I have taken up enough of your time, and if you will pardon me I will leave." One thing noticeable in the Army is that most of the senior officers are more of the social type than of the fighting type, although many are of both.

Rubber Boots.—Rubbers are not commonly worn but it is a good thing to add rubber boots to the equipment. One should never go into the field without having rubber boots and a rubber blanket. The writer has been out on horseback with rubber boots for two days in blazing sunshine. He rode in his stocking feet but never gave up those boots. In weather which is liable to be wet rubber boots should be most certainly worn because if not the feet get wet, one is soaked, cold and shivery and there is no opportunity to get dry. A whole regiment may go into a camp on a field with the grass almost covered with water. The men simply spread out their rubber blankets, splash down into them, and go off to sleep.

The present chapter is designed to instruct the medical or dental officer on necessary points in field service, but if a man wants to know anything after going into camp he must go to the adjutant or to the senior medical officer for further information.

CHAPTER XVII

HISTORY OF MILITARY DENTAL LAWS

FREDERICK A. KEYES, D.M.D.

The United States was the first country to recognize the importance of a Dental Corps for its army. A brief history of the rapid advance made by the Dental Corps may be obtained by reading the following extracts of various bills which have been introduced from 1901 to 1911 and from 1911 to 1916.

For much of this information the author is indebted to Lieut. S. D. Boak, U. S. D. C.

Extract No. 1 is the original law establishing a Dental Corps in the United States Army. This corps, as can easily be seen, was made up entirely of contract dental surgeons who were not commissioned officers. From 1901 to 1911 various bills were introduced into Congress each year, to give the Dental Corps a commissioned personnel, but without success.

ORGANIZATION OF THE MEDICAL DEPARTMENT

Extract from Act of Congress Approved February 2, 1901

This act provided:

> That the Surgeon General of the Army, with the approval of the Secretary of War, be, and is hereby, authorized to employ dental surgeons to serve the officers and enlisted men of the Regular and Volunteer Army, in the proportion of not to exceed one for every one thousand of said Army, and not exceeding thirty in all. Said dental surgeons shall be employed as *contract dental surgeons* under the terms and conditions appli-

cable to Army contract surgeons, and shall be graduates of standard medical or dental colleges, trained in the several branches of dentistry, of good moral and professional character, and shall pass a satisfactory professional examination:

That *three of the number of dental surgeons to be employed* shall be first appointed by the Surgeon General, with the approval of the Secretary of War, with reference to their fitness for assignment, under the direction of the Surgeon General, to the special service of conducting the examinations and supervising the operations of the others; and for such special service an extra compensation of sixty dollars a month will be allowed:

That dental college graduates now employed in the Hospital Corps who have been detailed for a period of not less than twelve months to render dental service to the Army and who are shown by the reports of their superior officers to have rendered such service satisfactorily may be appointed contract dental surgeons without examination.

The following extract is from the law establishing a commissioned personnel for the Dental Corps, which, however, limited the number of commissioned dentists to sixty. The law of 1911 gave dentists only one commissioned grade, that of First Lieutenant. From 1911 to 1916, again, various bills were introduced to secure additional grades.

FORM 142

WAR DEPARTMENT, SURGEON GENERAL'S OFFICE

(*Revised July 2, 1913*)

CIRCULAR OF INFORMATION

In relation to appointment in the Dental Corps of the United States Army; the requisite qualifications, examination of applicants, etc.

The act of Congress approved March 3, 1911, establishing the Dental Corps of the Army, is as follows:

Hereinafter there shall be attached to the Medical Department a Dental Corps, which shall be composed of dental surgeons and acting dental surgeons, the total number of which shall not exceed the proportion of one to each thousand of actual enlisted strength of the Army; the number of dental surgeons shall not exceed sixty, and the number of acting dental surgeons shall be such as may, from time to time, be authorized by law. All original appointments to the Dental Corps shall be as acting dental surgeons, who shall have the same official status, pay, and allowances as the contract dental surgeons now authorized by law. Acting dental surgeons who have served three years in a manner satisfactory to the Secretary of War shall be eligible for appointment as dental surgeons, and, after passing in a satisfactory manner an examination which may be prescribed by the Secretary of War, may be commissioned with the rank of First Lieutenant in the Dental Corps to fill the vacancies existing therein. Officers of the Dental Corps shall have rank in such corps according to the date of their commissions therein and shall rank next below officers of the Medical Reserve Corps. *Their right to command* shall be limited to the Dental Corps. The *pay and allowances* of dental surgeons shall be those of First Lieutenants, including the right to retirement on account of age or disability, as in the case of other officers:

The time served by dental surgeons shall be reckoned in computing the increased service pay of such as are commissioned under this act. The *appointees* as acting dental surgeons must be citizens of the United States between twenty-one and twenty-seven years of age, graduates of a standard dental college, of good moral character and good professional education, and they shall be required to pass the usual physical examination required for appointment in the Medical Corps, and a professional examination which shall include tests of skill in practical dentistry and of proficiency in the usual subjects of a standard dental college course:

This applies to the contract dental surgeons in the service at the time of the passage of this act, whose efficiency reports and entrance examinations are satisfactory.

The Secretary of War is authorized to appoint boards of three examiners to conduct the examinations herein prescribed, one of whom shall be a surgeon in the Army and two of whom shall be selected by the Secretary of War from the commissioned dental surgeons.

The next extract shows the House bill, part of which was finally enacted as the National Defense Act of June 3, 1916. In the *Sixty-fourth Congress, First Session, House of Representatives 12766, Report No. 297,* line 14, Mr. Hay, from the Committee on Military Affairs, reported the following bill, which was referred to the committee of the whole House and ordered to be printed:

A Bill to Increase the Efficiency of the Military Establishment of the United States

Provided: That hereafter the Dental Corps of the Army shall consist of the number of officers in said corps now provided by law, and that there shall be thirty-five captains in said corps; that appointees to the grade of first lieutenant in said corps shall be not less than twenty-two years and not more than thirty years of age; and that promotion to the grade of captain, herein provided for, shall be subject to an examination before a board consisting of not more than three officers of the Medical and Dental Corps of the Army, to be appointed by the Secretary of War; and that the captains provided for in this Act shall be appointed from the present members of the Dental Corps who have had five years' service in said Corps.

The following extract is the amendment introduced by Senator Pomerene to Senate bill 4840, which embodied the above grades. In the *Sixty-fourth Congress, First Session,* Senate 4840, in the Senate of the United States, March 22, 1916, was ordered to lie on the table and to be printed and an Amendment proposed to Defense Bill. On page 12 of the former bill the paragraph commencing with line 16 and ending with line 7 on page 13 is struck out, and in lieu thereof the following is inserted:

The President is hereby authorized to appoint and commission, by and with the advice and consent of the Senate, dental surgeons at the rate of one for each one thousand enlisted men of the line of the Army. Officers of the Dental Corps shall have the rank, pay, and allowances of First Lieutenants until they have completed five years of service, when they shall be eligible for promotion to the grade of Captain. Officers of the Dental Corps, after fifteen years of service, shall be eligible for promotion to the grade of Major:

That the number of majors at no time shall exceed twenty-two per centum of the strength of the Dental Corps:

> That the officers of the Dental Corps shall have the rank, pay, and allowances, including the right to retirement on account of age, service, or disability, as officers of like grade in the Medical Corps of the Army, and that service heretofore rendered as contract dental surgeon shall be computed as commissioned service:
>
> That promotion in the Dental Corps shall be governed by Act of April twenty-third, nineteen hundred and eight, section five, as prescribed for the Medical Corps, except that the examining and review boards shall consist of one medical and two dental officers.

The bill as it was passed and finally enacted into law is shown below. In the National Defense Act, June 3, 1916, Section 10, pertaining to Medical Department, it was enacted that

> The President is hereby authorized to appoint and commission, by and with the advice and consent of the Senate, dental surgeons, who are citizens of the United States between the ages of twenty-one and twenty-seven years, at the rate of one for each one thousand enlisted men of the line of the Army. Dental surgeons shall have the rank, pay, and allowance of First Lieutenants until they have completed eight years' service. Dental surgeons of more than eight but less than twenty-four years' service shall, subject to such examination as the President may prescribe, have the rank, pay, and allowances of Captains. Dental surgeons of more than twenty-four years' service shall, subject to such examination as the President may prescribe, have the rank, pay, and allowances of Major:
>
> That the total number of dental surgeons with rank, pay and allowances of major shall not at any time exceed fifteen:
>
> That all laws relating to the examination of officers of the Medical Corps for promotion shall be applicable to dental surgeons.

Since that time the General Staff of the Army introduced a universal training bill. This was of interest to dentists in that the length of service in the different grades of the Dental Corps was reduced. In the bill, House of Representatives, 92, April 2, 1917, line 10, it is stated:

> The permanent personnel of the Dental Corps shall consist of five hundred dental surgeons. Dental surgeons shall have the

rank, pay and allowances of First Lieutenants until they have completed five years' service. Dental surgeons of more than nine but less than nineteen years' service shall, subject to such examination as the President may prescribe, have the rank, pay, and allowances of Captains. Dental surgeons of more than nineteen years' service shall, subject to such examination as the President may prescribe, have the rank, pay, and allowances of Majors.

The following extract shows that the dental profession is striving for equality of rating with the medical profession.* In the Amendment introduced by Senator Lodge to bill, House of Representatives, 4897, it was proposed that:

Hereinafter the Dental Corps shall consist of commissioned officers of the same grades and proportionally distributed among such grades as are now or may hereafter be provided by law for the Medical Corps, who shall have the rank, pay and allowances of the officers of corresponding grades in the Medical Corps, including the right to retirement as in the case of officers; and there shall be one dental officer for every one thousand of the total strength of the Regular Army, authorized from time to time by law:

That all laws relating to the examination of officers of the Medical Corps for promotion shall be applicable to officers of the Dental Corps:

That Dental Examining and Review Boards shall consist of one officer of the Medical Corps and two officers of the Dental Corps.

That immediately following the approval of this act all Dental Surgeons then in active service shall be recommissioned in the Dental Corps in the grades herein authorized in the order of their seniority and without loss of relative rank in the Army.

That First Lieutenants in the Medical Department shall be promoted to the grade of Captain upon the completion of three years' service in that grade in the Medical Department and upon

* The latest legislation relative to this matter is practically the new Lodge amendment which we have quoted above as having been passed in the House of Representatives, Bill 4897. This last bill passed the Senate and was signed by the President and became a law June 6, 1917. The Judge Advocate General's opinion as to the construction of this statute has not yet been approved by the Secretary of War, whose interpretation has been asked by the Surgeon General. On the basis of 300,000 enlisted men it will probably commission 300 officers in the Dental Corps, and as nearly as may be determined now, there will be created nine Colonels, sixteen Lieutenant Colonels, seventy-one Majors and two hundred and three Captains and First Lieutenants.

passing the examinations prescribed by the President for promotion.

In order that the connection between the Lodge Amendment and House Bill 4897 may be fully understood, the latter is herewith incorporated:

That during the existing emergency Lieutenants in the Medical Corps of the Regular Army and of the National Guard shall be eligible to promotion as Captain upon such examination as may be prescribed by the Secretary of War.

For further information dealing with the latest laws, etc., in the Dental Reserve Corps, the following circular of information will show the present situation of the Corps:

FORM 146

WAR DEPARTMENT, SURGEON GENERAL'S OFFICE

(*Revised Feb. 27, 1917*)

CIRCULAR OF INFORMATION

In Relation to Appointments in

THE DENTAL CORPS, U. S. ARMY

The Requisite Qualifications, Examination of Applicants, etc.

Constitution of the Corps

The Dental Corps is one of the constituent members of the Medical Department of the Army, of which the other members are the Medical Corps, the Veterinary Corps, the Nurse Corps, and the Enlisted Force. It consists entirely of officers, who are commissioned as dental surgeons. Appointments therein are authorized at the rate of 1 for each 1,000 enlisted men of the line of the Army. During the first eight years of their service dental surgeons have the rank, pay, and allowances of First Lieutenants. After eight years they have the rank, pay, and allowances of Captains, and after twenty-four years the rank, pay, and allowances of Majors; subject, however, to such examination prior to advancement as the President may prescribe, and to the proviso that the number of dental surgeons with the rank of major shall not at any time exceed fifteen.

Officers of the Dental Corps have rank therein according to the dates of their commissions, and they rank next below officers of the Medical Reserve Corps. Their right to command is limited to the Dental Corps.

Qualifications

No applicant may under existing law be commissioned in the Dental Corps unless he is between 21 and 32 years of age, a citizen of the United States, a graduate of a standard dental college, and of good moral character, nor unless he shall pass the usual physical examination required for appointment in the Medical Corps, and a professional examination which shall include tests of skill in practical dentistry and of proficiency in the usual subjects of a standard dental college course.

Whether or not the applicant is married has no effect upon his eligibility for the Dental Corps.

Application for Appointment

Application for appointment must be made in writing, upon the prescribed blank form, to the Surgeon General of the Army, Washington, D. C., who will supply the blank upon request. All the interrogatories on the blank must be fully answered. In compliance with the instructions thereon the application must be accompanied by testimonials, based upon personal acquaintance, from at least two reputable persons, as to the applicant's citizenship, character, and habits.

The selection of the candidates is made by the Surgeon General from the applications submitted, and a formal invitation to report for examination to the most convenient examining board in each case will be issued by him.

Examination

Examinations are authorized and boards to conduct them convened from time to time, as may be deemed necessary. Each board consists of one medical officer and two dental surgeons of the Army. The examinations are conducted under instruction from the Surgeon General. They usually last six days.

No allowances can be made for the expenses of applicants undergoing examination, whether incurred in travel to and from or during their stay at the place of examination, as public funds are not available for the payment of such expenses.

Each applicant, upon presenting himself to the board, will, prior to his physical examination, be required to submit his diploma as a graduate of a standard dental college. Should he fail to do so the examination will not proceed.

The examination consists of two parts:

(a) Physical.—The physical examination must be thorough. Candidates who fall below 64 inches in height will be rejected. Each candidate must certify that he labors under no physical infirmity or disability which can interfere with the efficient discharge of any duty which may be required. Errors of refraction, if vision is not below 20/100 in either eye, are not causes for rejection, provided they are not accompanied by ocular disease and are entirely corrected by appropriate glasses.

The following table is given for convenience of reference:

Physical Proportions for Height, Weight, and Chest Measurement

Height	Weight	Chest Measurement	
		At expiration	*Mobility*
Inches	Pounds	Inches	Inches
64	128	32	2
65	130	32	2
66	132	32½	2
67	134	33	2
68	141	33¼	2½
69	148	33½	2½
70	155	34	2½
71	162	34¼	2½
72	169	34¾	3
73	176	35¼	3

It is not necessary that the applicant should conform exactly to the figures indicated in the foregoing table. The following variations below standard given in the table are permissible when the applicant is active, has firm muscles, and is evidently vigorous and healthy:

Height	Chest at expiration (inches)	Weight (pounds)
64 and under 68	2	8
68 and under 69	2	12
69 and under 70	2	15
70 and upward	2	20

(b) Professional.—The professional examination embraces both written and oral examinations, and clinical work, as follows:

Written:

- Anatomy, physiology, and histology.
- Materia medica and therapeutics.
- Pathology and bacteriology, dental.
- Chemistry, physics and metallurgy.

Oral:

- Oral surgery.
- Operative dentistry.
- Prosthetic dentistry.

Clinical work:

- Operative.
- Prosthetic.

An average of 75 per cent is required in the subjects of the theoretical examination and 85 per cent in the practical examination.

The questions in the several subjects are furnished to the boards by the Surgeon General. A sample list of questions is appended.

All instruments and materials used at examinations are furnished by the Government.

An applicant failing in one examination may be allowed another after the expiration of one year, but not a third. Withdrawal from examination during its progress, except for sickness, will be deemed a failure.

Appointment

Applicants who qualify are appointed dental surgeons according to the needs of the service during the ensuing year, in the order of their standing at the examinations. After the expiration of a year they will no longer be considered eligible until again examined.

The appointments are made upon the recommendation of the Surgeon General, by the President of the United States, by and with the advice and consent of the Senate, and the rank of first lieutenant immediately attaches thereto.

Pay and Emoluments

To each commissioned rank in the Army is attached a fixed annual salary, which is received in monthly payments, and this is increased by 10 per cent for each period of 5 years' service until a maximum of 40 per cent is reached. A dental surgeon with the rank of first lieutenant receives $2,000 per annum, or $166.66 monthly, during his first 5 years' service. At the end of 5 years his annual pay is increased to $2,200, or $183.33 a month. At the end of 8 years he is advanced to captain and receives $2,400 a year, plus 10 per cent of his first 5 years' service, making $2,640, or $220 a month; and thereafter his annual pay is—at the end of 10 years, $2,880, or $240 a month; at the end of 15 years, $3,120, or $260 a month; at the end of 20 years, $3,360, or $280 a month. At the end of 24 years he is advanced to major and receives $4,000 a year, that being the pay of his grade, $3,000 plus increase for prior service of 20 years up to $4,000, which is the maximum allowed by law to a major. Officers, in addition to their pay proper, are furnished with a liberal allowance of quarters according to rank, either in kind, or, where no suitable Government building is available, by commutation. Fuel and light therefor are also provided. When traveling on duty an officer receives mileage for the distance traveled. On change of station he is entitled to transportation of professional books and papers and a reasonable amount of baggage at Government expense. Groceries and other articles for their own use may be purchased from the quartermaster at about wholesale cost prices. Well-selected professional libraries are supplied to each hospital, and standard modern publications on medical and surgical subjects, including dental journals, are added from time to time. Dental surgeons are entitled to medical attendance and hospital treatment without charge other than for subsistence.

Privileges

Leave of absence on full pay may be allowed at the discretion of the proper authority at the rate of one month per year, which may accumulate to a maximum of four months, and at the end of four years is then available as one continuous leave. Beyond this an officer may still be absent with permission on half pay. Absence from duty on account of sickness involves no loss of pay.

Officers of the Dental Corps are entitled to the privilege of retirement after 40 years' service, or at any time for disability incurred in the line of duty. On attaining the age of 64 they are placed on the retired list by operation of law. Retired officers receive three-fourths of the pay of their rank (salary and increase) at the time of retirement.

Assignment, Duties, Etc.

Officers of the Dental Corps are not permanently assigned to any regiment or arm of the service. They are assigned to duty upon the recommendation of the Surgeon General or of the department surgeon of a territorial department. No choice of station can be accorded or promise made of assignment to any specified locality.

When an officer of the Dental Corps reports for duty at a post or station a suitable operating room will be provided for him, in the hospital if a room is available there, otherwise in one of the other post buildings. All instruments, appliances, and materials necessary to the performance of his duties are supplied by the Government. Ordinarily one enlisted man of the Medical Department will be detailed to assist in operations, in caring for public property and stores, and in the performance of clerical work.

Officers of the Dental Corps serve free of charge all those entitled to free medical treatment by medical officers.

WAR DEPARTMENT

Office of the Surgeon General

The next examination will be held

There are now   Vacancies in the Dental Corps of the Army.

EXAMPLES OF WRITTEN QUESTIONS

Anatomy, Physiology, and Histology

1. Name the cranial nerves and their functions.
2. (a) What is the Gasserian ganglion?
   (b) Where is it situated?
   (c) What is its function?
3. What structures pass through the foramen magnum?

4. Name the functions of the red and white blood corpuscles, and state number of each in a cubic millimeter.

5. Describe the first, second and seventh bones of the vertebral column.

6. What conditions may prevent putrefaction in dead organism?

7. Describe the mechanism whereby the heart tissue is nourished.

8. Name the principal tissues of the animal body.

9. State the functions of the epithelium.

10. Describe the salivary glands; their number, structure, names, location, functions, and ducts.

Materia Medica and Therapeutics

1. (a) For what purpose is arsenotrioxidum used in dental surgery?
   (b) What are its effects on soft tissue?

2. (a) State the difference between fixed and volatile oils.
   (b) Give two examples of each.

3. (a) Describe the physiological action of amyl nitrite.
   (b) State dose and method of administering it.

4. What are the dental uses of: pyrozone solutions? ethyl chlorid?

5. (a) What is an alterative? Name two, and state dose of each.
   (b) Name two mineral and two vegetable astringents.

6. From what are the following drugs derived: tannic acid? Monsel's solution? ether? ethyl alcohol?

7. What are the advantages and disadvantages of local as compared with general anesthesia for extraction of teeth?

8. Give doses of the following drugs: Pepsin, aromatic spirits of ammonia, potassium iodid, codein, phosphate of sodium.

9. Write a prescription for a dentifrice, in both metric and apothecary systems.

10. Name four derivatives of opium. Give dose of each.

Pathology and Bacteriology, Dental

1. What is an exostosis? Where does it ordinarily occur in or near the oral cavity?

2. What is a sanguinary or serumal calculus? Of what is it composed and where is it found?

3. Differentiate between congestion and acute inflammation of the gingivae.

4. What is septicemia, and what causes it? Describe its symptoms.

5. What is meant by fermentation? What kind of fermentation is of special interest to dentists?

6. What effects may be produced in the mouth from the administering of large doses of calomel? Name the condition and describe it.

7. Are there any objections to the use of hot applications externally in the treatment of dento-alveolar abscess? If so, give them.

8. What are bacteria? In what forms do they occur? Give an example of a pathogenic bacterium of each form.

9. What is a ptomain? A toxin? A virus?

10. What pathogenic organisms may be concerned in diseases of the mouth and throat?

Chemistry, Physics, and Metallurgy

1. What is aqua regia? What is its chief property?

2. Name the four most important elements found in the human body.

3. Describe the chemical changes that occur in the process of bleaching.

4. How is plant life sustained?

5. Mention the principal constituents of atmospheric air, and state the proportions in which these constituents are present.

6. Describe a method of refining gold scraps.

7. How can the specific gravity of a body lighter than water be determined?

8. How would you distinguish chemically between oxychlorid of zinc and oxyphosphate of zinc?

9. Give the chemical symbols of glacial phosphoric acid (metaphosphoric acid); chloroform; hydrogen sulphid; antimony; arsenious acid.

10. Describe the process of converting 1 dwt. of 22 k. gold plate into 18 k. gold solder.

EXAMPLES OF ORAL QUESTIONS

Oral Surgery

1. What three forces are applied in the extraction of teeth?

2. Give the local and the constitutional causes of non-union of fractures.

3. How are the after-pains of tooth extraction treated?

4. State your treatment of a fracture of the jaw, through the symphysis.

5. What constitutional effects are caused by a severe hemorrhage?

6. State the indications for trephining the antrum. Describe the operation.

7. What is pyorrhea alveolaris? State the latest theory of treatment.

8. How may general infection be caused by oral operation?

9. What diseases of the tongue may be mistaken for carcinoma?

10. Differentiate between fracture and dislocation of the mandibular condyle.

Operative Dentistry

1. How are cavities classified?

2. Give your treatment of a lower molar in which the nerve is alive in anterior canal and putrescent in posterior canal.

3. Give diagnosis and treatment of irritation from pulp stones.

4. State your method of restoring a fractured central,—fracture extending below gingival margin, root being sound.

5. What is a dental matrix?

6. Describe your operation for removing a live pulp from a left upper sound cuspid, the tooth to be used as an abutment for bridge work.

7. Describe Dr. Buckley's treatment for putrescent pulps.

8. Is immediate root canal filling advisable after extraction of nerve under pressure anesthesia? If so, state your method of operation.

9. State causes necessitating root amputation. Describe the operation.

10. State your method of sterilizing instruments.

Prosthetic Dentistry

1. How would you bridge a case replacing the right superior central incisor?

2. Suggest three teeth with cavities where you would insert gold inlays.

3. Describe your method of obtaining model, investing and casting a gold inlay.

4. In bridge work, posterior to first bicuspid, should the teeth fit the gum perfectly, or should a space be left between the gum and the bridge? Explain.

5. State your method of making a gold crown for a molar tooth, giving carat and gauge of gold used.

6. State your method of repairing a broken porcelain facing on an anterior bridge in mouth.

7. In soldering a small piece of gold to a large piece, on which should the solder be placed? Why?

8. Describe the method of constructing a banded Logan cuspid crown.

9. What class of cavities indicates the use of synthetical porcelain? State advantages and disadvantages of the porcelain.

10. Describe an appliance for expanding or enlarging the arch.

SCOPE OF THE PRACTICAL EXAMINATION

The examining board exercises its judgment in selecting the tests according to the time and clinical material available.

Operative

Examination of the oral cavity, and diagnosis of pathological conditions found.

Extraction of roots of broken-down teeth.

Adjusting porcelain crown, cast base, or grinding.

Gold filling; compound filling; compound amalgam filling; oxyphosphate filling.

Treatment of exposed pulps and putrescent root canals.

Prophylactic treatment.

Prosthetic

Taking impressions of mouth, running models, mounting on articulator, and articulating teeth.

Making gold crown, or gold and porcelain crown, or gold and porcelain bridge.

Great praise should be given to the patriotic efforts and results obtained by the Preparedness League of American Dentists, whose work in banding together the dental profession throughout the country has been highly commendable. This committee is now composed of such estimable dentists as Dr. Edward C. Kirk, Philadelphia, Pa., Chairman; Dr. Frederick B. Moorehead, Chicago, Ill.; Dr. G. V. I. Brown, Milwaukee, Wis.; Dr. J. W. Beach, Buffalo, N. Y.; Dr. Herbert L. Wheeler, New York, N. Y.; Dr. Weston A. Price, Cleveland, Ohio; Dr. W. H. G. Logan, Chicago, Ill.; Dr. Harvey Burkhart, Rochester, N. Y.

The Journal of the National Dental Association, Volume IV, Number Eight, August, 1917, prints the following announcement:

PREPAREDNESS LEAGUE OF AMERICAN DENTISTS

J. W. Beach, Chairman

Buffalo, N. Y.

The Preparedness League of American Dentists has become the medium through which the dental profession at large is carrying on the work or preparation for the great service that is ahead of it. For a year and a half this organization has been putting forth every effort to awaken our profession to the realization of the situation and had it not been for the unceasing labor of the organizers of the League surely we would have found ourselves in a deplorable state of unpreparedness when the stirring message that "War is upon us" was sounded from coast to coast.

The League has nearly 6000 active members and more than 125 Sectional Units in active operation. Study courses are planned for these Units and several lectures with slides are furnished free of charge. This has proven a most effective means of preparing hundreds of our members for the entrance examinations to the Officers Reserve Corps, Dental Section. We are gratified to report satisfactory progress in securing a splendid Dental Reserve for our Government and we predict the establishment of the most efficient service in this important department of any nation.

Caring for the mouths of applicants for enlistment who are unable to pay for dental service is a most important object of the League and we wish to take this opportunity to thank our members for the unparalleled response this phase of our work has received. We are proud of our profession and when the final reckoning shall come, it will be shown that we have saved our country many thousands of fighters. The League has been designated the official medium for prosecuting this work and members are requested to report to our headquarters all cases thus cared for so that we may compile statistics to present to the Surgeon General. The Government appreciates what we are doing and we believe our efforts will not go unrewarded when future favorable legislation may be desired by us.

We hope to bring many new members into the National Dental Association through the League and would call the attention of the Officers of our Units to this matter. We should bring many into the National before the annual meeting in October next.

The second annual meeting of the League will be held in conjunction with the National Dental Association on October 23rd, 1917, in Concert Hall, Hotel Astor, New York. We are planning a splendid program and will be able to report wonderful results from the different Units. Several dental ambulances for use in France are being supplied by our Units and other equally patriotic movements are under way.

We urge the formation of Units more generally in order to promote the various objects of the League. Organization is essential and we would point out that now is the time our best efforts are demanded, as the League is organized as a war measure, therefore we invite correspondence with this object in view. Headquarters are at 131 Allen St., Buffalo, N. Y.

You May Win the War

by caring for a single mouth! Stranger things have happened in the world's history. We would, therefore, impress you with your individual importance at this critical time when our great service to humanity has established pre-eminence.

Dentistry is marching to its own under the triumphal banner of unselfish service to the great army of our young manhood going forth to fight for their country.

The Report of Committee on Conservation of Practices of Enlisted Dentists introduced in the Colorado State Dental Association indicates the altruistic motives of the dental profession.

The Journal of the National Dental Association, Volume IV, Number Seven, July, 1917, quotes the following:

WAR NOTES

Report of Committee on Conservation of Practices of Enlisted Dentists

To the Colorado State Dental Association:

Your committee begs to submit the following resolutions as its report.

Whereas: The United States of America is at war and the efficiency of its army and comfort and health of the enlisted men are greatly increased by dental service, and

Whereas: The members of the dental professional are showing and will continue to show their love of country and fellow man by enlisting in large numbers, and

Whereas: Such enlistment entails great service not only in the hardships and hazard of service but in the loss of practice and deprivation of dependent ones of the usual necessities and comforts of life, and

Whereas: The greatest service to our country demands that many members of our profession shall stay at home and continue in their usual rounds of duties, and

Whereas: It is possible for those members of the profession who do stay at home to tender special service to their country, their profession and their fellow men by helping to conserve the practices and care for the dependent ones of those members of the profession who enlist in active service, and

Whereas: The men who enlist in active service are giving their all for us and are therefore entitled to all the consideration and help of those who remain at home, it must be considered that the services rendered under the provisions of these resolutions are for value received and are not in any way acts of charity nor are the enlisted men or their dependent ones to consider such services in the light of charity, be it therefore

Resolved: That this society appoint, by the rules governing the appointment of members to the state board of dental examiners, a committee of three to be known as the *War Committee,* and that the duties of this committee shall be to have general supervision of the conservation of practices of enlisted dentists and care of those dependent upon them under and governed by the provisions of these resolutions, of which this is a part. That this committee shall have the power to appoint three sub-committees of three members each, and that these sub-committees shall be appointed from and have jurisdiction over the three districts of the Educational Association of this state and the boundaries of the said districts of the educational association shall be the boundaries of the districts of the three sub-committees appointed under this resolution, and that these sub-committees shall be governed and directed by the War Committee as herein provided. Be it further

Resolved: That any dentist who is about to enlist may notify the War Committee to that effect either directly or through the sub-committee of the district in which he resides and that the War Committee shall then submit to the said man either directly or through the sub-committee aforesaid a question blank substantially as follows:

1. How old are you?

2. Married or single?

3. State relation and age of any who are dependent, wholly or in part, on you for support, and if in part state proportion.

4. Do you feel that the pay you will receive from the Government will be sufficient to properly care for those dependent on you, and if not what amount do you feel would be necessary to make up the deficiency?

5. Do you wish the help of this society in conserving your practice until your return from war?

6. Do you wish the help of this society, through the voluntary service of its members, in caring for your patients, to aid in the care of your dependent ones, and,

7. If you do, what per cent of the gross receipts for such work do you think would suffice to make up any deficiency of your salary in the care of your dependent ones?

8. What are the gross receipts from your practice?

9. What are your average net receipts?

10. If you desire the help of this society in conserving your practice or the voluntary aid of its members in helping to care for your dependent ones through services rendered to your patients, will you submit to the committee a list of your patients with their latest addresses?

Upon the receipt of the question blank properly filled out and a list of patients accompanying it, it shall be the duty of the War Committee to send a form letter to each person on the list, the letter to be substantially as follows:

Mr. John Doe, 13 Blank St., City.

Dear Sir: The Colorado State Dental Association is doing everything in its power to conserve the practices and care for the dependent ones of those dentists who enlist in their country's service during the war.

The undersigned committee is appointed to look after this matter and is addressing this letter to you in the interest of the practice of Dr. ——, who has enlisted for active service.

Inasmuch as Dr. —— has been serving you recently in a professional capacity, we are asking you if you will consider yourself a regular patient of Dr. —— and will return to him as a patient should he again take up his practice?

In the meantime will you further assist us in this work by informing whoever you may go to for dental services that you are a patient of Dr. —— and are so listed with this committee?

You will undoubtedly be glad to assist your country and her loyal defenders to this extent and we thank you now for mailing your reply to us in the enclosed envelope.

Cordially yours,
Committee.

The committee shall also notify the members of the profession in the district where the dentist resides who is about to enlist, of the fact that he wishes the help of the society.

Be it further resolved that the members of this society who shall voluntarily agree to the provisions of these resolutions, shall do the work for the patients of the enlisted men according to the lists submitted by said enlisted men and agreed to by the patients themselves, and shall turn to the War Committee or sub-committee that per cent of the gross receipts of such work as may appear necessary to properly care for the dependent ones of said enlisted dentists according to the information in the hands of the War Committee, but that in no case shall the dentists doing such work be asked or expected to turn to the War Committee more than 30 per cent of the gross receipts of said work, nor shall they be asked or expected to do work for said patients of such enlisted men in amount to exceed 20 per cent of their total average annual practice.

That the War Committee shall devise a special and standard system of bookkeeping for every phase and branch of this work.

Be it further Resolved: That the expenses of the said War Committee, such as stenographer, stationery, stamps, auditing, etc., be raised by voluntary subscriptions of the members of this society.

Signed: G. R. WARNER,
H. A. FLYNN,
Committee.

The above information relative to the Army Dental Corps has been selected from a great mass of dental legislation. There is much more of a similar nature but in the author's opinion the above excerpts include all that would be of most interest to readers of this book.

The first real test of patriotism has been met by the dental profession in a manner far exceeding the expectations of even the most sanguine dentist. The response to the cry of preparedness has penetrated into the farthest corner of professional indifference. Dentists who were formerly apparently dead to professional pride have burst forth into a fervor of patriotic effort unsurpassed even by their medical confrères. No longer are dentists looked upon as individualists, but rather as specialist members of the great mother body, medicine. Few among the masses appreciated the wonderful strides made by dentistry in the last twenty years. Many now are awakened to the wonderful power wielded for the good of humanity by men dentally trained.

From the European hospitals we hear frequent reports of the invaluable services rendered by the pioneer dentists in the armies of the Allies. What was previously looked upon as a fad is now appreciated as a dire necessity. Wounds of the most horrible type, jaws shot away, whole faces disfigured by shrapnel, have been treated and restored to usefulness by the dental profession. The mere mechanic of twenty years ago is today recognized as the skilled facial surgeon. The general surgeon admits his inability to compete with the dental specialist in face deformities. American dentists have thus gained long deserved recognition from the medical profession by their wonderful surgical results in Europe.

At home hundreds of dentists are entering the service. Hundreds more, unable to enter active service, are banded together with one aim in view:—to conserve the efficiency of our soldiers.

The future will place the dental profession side by side with the medical profession as a science whose aims are humanitarian, and whose efforts are unselfish and a most useful cog in the wheel of progressive civilization. Whenever humanity calls, dentistry has not been, and never will be, unresponsive to her needs.

Army legislation is needed, which will place dentistry on the same basis as medicine. A special dental corps should be created distinct from medical supervision, with a dental surgeon general, colonels, majors, sufficient in number to form an efficient organization, governed by men who appreciate the oral needs of the enlisted men and whose knowledge of dentistry fits them to command and supervise their own professional brothers. Misplaced medical supervision has done great harm. Even the best men, medically trained, are incompetent to supervise dentists. Dentists know what they need and what our enlisted men require. They should have unlimited control and supervision of the dental corps. Moreover the time is at hand when they will demand and should receive this right.

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