To Dr C F W Bodecker
with the compliments of the Author
Eugene S Talbot

ETIOLOGY OF OSSEOUS DEFORMITIES

OF THE

HEAD, FACE, JAWS AND TEETH

TALBOT

THE ETIOLOGY

OF

OSSEOUS DEFORMITIES

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BY

EUGENE S. TALBOT, M.D., D.D.S.

Professor of Dental Surgery, Woman's Medical College; Lecturer on Dental Surgery and Pathology, Rush Medical College, Chicago; Author of "The Irregularities of the Teeth and their Treatment"; Author of "Chart of Typical Forms of Constitutional Irregularities of the Teeth"; Honorary President of the Dental Section of the Tenth International Medical Congress, Berlin, 1890; Member of the American Medical Association; Member of the Chicago Medical Society; Fellow of the Chicago Academy of Medicine; Member of the American Dental Association; Member of the Chicago Dental Club; Honorary Member of the Odontologischen Gesellschaft, Berlin, Germany; Membre Honoraire de l'Association Generale des Dentistes de France, etc., etc.

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TO THE

FELLOWS OF THE CHICAGO ACADEMY OF MEDICINE

WHOSE PHILOSOPHICAL CRITISCISMS AND

MEDICAL ACUMEN HAVE SUSTAINED THE AUTHOR DURING THE

TEDIOUS PROCESS OF STATISTICAL INQUIRY

THIS VOLUME IS RESPECTULLY DEDICATED

PREFACE

The earlier editions of the present work were an outgrowth of researches which tended to oppose the too prevvalent theory (erroneous in its deductions and vicious in its effects on practice) that irregularities of the teeth and jaws were the result of local, not constitutional conditions. The increasing volume of evidence against this theory has forced the author to extend the scope of his original inquiry into departments of oral and nasal medicine, and surgery of the eye, ear and face, so intimately related to dental medicine through the causation originally assigned for irregularities of the teeth and jaws. The alleged causative factors in the case of the nose and mouth were themselves often found to be of constitutional origin. The scope of the researches presented in this edition, therefore, while seemingly extended, are practically confined to the limits of the original inquiry.

The author desires to acknowledge his indebtedness to Drs. J. G. Kiernan, Richard Dewey, H. M. Bannister and James A. Lydston for valuable suggestions. Illustrations, Figs. 77, 78, 79, 80, 81, 82, 89, 90 and 91, are taken from the work of Zuckerkandl as reproduced by Bosworth (Diseases of the Nose and Throat).

EUGENE S. TALBOT.

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INTRODUCTION.

The causation of deformities of the head, face, jaws and teeth has not received the attention from scientists which its importance demands. Of late these deformities have been traced to climatic changes, race intermixture, heredity and social environment. The unstable conditions of this last, as shown in commercial civilization, give rise to a tendency to the development of these conditions. The teeth, jaws and face have been variable factors in evolution, and hence are most readily affected by the forces tending to degeneracy. Such conditions are easily affected by the factors arising out of the "struggle for existence."

The law of the "survival of the fittest" affects not only the entire organism, but also the parts themselves. Some one part attains undue development. Such a product of degeneracy once obtained might, under proper conditions, remain, while the rest of the body returned to the normal type. The frequency with which these stigmata of degeneracy are found in otherwise sound systems indicates that the law of atavism tends to eradicate as well as to cause them. Given these deformities in a subject of normal mental health, they simply indicate that a more or less remote ancestor had been subject to the influence of the factors producing degeneracy, but that in the main the offspring were regaining the normal standard.

The lesson to be drawn from these stigmata is the hygienic one that, given the tendency to degeneracy shown in these deformities, the progress of that person under the factors named will tend more toward disease than that of the person in whom they are absent. The frequency of these deformities should hence have early created the suspicion that they were of constitutional and not local origin, and should have once more taught the old, old lesson in medicine: that a knowledge of a man's ancestry is of great value in treatment.

ETIOLOGY OF OSSEOUS DEFORMITIES

OF THE

HEAD, FACE, JAWS AND TEETH.

CHAPTER I.

HISTORICAL SKETCH OF THEORIES REGARDING THE ETIOLOGY OF IRREGULARITIES OF THE MAXILLÆ AND TEETH.

SUPERNUMERARY TEETH.

Hippocrates, who lived about 500 B. C., was the first to study human teeth, and laid down the dictum, "The more teeth the longer life." "The fewer teeth the shorter life," said Aristotle about one hundred years later.

In 1618 Hilkiah Crooke published a work, *Μιχροχοσμογραφια*, in which he gives the views of the best anatomists of his day. In this it is observed that there are sometimes four and sometimes five grinders.

On Second Dentition the author says: "The shearing (*i. e.*, incisors) teeth, when they do break forth, do thrust the first shearers out before them and issue betwixt the first two, the second and the dog tooth that is next unto them. But if the former teeth will not fall or be not pulled out, or if the latter issue before the first fall, then the latter make their way through new sockets, and turn in the upper jaw outward, in the lower jaw inward, so that there seemed to arise a new row of teeth, and this indeed hath deceived many historians and anatomists also."

Barth Ruspini, in 1750, says: "All the teeth that exceed thirty-two may be regarded as supernumerary." He attributes irregularity of canines and incisors to extreme narrowness of the jaws.

Robert Blake, in a translation of his inaugural Dissertation, published in 1798, speaks of supernumerary and inverted teeth.

Joseph Harris, "A Familiar Treatise on the Teeth," 1830: "Irregularity is due to supernumerary teeth."

John Winckworth, 1831, speaks of supernumerary teeth causing irregularity.

THUMB-SUCKING, AND SIMILAR CAUSES.

J. Imrie, *Parent's Dental Guide*, 1834: "Irregularity is due to want of development of jaw-bones, intemperance of various kinds combined with artificial modes of living introduced by civilization, and sudden transition from heat to cold to which the teeth are subject—all these have a tendency to prevent development of the bones. Rabbit mouth is due to keeping the thumb in the mouth for hours, after going to sleep. Underhung jaw is due to 'sucking the tongue,' by throwing the under jaw-bone from its articulation. A similar state of the teeth and jaw-bones is induced when attempts are made by the inexperienced to regulate them by the extraction of teeth in the upper jaw and neglecting to remove an equal number of the lower."

J. Lefoulon, "A new Treatise of Theory and Practice of Dental Surgery" (translated from the French by Thomas Bond, 1844): "Among the causes of Dental Irregularity we may regard as the most frequent the neglect of proper supervision of second dentition. Very often the temporary teeth are too precipitately removed, and again the opposite error is committed of suffering them to remain even after the permanent have partly appeared. There results from this an error of relation between the development of the palatine arch and the superior alveolar border, or of the two arches at once, relatively to the size of the teeth. Another cause is the bad habit of permitting children to suck their thumbs and continually to be putting their hands into their mouths. Another cause is the frequently repeated action of the tongue in the pronunciation of certain syllables called lingual, in which that organ, striking against the anterior superior teeth, gives rise to anterior obliquity of the superior arch. We may remark that this deformity is very frequent with the English, resulting from the pronunciation of lingual syllables."

About the same year Dr. Thos. Ballard claimed certain peculiarities, such as serrated teeth and projecting jaws, to be the result of fruitless sucking.

Stockton's *Dental Intelligencer*, 1845, from the "Forceps:" "The comparative ease by which, with pressure, the incisors or bicuspids may be made to alter their position, would naturally suggest the idea that the tongue, lips or cheek might, in some measure, influence their original direction; but as these are pressed by every one, while certain individuals only have their teeth unevenly arranged, we may look for some other accessory; and this may be found in the form of the palate, certain peculiarities of which are found in connection with similar forms of the dental arch. Irregularity of position is almost exclusively confined to anterior five teeth on each side of the medial line, brought about by pressure of tongue upon hard palate in sucking or mastication."

Nasmyth's "Researches on Development, Structure and Diseases of the Teeth," 1845: "Projecting upper jaw is often the result of a habit of sucking the tongue or finger in infancy. But both projecting upper and projecting lower jaw arise from an arrest of development in the jaw when expansion of the arch is deficient." He also states that we find the prominent mouth in uncivilized races.

The theory that irregularity may be due to thumb-sucking, so much made of in modern times, was mentioned by different writers during the last forty years. Among these H. D. Ross speaks of it in 1853. At the same time he remarks, what must have been observed as soon as there was an attempt at correction, that there is greater difficulty in keeping teeth in position after they are moved than in moving them.

A. A. De Lessert, 1873, attributes deformity to fruitless sucking and to enlarged tonsils, which necessitate an open mouth.

Thomas Salter, "Dental Surgery," 1874, attributes irregularity to hypertrophy of tongue and thumb-sucking.

J. W. White, 1879, says that the protrusion of lower jaw is due to the habit of sucking the first and second fingers; the weight of the hand and arm causing a protrusion of lower jaw and teeth.

Mr. Francis Fox, "Irregularity of Teeth and their Surgical Treatment," 1880: Causes of irregularity are "want of proportion in the size of the teeth and jaw-bones or prolonged retention of temporary teeth, supernumerary teeth, habit of thumb-sucking or undue pressure from an hypertrophied tongue, or heredity."

RETENTION OF TEMPORARY TEETH.

Thomas Berdmore, in 1768, says that the cause of supernumerary teeth or a double row of teeth is due to the fact that the milk-teeth are never shed, notwithstanding the fact that the permanent teeth appear. Irregularity of teeth is due to the resistance offered the permanent by the temporary, which also occasions snaggled, rough and indented teeth.

Joseph Fox, "Natural History of Human Teeth," in 1803: "Most frequent cause of irregularity is a want of simultaneous action between the increase of the permanent teeth and the decrease of the temporary ones by the absorption of their fangs, most commonly occasioned by the resistance of the nearest temporary teeth; also from the fact that the permanent teeth are too large for the space occupied by the temporary. The growth of more teeth than the natural number frequently occurs, and is always the cause of great irregularity of the teeth."

Joseph Murphy, in "Natural History of the Human Teeth," speaks of irregularity due chiefly to the first teeth not having been shed in time.

Benjamin James, in "A Treatise on the Management of the Teeth," 1814, says: "With proper attention paid to the removal of the first set of teeth, the regularity of the second set may be anticipated."

Parmly, in "Lectures on Natural History and Management of the Teeth," 1820, states that: "Want of attention during the period of shedding the first set of teeth is great cause why irregularity of the teeth, and consequent deformity of the mouth, are apt to take place." "When the permanent teeth are large, and growth of the jaw does not proceed in a corresponding proportion, they are found to crowd and overlap each other."

G. Waite, "Surgeon-Dentists' Anatomical and Physiological Manual," 1826: "Irregularities of the teeth are mostly occasioned by the pressure of the temporary upon the permanent, throwing them in a wrong direction."

S. S. Fitch, "System of Dental Surgery," 1835; "Irregularity is due to want of simultaneous action between the increase of the permanent teeth and the decrease of the temporary by the absorption of their fangs; to the greater size of the permanent in comparison with the temporary."

"Treatise on Diseases of the Mouth," by J. B. Garriot, 1843, translated by J. B. Savier: "Deciduous teeth, by their presence, often prevent the permanent teeth from arranging themselves in their proper position. Should we neglect to extract the milk-teeth and other measures capable of favoring a good arrangement of the permanent teeth, deformity—often very serious—may ensue.

GROWTH OF MAXILLÆ.

Hunter, in 1771, in "Natural History of the Teeth," speaks of supernumerary teeth; he states that the jaw grows *at the posterior edges*, and that irregularity is often due to the ten anterior permanent teeth being larger than the ten anterior temporary teeth, while the corresponding part of the jaw is of the same size; therefore in such cases the second set is obliged to stand very irregularly."

G. M. Humphrey made observations on the mode of growth of the lower jaw. He claims there is no interstitial growth. The five permanent front teeth occupy exactly the same position throughout life, and all other additional teeth are added to the hinder end of the jaw. This hind end is enlarged by the absorption of the anterior coronoid edge and the deposition on the posterior edge. When the molars are first formed they are under the coronoid process, and are subsequently exposed—theories proven by experiments on young pigs.

SLEEPING WITH THE MOUTH OPEN.

Tomes, in "Dental Surgery," 1859 and 1870, mentions the fact that deformity is caused by sleeping with the mouth open. He makes no mention of this in edition of 1848.

W. Matthews, 1880, in paper read before Students' Society of the Dental Hospital of London, attributes irregularity to enlarged tonsils, which necessitate breathing being carried on with open mouth; also to heredity, maxillæ being smaller in proportion than the teeth, which is due to the lessened work of maxillæ and teeth by civilized races; also cross-breeding and thumb and lip-sucking, retarded shedding of temporary teeth, and too early extraction of first permanent molars. "Congenital V-shaped jaw is that form in which, previous to birth, the form of the upper maxillæ is such that its cornua do not diverge posteriorly, but are parallel, and as that portion of the jaw already formed never changes its form, the newly-added parts will pass off in divergent lines, forming an angle with that previously existing, in order to correspond with the increasing width of the base of the skull."

PREMATURE EXTRACTION OF TEMPORARY TEETH.

L. Koecker, 1826: "The deformity which consists in shutting the under incisors and cuspidati over the upper, has been produced by the injudicious extraction of some of the teeth of the upper jaw, without taking proper care to secure a due proportion between the upper and under jaws." We have irregularity also when the temporary teeth are not extracted in time, and when we have too long persistence of temporary.

Thomas Bell, "Anatomy, Physiology and Diseases of the Teeth," 1829: "Most unusual cause of permanent irregularity is the actual want of sufficient room in the jaw of the ultimate regular arrangement of the teeth, and this may occur from disproportionate narrowness of the jaw (whether from original formation or produced by too early removal of temporary teeth) or from preternatural size of the permanent teeth."

Joseph Scott, "Art of Preventing Loss of Teeth," 1831: "Irregularities arise from—first, a natural want of sufficient expansion in the jaw bone at the time of their protrusion; second, from not extracting the temporary teeth at the proper time; third, by too early an extraction of the temporary teeth; fourth, from supernumerary teeth."

John Nicholles, "Teeth in Relation to Beauty, Voice and Health," 1833: "Deformity may be due to too long persistence of temporary teeth, or may arise from some malformation of the teeth or jaw, entirely beyond the previous control of the dentist."

R. Maclean, "Treatise on Human Teeth," 1836: "Due expansion of the jaw is prevented by premature extraction of the temporary teeth; the permanent thereby becoming crowded and irregular."

E. Spooner, "Popular Treatise on the Teeth," 1836: "First, and most frequent cause of irregularity, is a want of simultaneous action between the protrusion of the permanent teeth and absorption of the fangs of the temporary. Second cause is a narrowness of the maxillary arch or a want of proportion between the extent of it and the size of the teeth. Another cause is by the premature extraction of the temporary teeth; the jaw is liable to contraction, and when the permanent teeth come in there will not be room in the jaw for them. Irregularity is also due to supernumerary teeth."

Wm. Thornton, "A Popular Treatise on the Preservation of Teeth and Gums," 1836: "Irregularities of the teeth proceed from three causes,—first, from a natural want of sufficient expansion in the jaw-bones at the time of the protrusion of the teeth; second, not extracting the temporary teeth at the proper time; third, too early an extraction of the temporary teeth."

Mortimer, 1836: "Irregularities arise from natural or accidental causes.

"*Natural* causes arise from a bad conformation of the jaw, so that several teeth are over each other; from the teeth being much larger than they should be; from coming out of order and place; from teeth growing out of the palate or projecting into the mouth.

"*Accidental* causes arise from neglect or ignorance in removing milk-teeth too soon; when the second teeth from some internal cause take a direction inwards or outwards; underhung jaw arises from making faces."

Charles De Loude, "Surgical, Operative and Mechanical Dentistry," 1840: "Irregularity is due to supernumerary teeth, to second teeth being too large and maxillary arch too narrow, and to too early extraction and too long persistence of temporary teeth, and to shape of the maxillary arch, and to heredity, where the child inherits the jaw of one parent and the teeth of the other."

Sam Ghimes, 1843, speaks of the underhung jaw being due to the upper incisors extending inwards, and on closing the mouth they come in contact with the lower; this makes the child inclined to protrude the lower jaw, which finally becomes habitual, and promotes the increase in the length of the jaw itself.

Early French writings contain little or nothing on the subject. In a German work—"Nessel's Compendium der Zahnheilkunde," 1856—the cause of irregularity is attributed to the premature extractions of temporary teeth. The alveoli, it is stated, form a bonescar in such cases, which is an obstacle to the advancement of the permanent teeth. In consequence, it is claimed, the permanent teeth come before the jaw is sufficiently expanded to receive them.

DEVELOPMENT OF SPHENOID.

J. L. Down, "Relation of Teeth and Mouth to Mental Development," 1871, wrote: "Excessive vaulting of palate, due to arrest of development of the sphenoid or defective growth of vomer. The defects are developmental defects, and betoken a cause long anterior to the time when sucking the thumb is practiced, unless that habit be an intra-uterine one."

Mr. Oakley Coles, "Origin and Treatment of Certain Irregularities of the Teeth," 1881, before International Medical Congress, said his observations in regard to intermaxillary prognathism were based on the authority of Mr. Hilton.

Dr. Oakley Coles expressed the opinion, held by others about the same time, that the best types of English jaw give an equilateral triangle. He applied Greek names to the different classes into which he divided various forms of arches; he gave no basis for his classification except that of form. He attributed intermaxillary prognathism to a force originating in the sphenoid bones and acting on the intermaxillary bone, and held that premature ossification of the sutures operates powerfully in the production of oral deformity.

ATTRIBUTED TO CIVILIZATION.

J. P. Clark, "A New System of Treating Human Teeth," 1829: "Irregularity may arise from too premature extraction of temporary teeth. Disproportion between the teeth and the jaws may be occasioned by a natural conformation of the parts, or may be the unnoticed effect of accident. For we seldom find any such disproportion and consequent irregularity in the teeth of men and animals in a wild state."

J. L. Levison, in "Jaws and Teeth of Semi-barbarous Men," 1852: "The jaws of civilized men are more contracted than those of semi-barbarous races, and this is the result of the direct violation of the Creator's laws, who willed that the brain and nervous system of the growing child should not be overtaxed, and that the dental process of attempting to build up the organic instruments and cultivate the mental faculties at the same time is a matter almost impossible to accomplish."

In *British Journal of Dental Science* of 1864 an extract of George Catlin's "Breath of Life" is given. In this he states that malformations of teeth are due to keeping the mouth open, as *civilized* man is the only animal who keeps his mouth open during sleep.

Mr. Mummery and Mr. Nichols made extensive observations in 1860 on the teeth of savage races. They report that irregularities of the teeth and contracted jaws were rare. Mr. Nichols found but one case of slight irregularity among the thousands of Indians and Chinese which he examined. Messrs. Coleman and Cartwright examined a large number of skulls in the crypt of Hythe Church in Kent. These were very old, though their history is not known definitely. All of them had well-developed jaws and alveolar arches, and the teeth that were still present were remarkably regular.

About 1864 Mr. Samuel Cartwright read an able paper before the Odontological Society of Great Britain. In this he expresses his views that irregularities result from selective breeding; that they are both congenital and hereditary; that there is very little increase in the anterior part of the jaw after eight or ten years; that if the temporary teeth were to remain the jaws would not change from those of childhood; that in all cases of irregularity the maxillæ are more or less altered in proportion of development, whilst the teeth maintain, in regard to their size, an average development.

Mr. Hepburn, in "Irregularities of Teeth and Their Treatment," 1870, says: "Contracted maxillæ and alveoli are the result of artificial life and other causes attendant on civilization. Ethnologists affirm that with the advance of civilization, there is decrease in the size of the facial and maxillary bones." Deformity is also attributed to cross-breeding.

Among comparatively recent works on irregularities, that by Kingsley on "Oral Deformities" is one of the most important. He attributes irregularities chiefly to premature extraction of temporary teeth, intermarriage between persons of different nationalities, hereditary or disturbed innervation.

CONSTITUTIONAL CAUSES.*

John Fuller, 1810, attributes irregularity to too long persistence of temporary teeth; he also says that the upper jaw is too small for the permanent teeth, which fact often occasions irregularity. "Some children have the habit of projecting the under jaw forward, and, of course, shutting one or more of the under front teeth beyond the upper, which soon becomes permanent."

Mr. Sigmond, in "Treatise on Disease and Irregularities of the Teeth and Gums," 1825, attributes irregularities to—1, natural; 2, accidental causes. "Natural, (1) when they result from the jaw not expanding sufficiently to allow the teeth to form a regular circle; (2) when they are larger than the ordinary dimensions; (3) when they do not appear in their proper order and place. Accidental, when caused by negligence or improper treatment at the time of their growth."

Andrew Clark, "Practical Directions for Preserving the Teeth," 1825: "That irregularity of the teeth is occasioned by want of room in the jaw, and not from any effect that the first set produce upon them, is evident because, in all cases of irregularity, we find that really there is not room to admit of placing all the teeth properly."

William Robertson, "A Practical Treatise on the Human Teeth," 1841, says: "Deformity is due to inheriting the contracted jaw of one parent and the large teeth of the other."

Savier's translation of F. Maury's "Dental Art" 1842: "Prominence of upper jaw is due to narrowness of the arch; recession, due to the anterior teeth."

C. A. Harris, "Principles and Practice of Dental Surgery," 1845: "An infringement of laws of growth or dis-

*The terms "attributed to civilization" and "constitutional causes" are used by the author in order to harmonize the views held by the early writers and those of the author. By this arrangement the student can comprehend the actual causes more readily. The terms used by the author are explained in chapter XXXI.

turbance of the functional operation of any of the organs of the face or head may determine an improper development of the jaw and a bad arrangement of the teeth." He also mentions supernumerary teeth and irregular individual teeth; he attributes irregularity of the teeth to the narrowness of the maxillary arch, and sometimes to the presence of temporary teeth.

Arthur, "A Popular Treatise on Diseases of the Teeth," 1845: "Irregularities of the teeth may proceed, amongst others, from three principal causes: First, the presence of a greater number of teeth in the mouth than is natural; second, a deficiency of space in the jaw; third, a wrong direction given to one or more at the time they make their appearance. A deficiency of space may arise from a contraction of the jaws in consequence of the too early extraction of the temporary teeth; from some original malformation of the jaw, or from a great excess in size of the second set over the first."

W. K. Brideman, 1845, "On Causes of Irregularity of the Teeth," denies the aid of the tongue, lips or cheek in influencing the teeth from original direction; but attributes it to shape of the jaw.

Sam Harbert, 1847: Irregularities of teeth are due to premature extraction of deciduous teeth and protrusion of permanent before the absorption of a deciduous fang. A projection of lower jaw is attributable to neglect in second dentition; generally it is supposed to be due to elongation of the jaw, which is almost always an error. When the dental arch becomes contracted at the medial line, giving to the mouth a pointed appearance, it is often the result of premature extraction of certain of the temporary teeth. "Practical Treatise on the Operations of Surgical and Mechanical Dentistry."

Alfred Canton, 1851, "Teeth and their Preservation:" "Irregularity of teeth, as regards their shape, position, direction, crowded condition, etc., are met with more frequently than is supposed to be the case. Causes are chiefly mechanical, depending either on the non-increase in size of the jaw in proportion to the growth of the teeth to be contained in the alveolar arch; on the position of the permanent teeth with reference to the fangs of their predecessors, and lastly, on the increase in size of one jaw in preference to the other."

"Treatise on Second Dentition," by C. F. Delabarre, translated for *American Journal of Dental Science:* "Malconformation of denture may be occasioned, first, by a defect in the conformation of the jaw; second, by the simple want of their development depending upon the health of the individual; third, by an excess in the development of all the teeth, though the jaws are in other respects well formed; fourth, by rapid development of the dentition of one set and delay in that of the other; fifth, finally, by the too great size of the teeth of one jaw, which do not harmonize with those that are opposite." "Some forms of defective palatine arches are hereditary."

J. R. Duval, "The Youth's Dentist:" "In a projecting chin the alveolar arch, in which the incisors and canines are placed, has taken a development upon a parabolic line, greater and more prominent than that presented by the body of the bone; this differs very little from a similar one in upper jaw, which projects over the lower. Upon attention to shedding of temporary teeth depends the fine arrangement of the lower."

Dr. Gunnell, in *American Journal of Dental Science*, states that protrusion of lower jaw is in many cases hereditary; but often is brought about in this way—the incisors of the lower jaw are cut first, and when the upper ones make their appearance the lower have nearly arrived at their full growth. In closing the mouth they come in contact with the gum on the inside of the upper incisors, and for relief the lower jaw is thrust out, which soon becomes permanent."

Samuel Cartwright, Jr., in lecture delivered before King's College, reported in *British Journal of Dental Science*, in June, 1857, says, the "irregularities of permanent teeth are due, first, to non-absorption of the roots of temporary teeth in proportion to the rise of those of replacement; second, the great difference which commonly exists in the size of the new teeth as compared with those of the first set; third, contraction of the arches of the jaws and other malformations of maxillary and palate bones, originating in hereditary, congenital and other causes."

A. A. Blount, "Orthodontia," 1866: "Remote causes which produce irregularity will be found in the commingling of all nations, with national and individual characteristics. Most frequent causes are the result of accident, indiscriminate extraction of the deciduous teeth and too early extraction of permanent teeth."

H. Sewell, "Irregularities and Diseases of the Teeth," 1869: "Protrusion of incisors is due apparently to an abnormal development of premaxillary bone." Irregularities are due to "retention of temporary teeth, causing permanent teeth to assume an unnatural position, also to malformation of jaw, which are usually congenital and at the same time hereditary; may, however, be due to injury or other accidental causes."

WANT OF PROPORTION BETWEEN JAWS AND TEETH.

David Jobson, "On the Teeth," 1834: "Irregularity is due to smallness of maxillary arch and great size of permanent teeth and their situation, part on inner and of others on outer side of temporary teeth."

John Mallan, "Practical Observations on Physiology and Diseases of the Teeth," 1835: "Now, the adult teeth being larger as well as more numerous than the milk-teeth, it is obvious that they require a great deal more room, and when the absorption of the latter does not progress equally with the growth of the former, the new teeth are crowded up and are apt to be forced out of their natural position by the resistance of the old. Again, if the permanent prove, as they sometimes do, disproportionately large in comparison with their predecessors, the jaw may not be sufficiently extended to admit of their being arranged in regular order, in which case some overlap the others and considerable deformity is occasioned."

Paul Goddard, "Anatomy, Physiology and Pathology of the Teeth," 1844: "Most prolific cause of irregularity is the want of room in the dental arches—this arises sometimes from a congenital defect, but more commonly from early decay and loss of the temporary teeth, which failing to keep up the alveoli, enables the jaw to contract and thus afford too little room for the permanent set."

The author, after seven years of constant study and scientific research, in a paper read before the Dental Section of the Ninth International Medical Congress in 1887, entitled, "Etiology of Irregularities of the Jaws and Teeth," called attention to the following points:

1. The peculiarities in the size and shape of the jaw-bone may be inherited, but the manner of the eruption of the teeth cannot be transmitted; that is, irregularities of the dental arch *per se* are not inherited.

2. That the muscles of the cheeks have nothing to do with the production of the V or saddle arch.

3. That the only tissues involved are the jaw-bone on the one hand and the teeth and alveolar process upon the other; and in 1888 (see Dental Cosmos), by diagram, he showed how the different deformities were produced.

4. That the incisors in the V-shaped arch always protrude; in the saddle arch, never.

5. The manner of the formation of the V and saddle arches in the arrangement of the teeth.

6. No matter what position the teeth may take, the alveolar process is dependent upon the teeth for its shape and position.

7. He showed the difference between thumb-sucking deformities and those of the V and saddle arch.

In the same paper on "Arrest of Development and Excessive Growth of the Maxillary Bones," the author called attention to the fact that the jaws would become arrested and excessively developed from constitutional diseases in the following words: "The last, but not least, of the causes of arrested development of the maxillary bones, which I shall mention, is that due to constitutional diseases and the eruptive fevers. Debilitating acute diseases (fevers, the exanthemata), in children are sometimes followed by sudden overgrowth of bone, which is quite noticeable. This process affecting the jaw, may account for a certain proportion of those cases of measles and pneumonia which are followed by dental irregularities and maxillary deformities. In some cases, however, the process is a low grade of inflammation, which is followed by atrophy of the jaw, instead of hypertrophy or hyperplasia."

In a paper read before the Section of Dental and Oral Surgery of the American Medical Association, at Cincinnati, May 8, 1888, the author first classified the irregularities of the teeth into, (1) constitutional, those which develop with the osseous system; (2) those due to local causes; (3) *resume* 2 "Irregularities of the teeth cannot occur until they have erupted and thus shown their relation to each other and to the jaw." That is, the deformity commences at the sixth year and is completed at the twelfth year. By diagrams the author has explained how the forward movement of the posterior teeth would produce the same result as arrest of development of the maxillæ. Although the jaws were sufficiently large, the result of the forward movement would be to develop a V or saddle arch; hence the necessity of keeping the first permanent molar in its normal position. (In 1888, first edition of Irregularities of the Teeth.) In 1889, the author read a paper before the American Dental Association, Saratoga, New York, on "The Classification of Typical Irregularities of the Maxillæ and Teeth," the result of a collection of over two thousand models, and an examination of a thousand more, in the collections of Dr. Farrar, of New York, and Dr. Shepard, of Boston, and others in different parts of this country and Europe, making in all over three thousand. This classification was V, partial V, semi-V, saddle, partial saddle, semi-saddle, semi-V on one side and semi-saddle on the other. In 1889, a paper was read before the Dental Section of the American Medical Association, at Newport, R. I., June 25th, entitled, "Statistics of Constitutional and Developmental Irregularities of the Jaw and Teeth of Normal, Idiots, Deaf and Dumb, Blind and Insane Persons." In 1890, second edition of Irregularities of the Teeth; in 1890, a paper read at the International Medical Congress, Berlin, "The Differentiation of Anterior Protrusion of the Upper Maxillæ and Teeth;" in 1891, "Mouth Breathing not the Cause of Contracted Jaws and High Vaults." He showed by a large number of measurements and actual cases in practice that the vault was not contracted by mouth breathing; that contracted dental arches were as common among low vaults as high; that they simply looked high because of the contraction; that mouth breathing due to hypertrophy of the bones of the nose and mucous membrane, deformities of the nasal bones, adenoid growth and any pathological condition that would produce stenosis, does not produce the contracted jaws, but that all of these conditions are due to neuroses of development.

CHAPTER II.

CHANGES IN CLIMATE.

Man, in his development, must or should be studied as an animal, and from two great standpoints, because of the structures involved. First, the nervous system, and, second, the osseous or bony system. The changes that take place resemble the moulding of a human being in clay. If we watch the sculptor as he prepares his figure we perceive at first how ungainly and ungraceful it appears, but as he adds pieces of clay in one place and removes them from another, we see developing a most beautiful piece of art. Just as the changes take place in the model of clay, so greater ones take place in man. Having accepted the Darwinian theory, let us call the uncouth model the orang and chimpanzee; then as the figure passes through its various changes until it becomes a thing of beauty, so man, in his vicissitudes, rises to what we might call a perfect being.

We have now the framework upon which to build; the brain begins its development, and we find the osseous system built out at one point, reduced at another, just as the clay model was moulded. The animal which formerly possessed only instinct now begins to reason and to think for himself. When he depended upon nature for his subsistence he had no need for reason; now, through the various changes of climate and conditions, he begins to collect material for shelter and protection, and to cook his food.

The development of the nervous system is accomplished at the expense of the osseous system. Thompson says:* "The structure of the face arose from its parts having been created for the accommodation of the speech and sense organs, and upon these foundations the facial features were constructed and facial expression became possible. The invertebrate animals have the special sense organs scattered over the

*Dental Cosmos, 1890, pp. 633, 683.

entire body, so that there is really no face, strictly so-called, until we reach the vertebrates, where the face and special senses are located within a limited area upon the front of the head."

In the animal depending upon its physical strength for protection and food, the bony framework is very strong. The bones are large, long, and the attachment of the muscles very marked, thus indicating the muscular strength. Ascending the scale to man, the bones are smaller in diameter and shorter, showing that the muscles are not so large or strong. Like changes also take place in the shape of the head, face, jaws and teeth, and since man is no longer compelled to procure his food with his teeth or protect himself with his jaws, the jaws and teeth become smaller and change their shape. The brain is constantly enlarging and changing its shape, and the bones of the head, particularly the parietal and frontal, expand forward, laterally and upward, while the temporal muscle, zygomatic arch and jaws decrease in size.

In comparing the jaws of the orang and chimpanzee with that of the negro, we find a great difference in the size, shape and character of the teeth; and in comparing the negro jaw with those of the working classes, and the latter with those of the well-to-do class, who do not perform physical labor, there is as great a change as in the case of the orang and the negro. The changes are the result of the law of compensation. The human race has to develop in an intellectual line; to seek a higher plane and brain development without any or with little physical training. The result is a fully developed brain and a weak physical structure, which soon succumbs to death. In the preparation of the food of the present time mastication seems totally unnecessary, and arrest of development of the jaws and early decay of the teeth, with a weak physical frame, result. In comparisons of the shape of the head, face and general appearance of the people of the present time with those of our ancestors, it is plainly evident that the human race is improving in grace, beauty and intellect, while the changes in the general outline of the head, face and jaws in a few generations are very marked.

It makes no difference what views the reader holds in regard to the origin of man; we shall observe from facts which we have been able to glean here and there, that there is a gradual change in the structure of the bones of the face and jaws from the earliest race to the present time, and frequently we observe retrograde metamorphosis. As we look upon the different shapes of the head, face, and jaws of different nationalities, as well as of the people of one nationality at the present time, we must admit the fact that great changes have taken place in past generations, and that changes are still going on. The changes that are going on around us in almost everything, such as occupation, modes of living and dress, are much greater. Three of the greatest factors, however, which influence the changes are, change in climate, intermixture of races, and hereditary influences.

Taking this classification in order, we have first, change of climate. It is a well-known fact that climate has a great influence over the inhabitants of a country and their customs, both physically, intellectually and morally. The earliest races were a people among whom a physical degeneracy was seldom found. They had a nomadic tendency, consequently in journeying from one country to another, there was a mingling with foreign races, (the latter of which I shall speak more fully on in another chapter) and the various changes of climate from extreme cold or hot, and *vice versa*, have at last formed an entire new race. I can do no better at this time than to quote Dr. Quatrefages: "The human species springing originally from a single center of appearance is now universally distributed. In their innumerable travels, its representatives have encountered the widest difference of climate and the most opposite conditions of life, and now inhabit both the polar and equatorial regions. It must, therefore, have possessed the necessary aptitudes for accommodating itself to all the natural conditions of existence; in other words, it must have had the power of becoming acclimatized and naturalized in every place where we meet with it."

Certain monogenists have held that a human race could not effect a change of extreme climate without the loss of life, while others maintained exactly opposite opinions. At any rate, we know that many races have passed these two extremes, but it causes an entire change in the structure of the offspring, both in man and beast as well as fruit and vegetables. We know that the wool of sheep is different in each state of the United States, and an expert wool dealer can tell by the feeling from what part of the country or what state it has come. The same changes take place with the hog. In Russia, the hog has long, stiff, rough bristles with soft ends and long roots, with a large amount of wool intermixed for the purpose of keeping the animal warm. The color is gray, black, yellow and white. In Germany, the domesticated hog has short, slightly rough bristles with small roots. The color is gray and black. The French hog has short and soft bristles with very little wool. The color is white and yellow. In India, the bristles are short and stiff, intermixed with long hair with split ends; the roots are rough and large. The hog of China has smooth, medium length bristles with no roots, and the color is black. In the Southern part of America, the wild hog has stiff bristles; in the North, the domesticated hog has soft bristles. The color is black and white. It has been asserted that horses kept in the deep coal mines of Belgium become covered with a soft velvet coat not unlike that of a mole, while the change in cattle, dogs and birds is perceptible to all, but the change that takes place in man is equally as great.

The negro, perhaps, has undergone the most remarkable changes since being brought to the United States; his physiognomy is changed entirely. Reclus says: "In the space of 150 years they have passed a good fourth of the distance that separates them from the white race, as far as external appearance goes," while Quatrefages declares that a "sub-negro race has been formed." However, they still retain some of their ancestral characteristics, conformed to the effect of climate and associations. We notice this even in the colored people of the Northern and Southern states. In the South we find him still under the influence of slavery, or rather, the effects of bondage. There are a great number who are thrifty, well-to-do and educated, but the greater number still remain in ignorance, are lazy, and take on the character and manners of the poorer class of white people. This is due in a great measure to the high temperature of the country. In the North, where the temperature is lower, nearly all the colored people are educated and occupying good positions. The theory has been advanced that this is due to the colder climate arousing the people to activity. In the Irish people, we find the broad, massive jaw changed to a delicate one like those of the Americans. This is also true of the Swede and Norwegian, while the teeth of the Scandinavians decay almost immediately on their arrival in this country. This has been proven as due to the change in climate, as well as of diet. It has been well proven that Frenchmen can live perfectly well in Corsica, only they must avoid the Eastern coast marshes, which even the natives themselves cannot inhabit.

Every race being a resultant whose components are partly the species itself, partly the sum of the modifying agencies, has produced deviations from the original stock. This is in accordance with nature's laws, that still further modifying causes produce conditions differing from any that the race has known before, thus changing types in a very marked degree.

The pilgrims, who braved the storms of the ocean and landed on Plymouth Rock, would doubtless have remained in obscurity had they still continued to live in the Old World, but instead they founded a country which at this time compares with any on the globe. Through their bravery in withstanding the winters upon the bleak and barren coast of New England, and also the fortitude with which they bore the hardships and trials of life, they have won an everlasting fame. Had they landed upon any other point than in New England, in all probability the foundation principles of the Constitution of the United States or the Declaration of Independence would never have been written with such forethought or decision.

These people and their direct descendants stood by and protected the infant republic, first from the depredations of the red man and second from the still greater power of England.

Many years ago, when the government surveyors had finished their work in Minnesota, they reported to the authorities in Washington, D. C., among other things, that it was impossible for human beings to live the whole year in that state, owing to the extreme cold in winter; now not only do people live and cultivate the soil throughout the entire state, but a large city has sprung up still farther north, and the country around has become well populated.

In a lecture, delivered by the late Henry Ward Beecher, after an extended tour of this country, he said that the representative men of this country would come from the Northwest. He believed that the climate and its various changes would develop a race which would be unequaled anywhere in America. I can well remember fifteen years ago when emigrants were unable to obtain a living throughout the middle and western part of Kansas, owing to the drouth. The soil would not yield crops, trees would not grow, and fruits and vegetables could not be cultivated. Now the state is well populated; the finest fruits and vegetables are raised; the country is well watered, and prosperity is noticed upon every hand. As a marked illustration of the effects of climate upon people, we have only to look at the prosperity and growth of some of our Western cities and towns. The inhabitants are made up of people from every climate. The Spaniards, Italians and Greeks from the balmy shores of the Mediterranean, the white and negro from the sunny South, are all transformed from their indolent habits, become enthused and rush on to keep pace with their brother from the colder North. In many cases this is due to the sudden changes in heat and cold, and these changes in climate frequently produce suffering and even death.

It has been a disputed question among anthropologists as well as doctors as to the possibility of acclimatization of Europeans in the archipelagoes of the great Mexican Gulf. A number of general facts seem to leave no doubt but that the answer should be in the affirmative; but the yellow fever and its influence appear to be particularly fatal. The reader must not mistake my meaning to be that the Europeans cannot live on these islands, for they have occupied them since the discovery of America, but the climate seems to be more fatal to them than in any other part of the New World. The white race has brought the negro to these islands, and in the course of time they have replaced the Carribean race; but though these islands are among the most favored spots on the globe for emigration, yet the race if left to itself would almost entirely disappear.

The structure of the osseous system of individuals changes greatly. I do not mean those who have attained their growth, but the children taken to the new country, and those born there. For instance, when Europeans settle in America, their bodies and limbs become elongated. In all probability this is due to the dryness of the atmosphere causing more evaporation. Observe the stature of the American Indian; the great development of their bones and limbs is the result of abundant food, a temperate climate, and roving habits in a wild country.

Some authors assert that climate does not cause the differences in the races, and that the intermixture of races causes the difference. We all know that intermarriage has a great influence, but climate, while, if it has not a greater influence, is at the same time one of the prime factors. It is the climate more than any one thing that has made the Aryan of India so different from the Aryan of Persia.

We all know that the people who live in the limestone regions develop larger osseous systems than those of other parts of the country, and also people who live in places supplied with water from artesian wells develop large-framed men and women.

A change of climate and soil, in cases of long illness, is nearly always beneficial, when made at the proper time, especially in case of people with weak lungs, and arrest of development of children as a result of constitutional diseases. The effects of climate upon the individual either tend to build up or break down the general system of those who have obtained their growth. In such cases the osseous system is not changed materially; but it is in the young children brought into the country, or children born of parents who have emigrated, that the general changes take place.

Thus we see that climate and soil have a great influence on the inhabitants of a country.

CHAPTER III.

INTERMIXTURE OF RACES.

In the preceding chapter we have shown that man from the earliest times was a traveler. He had the same desire to explore unknown regions and to mingle with strange people that he has today.

Let us assume the fact that previous to 300 years ago the races did not mingle as they do now. Also, the tribes and races that did come together did not present such a marked contrast in appearance.

In the early times the people made only short voyages along the coasts in rudely constructed vessels, of which the caravels of the Spaniard and vikings of the Norseman are good illustrations. These vessels could not withstand the heavy seas and high winds of mid-ocean, and even in many cases the winds and rains which swept along the coast doubtless carried some poor ship down; so that emigration by water was almost nothing, and hence nothing was known of distant countries or races; but the question arises, was it any better by land? The people in their journey over mountains and plains, through barren tracts of land, many of their companions a prey to wild beasts, while oftentimes whole caravans were destroyed by the fierce torrid winds of the desert, overcame these great disadvantages, and though it took many hundreds of years, and at last populated European countries and produced the various types of man now found.

We must date the commencement of emigration, as well as the discovery of the New World, that was eventually to produce the marked changes that constitute the new races, to Columbus. Very little, however, was accomplished in this direction in this country until a century later, when the mixture of blood became very conspicuous, as the result of the conquest of the Indies, Mexico and Peru, 1515–1534, and still later the landing of the Pilgrims, 1620.

In the nineteenth century we find that intermixture of races and emigration has gone on to such an extent that we sometimes stop and ask the questions, what shall we call this new race that has sprung up, and is there a pure race on the globe at the present time. As regards the first, it has never been answered satisfactorily; for the second, let us take as illustrations the Jews, Chinese and Japanese. I think I am quite safe in saying that these are the only pure races. Of course, some few of these have intermarried, but the nations as a whole are almost entirely pure.

The great emigration and intermixture are due to the inducements of liberty in religious beliefs, labor, high wages, liberty as opposed to oppression, and the desire of the people for better conditions and comforts in new countries, in contrast to the crowding and scarcity of work in the old country.

Traveling long distances by sea and land has brought together nations of the greatest possible differences in opinions, modes of living, and peculiarities in the structure of the osseous system.

Each country has its peculiar type of people. Africa its negroes, America its tribes of Indians, Japan and China their own particular people, and throughout Europe, the white races, each indigenous to its own country; but how different and marked are the changes in the osseous system. This has been nicely illustrated by Prof. Putnam in his collection on anthropology at the World's Fair, showing conclusively that the marked changes are in the size and shape of the bones.

When a race has lived in its own country, without change in habits or mixture with other races, there is no reason to expect a change in its type.

The Egyptian is a good example of this. In comparing a picture taken from Rameses II, about 3,000 years ago, with the Egyptian of today, we can discover little or no change. The Ethiopians on the early Egyptian bas-reliefs have their counterparts among the white Nile tribes, while we recognize in the figures of the Phœnician or Israelite captives, the familiar Jew of our own day. This illustrates conclusively that a race may keep up its special characters plainly recognizable for over thirty centuries.

One of the most conspicuous examples, and the one most familiar to all English speaking people, is that between the negro and the white race. The mulatto complexion and hair are intermediate between those of the parents, and new grades of complexion appear in the offspring of the white and mulatto, the latter being known as the quadroon. The intermediate character in all race mixtures, however, has a tendency to revert to one or the other parent in a more or less degree. Referring again to the colored people for example, we see that here the offspring presents all the characteristics of the mixed race. Some of the children may resemble the white father in color, but have the features of the mother; rarely do we find two children whose parents are one white and the other colored, that have the same color, or whose hair is the same. The greatest change, other than color, is the hair. The mulatto's hair is an intermediate between the short, crisp, woolly hair of the negro and the hair of the white man. When mulattoes marry into their own race—that is, the colored race—in most cases their offspring will take on the full negro type, but if a mulatto marries any other race, the offspring rarely has any of the negro features; sometimes, however, they will revert to their negro ancestors.

A mixed race invariably arises where the races inhabit the same district, and within the last few centuries it is a well-known fact that a large fraction of the world's population has actually come into existence by race-crossing. This is more evident on the American continent than elsewhere, for such districts as Mexico, which, since the Spanish conquest, has become largely populated with descendants of Spaniards and native Americans. The intercrossing of races has given anthropologists a wide field in the endless shades of diversity among mankind. It is a hopeless task even to classify each group into a special race. The difficulty of making a systematic assignment of each man to his particular race is well illustrated among the Arabs. There is a class of them who speak the Arabic tongue, are Moslem but not

Arabs proper, neither are they Egyptians of the old kingdom, but of a land where the Nubian, Copt, Syrian and Bedouin have mingled for ages; hence their ancestry may have come from three quarters of the globe.

In India, a variety of complexion and feature is found which cannot be classified by race exactly, but we must remember the distinct varieties of men who have contributed to this dense population, the dark-brown indigenes, or hill tribes, the Mongolians from the frontiers of Thibet, together with the fair Aryans or Indo-Europeans from the Northwest, and this mixture going on for ages has produced numberless crosses. So in Europe, the fair nations of the Baltic and the darker nations of the Mediterranean by their crossing have produced an indefinite diversity of brown hair and intermediate complexion.

Heterogeneous races have by intermixture given rise to raceless masses, people which present no fixed characters, and who form, so to speak, dispersive circles around the original species, which at their points of contact become confluent.*

Pure races exhibit a more uniform type, and the mixed races a variegated type, and this variation increases as the intermixture increases.†

When we hear of a people which, despite a low state of intellectual culture, exhibits a variety in features, nose, lips, as for instance among the Tschuvashes, we shall not be wrong in considering it as of mixed origin.

The Samboes, descended from an Indian and negro, in the south of the United States, present sometimes crisp hair with copper-colored skin, and all other Indian characteristics, and sometimes the coarse hair of the Indian upon the head of the negro, with a black skin. There is here no intermediate type produced by intermixture, but there is produced an irregular agglomeration of the characteristics of the parent forms.‡ It might be demonstrated that these different races, the people of Northern Italy, Southern Germany, Great Britain, not to

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* Vogt.
† Waitz, "Anthropology."
‡ Ibid.; Forey on Schoolcraft.

speak of the United States, where the fusion of blood is probably inexplicable, have given birth, by their intermixture, to ethnological modifications still recognizable. In all these countries the instability of anthropological characters is in contrast with the fixity which marks pure races.*

The union of different nationalities is more common in this country than in any other; due, no doubt, to the fact than people of all countries and nationalities flock here to better their condition in life. We would expect that marriages would naturally result from a commingling of these foreign elements, especially in the newer parts of the country. Immigration of different nationalities, and intermarriages which take place, tend to improve the race physically in some respects, and in others degeneracy results. Inasmuch as the tendency in this country is toward the production of small jaws, while the jaws of foreigners are much larger, the offspring of such marriages would naturally inherit the extreme peculiar characteristics of both parents. Such peculiarities are very noticeable in the tribe of Marshpee Indians on Cape Cod. The present people are descendants of the original Indians, who married among the whites, negroes and Portuguese. These intermarriages have continued down to the present generation, making seven or eight generations in all, until, as Professor Putnam, of Harvard College, has said, "there is very little Indian blood left." There are, however, three or four of the older people who still retain all the characteristics of the early Indian race. It is very interesting to observe the peculiar features of the younger generation, a few of which I will describe. A little girl, eight or ten years of age, presented all the peculiarities of the negro,—broad nose, thick lips, dark skin, with the long, straight, black hair of the Indian, reaching nearly to her waist. Another, Mrs. H., whose mother is half white, father negro; she is full negro in appearance, except the skin, which is copper-colored. The jaws are slender in outline, and quite unlike the father's. Mr. K., great-grandfather, negro; mother, Indian; father, three-fourths Indian. He has large jaws like the

* Broca, "Hybridity in Genus Homo."

negro; long, straight hair, copper-colored skin, high cheek-bones. Mr. P., maternal grandfather, Portuguese; paternal grandfather, negro; paternal grandmother, Indian and white; maternal grandmother, Indian and negro. He has fine curly short hair, negro nose, high cheek-bones, large jaws and teeth, upper and lower teeth occlude. I could give from my note-book many other illustrations of these marked changes in bone-structure, and also peculiar mixtures, produced by the union of different nationalities, but enough has been said in regard to this tribe to show that when there is a union of different nationalities, the offspring inherit not only the peculiarity of one parent, but frequently possess a mixture of the peculiarities of both. A similar class of people, made up of a union of Indians and negroes, is located in South Carolina, and called by the people "Red Bones." They have been thus described in an interview with Senator Hampton: "They live in small settlements at the foot of the mountains, and associate with none but those of their own race. They resemble in appearance the gypsies, but their complexion is red. This intermixture, which is common in the Carolinas, produces marvelous results. It takes the kink out of the hair of the African, strengthens his features, and improves him in every way except in temper."

These inherited peculiarities do not cease at the first generation, but are transmitted to at least the seventh or eighth generation, as I have shown in the cases of the Marshpee Indians. It would seem that, from these cases, race peculiarities under favorable circumstances might be carried on indefinitely. There is a tendency on the part of these Indians, due no doubt partly to the mixture of white blood and partly to the soil, climate and environment, to take on the general make-up, as regards the osseous system, of the native white people, but far as my investigations went, I was unable to observe the high vault, irregularity of the teeth, and the neurotic condition so noticeable among the native white people. While they possess the same facilities for schooling, they lead a very quiet life of farming, fishing and out-door work generally. The trades, professions, and such lines of work are not sought after, and hence neurotic conditions are not found.

The improvement of the "Red Bones" over the negro by "straightening his features," mentioned by Senator Hampton, must necessarily consist of a change in the bones of the face. These changes must be brought about by the union of the negro with the Indian, producing children not unlike those already mentioned in connection with the descendants of the Marshpee Indians. Americans are all familiar with the changes that have taken place in the features of the negro, due to their consorting with the whites. The lower jaw of the children diminishes in size from generation to generation, and the anterior lobes of the brain increase posteriorly, the vertical portion of the frontal bone assuming more of a right angle with the horizontal portion. In this manner the octoroon and quadroon acquire in many cases beautiful features.

That mankind was already divided into a few great main races, in remote antiquity, will go far to account for the innumerable slighter varieties which shade into one another.

In speaking of the mixed races which come to this country, we must not lose sight of the fact that the neurotics and degenerates of all the countries of the world either come here from the great inducements offered or are exiled, and when they intermarry with our own population, the result is a native class of degenerates made up of all the deformities of the brain and osseous system that are known to civilization. As early as 250 years ago this class of the degenerates settled in Pennsylvania, Virginia, but more particularly in Georgia. The result of the accumulation of paupers and degenerates has flooded the country and lowered the standard of mankind. As will be found in another chapter, this taint has crept out in otherwise respectable families.

What we have found to be true of the people of this country is also true of our English cousins. Here we find the deformities more marked than in this country, or even among the other nationalities of Europe.

In prehistoric times, and even as late as the Roman Conquest, the natives of Britain were a race of immense stature. It has been stated that captives taken to Rome were the tallest people in the entire city.

Of all the races of Europe the English are, perhaps, the most mixed. The English may be considered as a race resulting from the intermarriage of the Angles and Saxons with the native inhabitants of the British Isles prior to the Saxon invasion. According to Prof. Huxley, Britain was populated by a dark and a fair race. The dark race, resembling the Iberians, inhabited the western parts, while the fair race, resembling the Belgian Gauls, the eastern districts of the island. At the time of the Roman Conquest the language of Britain was wholly Celtic, but the land was still in the possession of the two races. Subsequent invasions failed to alter the relation of these stocks, though they spread a third wave of language (Teutonic) over the entire Celtic-speaking area, leaving only traces of the old tongue in Wales, Ireland, Scotland and Isle of Man. About the fifth century after Christ, the Angles and Saxons invaded Britain and mingled with the Celtic-speaking inhabitants, who, together with the few remaining Romans, peopled Britain. Then, the first invasion of Great Britain by the Normans and Danes during the ninth, tenth and eleventh centuries added to this blood, already so mixed, another foreign infusion. Figuier, in his "Human Race," says: "The level plains, which are as a rule met with in England, are not favorable to the development of the lower extremities, and it is a fact that the power of the English lies not so much in the legs as in the arms, shoulders and loins. The fist is an Englishman's natural weapon, either for attack or defense." The changes which have taken place in the size of the jaws between the early Britons and English people of the present day are of the most marked character. By actual measurement of the superior maxilla, from the outer surface of the first molar upon one side to the outer surface of the other, there is a difference of .32 of an inch, showing that the jaws have been gradually growing smaller. If the measurements had been taken from the outer surface of the second bicuspids a greater change would have been noticed, because of the fact that degeneracy of the jaws takes place anterior to the first permanent molar.

Anthropologists claim that in the earliest history of the world man was divided into two great classes—brachycephalic, or broad head, and dolichocephalic, or long head. There is a difference of opinion among anthropologists as to what constitutes a broad or long head. Broca's division is perhaps the most authentical. He gives five divisions, as follows:

True dolichocephalic, -	below 750
Sub-dolichocephalic, - -	750 to 778
Mesocephalic, - -	778 to 800
Sub-brachycephalic, - -	800 to 833
True brachycephalic, -	above 833

While Professor Flower, of the Royal College of Surgeons, England, simplifies this table by the following:

Dolichocephalic, - -	below 750
Mesocephalic, - - -	750 to 800
Brachycephalic, - -	above 800

These measurements are obtained by dividing the extreme breadth of the skull by the length from front to back and multiplying by 100. The general subdivisions, as given by anthropologists, are: the black race, dolichocephalic; the white races, mesocephalic, and the yellow races, brachycephalic; the Lapps, brachycephalic, and the English, mesocephalic, while the North Germans are sub-dolichocephalic, and the South Germans sub-brachycephalic.

It is not the intention of the writer to discuss the antiquity or the classification of these different types of man. That they did exist very early in the history of the world is amply illustrated by the specimens that have been exhumed in different parts of Germany and England, and are to be seen in the different museums throughout Europe.

From the earliest history down to the present time these two types have intermingled, and are to be seen to a greater or less extent among all the nations of the world. The tendency seems to be for the dolichocephalic, or long-headed race, to merge or change into the brachycephalic, or broad-headed people, although the evolution of the brain would at first contradict this statement. The evolution of the brain has developed anteriorly by a gradual pushing forward of the frontal bones. The original, or pure African, type representing the lowest form of man, shows how quickly in the colored race the changes from the dolichocephalic to the brachycephalic have taken place by changes of climate and intermixture of races. The dolichocephalic, or long-headed type of the African, has changed during the past two or three generations to a mesocephalic and brachycephalic.

Upon the examination of about 2,000 colored people in Chicago, I have been unable to find but six who possessed dolichocephalic heads. The others were mesocephalic and brachycephalic, with their modifications. This tends to show that changes in climate and intermixture with the Indian and white races have completely changed the shape of the head as well as the entire physical structure of the African. The sudden changes in type are not confined to this race, but are found among some of the New England families. This leads me to believe that these sudden changes in type could take place in the shape of the head from dolichocephalic, and *vice versa* in any family under similar conditions in any part of the world. As we have seen, marked changes in the shapes of the head result from change of climate and mixture of races; the shape of the jaws must necessarily change to correspond with the shape of the head.

The changes, which occur in the general outline of the head and jaws in a few generations, are excellently illustrated in the following portraits of a noted family in this country. Four generations are here shown, in the order in which they lived. The cuts are drawn from daguerreotypes and photographs, and of course are useful only in giving the general outlines of the shapes of the heads. Unfortunately, the hair upon the faces depicted in the last two illustrations forbids any comparison being made so far as the jaws are concerned. There is, however, such a contrast in the shapes of the heads that those who are familiar with craniology can readily trace the changes which would naturally take place in the shapes of the jaws.

Fig. 1 represents a man born in Connecticut in 1761; died in 1826. This picture represents a dolichocephalic head with massive jaws, prominent lips, especially the upper. The nose

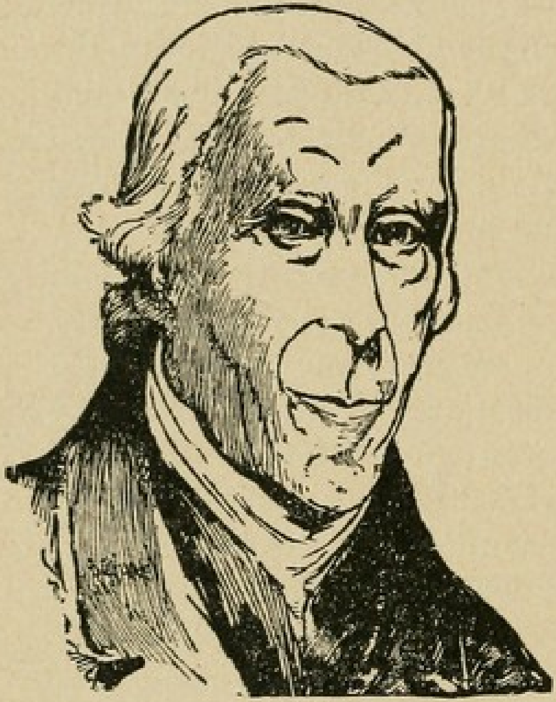


Fig. 1.

Fig. 2.

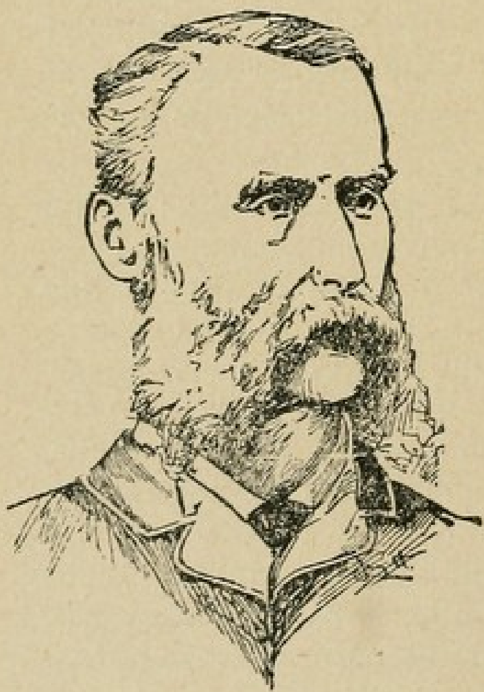


Fig. 3.

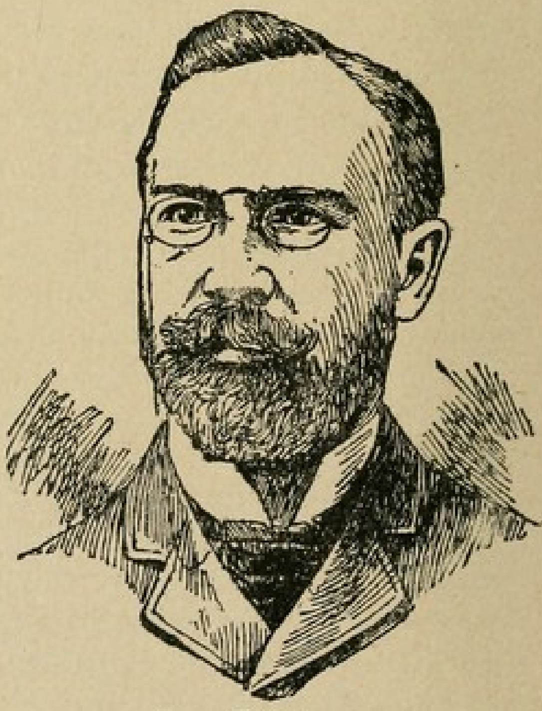


Fig. 4.

is long, and the eyes are set close together; the forehead very high and straight.

Quite a change is noticeable in the second generation, depicted in Fig. 2. The face is not so long, the lateral diameter of the head is larger, the forehead more prominent, and the eyes are a little farther apart. The nose is about the same length, and while there is a general resemblance about the mouth and chin, the distance from the front of the chin to the tip of the nose is not quite so long. The change seems to be in the shortening of the chin.

Fig. 3 shows still further change. The forehead is broader and less retreating than either. There is perceptibly less prognathism. There is less prominence in the supraorbital region.

Fig. 4 shows a head just the opposite of Fig. 1. This is a brachycephalic head. The head is nearly round; forehead full; eyes set in the head to correspond with the width of the head; nose broad; upper lip short, and lower jaw much broader than in Fig. 1. The lower jaw is evidently much shorter in a perpendicular line. These changes are due to a protruding forehead, receding chin, and delicate features.

We have seen by these cuts that in four generations shapes of heads have entirely changed. It is possible that the reverse changes from brachycephalic to dolichocephalic might take place, but I am of the opinion that the long-headed races are gradually becoming extinct and the broad-headed race taking their place.

Anthropologists are familiar with the changes that take place in the jaws, corresponding to the changes in the head.

CHAPTER IV.

HEREDITARY INFLUENCE.

It is not the intention of the author to say more than a few words upon the subject of heredity; so much has been written that it is useless to enter deeply into the subject. It will only be attempted here to give a few facts pertaining to heredity in general, thus bringing the matter more vividly before the reader; but later on heredity as relating to the special study of the cranium, face, nose, jaws and teeth will be discussed.

Anthropologists agree that heredity is that influence which foreordains that the offspring shall be in the likeness of the parents. This is Nature's great law, and it is universal from the lowest forms of vegetable and animal life to man.

It is marvelous what an extent the hereditary influence of each of the parents has over the offspring, with such different characteristics, however, that it is almost impossible to speak of both in the same terms. Each individual is single or simple in one aspect and composite in another. We seem to inherit bit by bit, or piece by piece, this element from one parent, that from the other, until an intermediate individual is formed. These elements, however, are liable to some small changes during the process of transmission. The child receives life from his parents, and with that life takes up a certain estate of moral, mental, and physical characters.

The inheritance of a trait of bodily figure, character or action is a mystery as great as the apparently sudden change in a race, which for many generations has produced a seemingly unchanging succession of attributes—bodily, mental or physical.

Peculiarities of structure, however, possess a double interest, both of variation and persistence. Science has as yet failed to find the cause of these peculiarities. They appear in a family, from what source no one knows, and there they remain as hereditary traits, inherited intermittently or regularly. We shall be able, in the study of the face, jaws and teeth, to show quite clearly how modification in structure is handed down from parent to child.

Heredity is often dependent upon climate, soil and intermixture of races. While children are inclined to inherit parental qualities, yet the tendency is eventually to develop a race like the indigenous stock referred to in the chapter of climate. In other words, climate and soil modify the different generations to such an extent that in the period of five to ten generations the offspring will assume the outward appearance and also the habits of the people with whom they associate.

In an area of a few hundred miles in Europe, we find the Italians, Germans, French, Spaniards, Russians and Bohemians, each with different features, customs and modes of dress. In the same area in the United States, the native Indians of the several tribes, have the same different characteristics in features. Transport a French colony to Russia, the future generations will conform to Russian type (though they do not intermarry); that is, they will assume the Russian customs and habits through climate, soil and associations. In the United States, these same conditions would take place, if the Penobscot Indians of Maine or the Marshpee Indians of Cape Cod had emigrated to the western country. In this case, however, the changes would be more marked. In the course of two or three generations, the long, slim individual would become more like the short, thick-set individual of the Sioux or Manitoba tribes, and their peaceful nature would change to the character of the ferocious Apache or Crow.

This is also nicely illustrated in comparing the inhabitants of today of the Eastern, Southern and Western states of the United States and the negroes of the South with those of the North. The people differ in features, speech and modes of living nearly as much as if they resided in different countries.

Owing to the fact that the greater part of the United States has only been lately developed, and emigration dates back only about one generation, and to the intermixture of different nationalities, the fixed types, which are so marked in Europe and among the different tribes of American Indians, are not observed to such an extent, but the transformation is slowly going on. Nisbet says: "If a Latin-Spanish colony settled in Germany, and remained there, we are bound to believe they would eventually conform to the German type. The influence of the physical surroundings steadily exerted would gradually overcome that of heredity, although the process might occupy thousands of years. Thus we see that heredity and physical conditions work together in the moulding of a race."

The Jews, from an hereditary point of view, are also interesting. They inhabit every country of Europe, and though they frequently intermarry, and differ greatly in physical characteristics, still any Jew can be told by his nose, which, according to Nisbet, "is as much a matter of heredity as the thick lip of the Imperial House of Austria." The German Jew differs from the Portuguese or even the Spanish Jew. Each may be of pure Jewish blood, but he conforms in a more or less degree to the type of the people with whom he associates. The hair and complexion are mainly affected, but the expression and shape of the features are everywhere significant of Jewish blood. Victor Cherbuliez has said that "every country has the Jew it deserves," and to my mind this must be partially true, for Jews that have lived for generations under free goverments are not so apt to be as treacherous and unreliable as those who have lived under despotic governments. The English and French Jews make better citizens than those living in the eastern countries of Europe.

Hereditary peculiarities are both natural and acquired. By natural conditions we mean those that are of a physical nature, while acquired conditions are those that come to us through habit, association or accident. De Quatrefages says: "The acquired nature is, so to speak, welded to the original nature of the being."

It is of the natural conditions, however, that I wish to speak most in this chapter. They are everywhere noticeable;

sometimes not appearing until late in life, yet they are rightly to be called natural, unless they are extremely exceptional or have never previously appeared in a family; even if possessed by some ancestor, they would still be hereditary and natural. Galton says: "Natural peculiarities are apparently due to two broadly different causes; the one is family likeness and the other is individual variation." These seem to be much opposed to each other and to necessitate a separate discussion, yet the reader can readily understand how the offspring can possess a general or even an individual likeness to its parents and at the same time have a large amount of individual differences. Thus, to my mind, family likeness and individual variation are dependent upon each other, each being different effects of the same cause. Some variations are, however, so remarkable that they appear to belong to a separate class. We shall be able to show, in a future chapter on Neuroses of Development, why these marked differences exist between the child and parent.

A number of small accidents tend to produce variations in the different members of a family; therefore it is almost impossible to enumerate the qualities of an individual from hereditary data, but we can predict the average results with great certainty.

The possibilities of inheritance do not differ much more than the varieties actually observed among the members of a large family. We may have the life-histories of parents and relatives and also the offspring. In comparing them, we find that each one's life seems to run apparently in the same line; that is, the offspring from generation to generation will have some characteristics of his ancestors.

Perhaps there is no one thing that is inherited more directly than disease.

Family history often shows that two and three generations have died from inherited diseases, and then again it will pass over one generation and appear in the next. The inheritance of insanity, and co-existing diseases of the brain, have about the same direct per cent that lymphatic disease does; yet, lymphatic disease, as an hereditary trait, "dies out," as we say, much quicker than insanity.

A good example of this is found among the royalty of Europe. Even as far back as the Cæsars we find this taint, beginning with Julius, though during the entire reign of the Cæsars Roman society was so corrupt that the family may even be considered a model one for the times. But let us now observe the royalty of England, beginning with the Plantagenet period. According to Jacoby, the rival houses of Lancaster and York were both degenerate, the former being a family of imbeciles, and the latter, to use a strong term, villains. The deformed moral imbecile, Richard III, nicely illustrates the villainous nature of the family. The Tudors were somewhat similar. Henry VII was an epileptic, and the morbid features of Henry VIII and his children are familiar to every reader of history. Insanity of the Stuart line dates from Mary Tudor, and was inherited through Mary, Queen of Scots, by James I of England. We shall return to Elizabeth and her successor's reign later, and now follow the direct Stuart line. Nisbet speaks thus of the Stuart line: "Charles I was perfidious and cowardly; Charles II, depraved, epileptic and without lawful issue; the brother of the latter, James II, was treacherous, epileptic and vindictive, mendacious, cruel and ridiculous to boot; Mary, daughter of James II, was weak-minded and childless, and hence a prolific neurotic, and not a healthy or long-lived family. Finally, Charles Stuart, the pretender, the last of his line, was illiterate, dipsomaniac, paralytic and died insane." But, to return to the Stuarts: several of the children of Elizabeth died young, and it was through her younger daughter, Sophia, who became heiress to the throne, that the Hanoverian line was established, and the question arises, did she bring this taint to the throne? For an answer we must look at the careers of the Four Georges. In George III, however, the insanity of the Stuarts re-appeared. From the Georges on, the occupants of the throne of England, according to Bismarck, are the "crazy and scrofulous Guelphs," among whom are bleeders, epileptics, hysterics and other neurotics, and the taint is still observed at the present day. History but repeats itself in the royal families of Spain, Germany, Austria and Russia.

I have mentioned the lives of these royal families, with the names of which we are at least all familiar, to show that the taint of insanity, and its modifications, is inherited from generation to generation for hundreds of years; but the common inhabitants of the world are not exempt from this taint. It should be noted that the great causes of insanity and its modifications are the result of idleness, drunkenness, debauchery, and consanguineous marriages, and that the consequences of these conditions are a weak physical structure in the progeny, which results in early death or insanity, drunkenness, epilepsy, deafness, mutism, blindness, idiocy, egotism, genius and brilliancy.

Few will deny that what is true of the whole organism is equally true of its different parts, organs, functions and energies, and that in the formation of a new being, the action of heredity is divided into as many varieties as there are characters to be transmitted. There is a tendency on the part of each parent to reproduce itself in the child, and consequently there is a constant struggle between the two natures in the morphological growth of the child. The more dissimilar the parents, the greater the struggle, and the more certain the predominance of leading characteristics, and the greater the tendency to morphological abnormalities, arrest or excess of development. The outcome of this struggle, assuming inequality of action on account of one parent being stronger, is a number of single combats in which one or the other of the parents is vanquished.

Differences of opinion of scientists have existed for many years as to whether acquired peculiarities are capable of inheritance. Some of the latest writers upon this subject claim that they are not inherited, but even Weissman, the strongest opponent of the inheritance of acquired qualities, has to admit the inheritance of epilepsy, and Eimer has shown that Weissman's admission in the case of epilepsy must, on Weissman's own principles, be extended to other neuroses.

In a future chapter it will be shown, by actual demonstration, that peculiarities of structure, which are known to be the result of constitutional diseases, are inherited by the successive generations.

Children may resemble their parents in habits, manners, customs and disposition, yet be wholly unlike them in structure as far as the features are concerned, though the physical structure may be the same. The effect of habits and manners of parents on the offspring is very striking. It is usually said that boys assume the habits of the father and girls those of the mother. This may be or is so from association.

Such peculiarities as stammering, lisping and the like may seem to some scientists as referable to a special class of hereditary traits, but it appears to me that this cannot be so, and that they are acquired habits. In my own experience I have known children who both stammered and lisped either because they heard one or the other of their parents or playmates do so. This class, I believe, may be termed neurotic individuals. Neurotic qualities of parents are often inherited by the child, who becomes the victim thereby of contending mental states.

I have purposely referred to inherited neuroses and degeneracy in the royal families of Europe, because in the chapter upon Developmental Neuroses we can more easily understand why deformities of the face and jaws are noticed in otherwise apparently healthy individuals, as well as in idiots and feeble-minded.

CHAPTER V.

DEVELOPMENT OF THE CRANIUM AND FACE.

In early stages of development the posterior part of the cranium is large in proportion to the anterior part. At about the second month of fœtal life the parietal region begins to increase rapidly in volume along with the greater development of the cerebral hemispheres; the frontal region next begins to increase in size, and toward the latter part of fœtal life the occipital region increases as the brain extends backward. The face at birth is in surface about one-eighth of the cranium, while in the adult it is fully one-half.

At birth the face still shows peculiarities which resemble those of the fœtus. The ears are much lower than in the adult, the external opening being but little above the mouth. Racial distinctions are not at all pronounced, the children of the most strongly marked races showing great similarity, according to the law that the farther back we go in development the more generalized are all the features.

After birth there are three distinct periods of development, the first ending at about the seventh year, the second at about the fourteenth, and the last at about the twentieth year.

The transition from the first to the second type is quite a striking one. The skull grows rapidly during the first seven years. By that time certain parts have reached their definite size: the circumference of the occipital foramen, the body of the sphenoid, the cribriform plate of the ethmoid, and the petrous portion of the temporal bone. The eruption of temporary teeth, the gradual modeling of bones by growth, the development of muscular prominences and depressions gradually change the infantile character of the physiognomy.

The face becomes longer in proportion to its width, and the jaws are shaped with reference to use in mastication. In the second period very many of the forms are already adult, and, if not at their fullest development, have very nearly approached it. From six to twelve the growth is somewhat slow. With the approach of puberty a second period of active growth begins. This period especially affects the face and frontal portion of cranium. With this we also note the expansion of the frontal and other air sinuses. From fourteen on there is very little advance in cranial development.

The face becomes elongated in the process of growth, partly by the increased height of the nasal fossæ and the adjacent air sinuses, partly by the lengthening growth of the alveolar process and the enlargement of the jaws.

The base of the skull, together with the face, increases relatively in size from birth onward; the skull as a whole, in proportion to the face, decreasing.

The bones of the face are developed by the intramembranous ossification, with the exception of the symphysial portion of the inferior maxilla. The nasal bones are each developed from a single center in the membrane overlying the fronto-nasal cartilage. This center is seen in the eighth week of fœtal life. At birth the nasal bones are nearly as wide as they are long, but in the adult the length is three times greater than the width.

The malar bones each ossify from two centers, which appear also in the eighth week.

The superior maxilla arises from four centers, termed the pre-maxillary, maxillary, malar and pre-palatine, which appear about the eighth week, and ossify rapidly.

The portion of the bone which lodges the incisor teeth arises from the pre-maxillary nucleus. The nasal process and the greater part of the body arise from the maxillary nucleus. The portion of the bone external to the infra-orbital groove arises from the malar center, and the nasal surface and part of the palatine process arise from the pre-palatine center.

The inferior maxilla has six centers of ossification for each lateral half.

These centers, all but the splenial, are deposited between the sixth and eighth weeks. The splenial appears about three weeks later.

At birth the inferior maxilla consists of two lateral halves, which unite during the first year; union, however, is not complete until the second year. The most striking features of the skull at birth are its relatively large size in comparison with the body, and the predominance of the cerebral over the facial portion of the skull.

The origin of the structural points, which constitute the permanent expression of the head and face, as we have already said, is to be studied from the standpoint of evolution.

The bones of the head and face are shaped and clothed with flesh according to the action of past and present influences. The present influences are the present needs, surroundings and habits of the individual. The past influences shape the embryo, and mark the infant with a likeness to its parents. After birth the hereditary impulse carries on the development of the structures through the nervous system. The types of the parents and ancestors are mingled and modified by present circumstances, such as climate, food, habits of thought and action.

E. D. Cope, in his article on "The Development and Significance of Human Physiognomy," has brought together the following statements in regard to the changes in the face and head of man during his evolution from an animal to a civilized being.

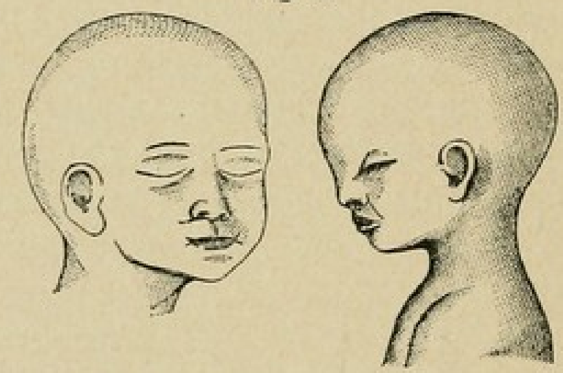
The points to be considered in the structure of the head and face are as follows:

1. Relative proportion of cerebral and facial regions.
2. Prominence of forehead.
3. Prominence of superciliary ridges.
4. Prominence of alveolar borders.
5. Prominence and width of chin.
6. Relation of length to width of skull.
7. Prominence of the malar bones.
8. Form of nose.
9. Relative size of orbits and eyes.
10. Size of the mouth and lips.

Changes in the above points are traced from previous conditions of man by the study of paleontology, and by the study of the development through the embryological existence. In comparing the human head and face with that of the order Quadrumana, we notice the following general differences in the shape of the head and face. Numbers correspond to the list above given.

1. In the ape the facial region of the skull is large as compared with the cerebral.
2. Forehead not prominent, generally retreating.
3. Superciliary ridges more prominent.
4. Edges of the jaws more prominent.
5. Chin less prominent.

Fig. 5.



A — B

A—Front view. B—Side view, after Cope.

6. Cheek bones are more prominent.
7. Nose without a bridge, cartilages short and flat.
8. Orbits and eyes smaller (except in Nyctipithecus).
9. Mouth small; lips thin.

Should any man possess any of the above characteristics, he, in feature, becomes more like the monkey, as he retains features which have been obliterated in others of his species in the process of evolution.

In studying from an embryological standpoint, we must consider the head of an infant at birth. (Fig. 5.)

1. The cerebral part of the skull greatly predominates over facial.
3. Superciliary ridges are not developed.
4. Alveolar borders are not predominant.

8. Nose is without bridge, and cartilages are flat and generally short.

9. Eyes are larger.

It is evident that the possession of these characteristics in adults show them to be infantile in that respect, and their absence shows that they have been obliterated in reaching maturity.

In reviewing the characteristics of the monkey and infant, we find the following points in common:

8. The nose without bridge, and cartilages short and flat.

The following points are found to be different:

1. Facial regions of skull larger as compared with the cerebral.
2. Forehead not prominent.
3. Superciliary ridges are more prominent.
4. Edges of the jaws are more prominent.

It thus becomes apparent that as man develops from infancy he becomes more like the apes in some important parts of his facial expression. But it may also be noted that there exists the same difference between the embryonic and adult monkey and the embryonic and adult man. The change is greater in degree in the monkey than in man.

The following is quoted *verbatim* from Professor Cope: "Man stops short in the development of the face, and is insofar more embryonic. The prominent forehead and reduced jaws of man are characters of "retardation," since it is a superaddition to the quadrumanous type from both the standpoints of paleontology and embryology. The development of the bridge of the nose is, no doubt, directly connected with the development of the front of the cerebral part of the skull and ethmoid bone, which, sooner or later, carries the nasal bones with it.

If we now examine the leading characters of the physiognomy of three of the principal human sub-species—the negro, the Mongolian and the Indo-European—we can readily observe that it is in the two first named that there is a predominance of the quadrumanous features which are retarded in man; and that the embryonic characters which predominate are those in which man is accelerated. In race description the prominence of the edges of the jaws is called prognathism, and its absence orthognathism; as compared with those of the Indo-European, is as follows:

Negro—Nose flat, without bridge (quadrum. retard.); prognathous (quadrum. accel.); malar bones prominent (quadrum. accel.); beard short (quadrum. retard.).

Mongolian—Jaws prognathous (quadrum. accel.); nose flat or prominent, with or without bridge; malar bones prominent (quadrum. accel.); beard, none (embryonic).

Indo-European—Jaws orthognathous (embryonic retard.); nose (generally) prominent with bridge (accel.); malar bones reduced (retard.); beard long (accel.).

The Indo-European race is the highest by virtue of the acceleration of growth in a well-developed nose and beard. It is superior in those points in which it is more embryonic than the other races, viz., the want of prominence of the jaws and cheek bones, since these are associated with a greater predominance of the cerebral hemispheres and greater intellectual power.

Some people are always partially embryonic in having a short face and light lower jaw. Such faces are still more embryonic when the forehead and eyes are protuberant. Retardation of this kind is frequently met with in children, and less frequently in women. The brain, or nervous system as a whole, holds direct supervision over the formative process going on in the face and cranium. We find at birth the brain relatively large and its growth rapid. During the first seven years of life the brain attains to nearly its whole size and weight, ninety per cent, in fact. The remainder of its bulk (about ten per cent) is added very slowly. According to Boyd, and others, after the age of fourteen the increase is very slight, scarcely perceptible, and after seventeen or eighteen, there is none; but from my own investigation, after the age of eight, the brain slowly develops. The cells, however, are constantly taking on new energy and resistive power.

The shape and form of the face depends principally upon the bony structure. The bones of the cranium are developed to form a convenient protection to the brain, and they are shaped accordingly; the brain, expanding in the prefrontal territory, directly shapes its bony case to fit the requirements. We see the shape of the cranium depending directly on the shape and size of the brain. Not so with the bones of the face. They seem to have a more independent development, which calls into action some different brain force.

We notice that there seems to be an arrest of development in the bones of the face at the time when the bulk development of the brain ceases. This normally should be at about the sixth or seventh year.

The arrest of development of the bones begins to appear with the arrest of bulk development of the brain, and only is complete when the brain is completely formed.

It has been very properly observed that the human face is actually a result of arrested development. Frontal peculiarities, common to man and other animals, are retained at birth by the former, and the flat face of the white man may be said to be an arrested fœtal condition. The negro has the same fœtal appearance until puberty, when prognathism begins to develop.

The prognathism of the jaws of the negro is, I believe, due entirely to the excessive development of the inferior maxilla. The rami and the body of the lower jaw, and also the muscles of mastication, are very large and massive as compared with those of the white man; while upon the other hand, the superior maxilla is small and more delicate. The constant force of the larger lower jaw upon the upper causes the alveolar process to be carried forward and upward, thus producing prognathism. The law of heredity, whereby the offspring tends to reproduce its kind, is here nicely illustrated. This theory is easily demonstrated by the examination of negro skulls in the Army Medical Museum at Washington and at the College of Surgeons in London. The negro of today, especially those living in the Northern States, possess jaws not unlike those of the white people; the zygomatic arches are smaller, the muscles less dense and rigid, the lower jaw less massive, and orthognathism instead of prognathism exists to a certain extent. This is brought about by the arrest of development of the muscles and body of the lower jaw, due to change of climate, soil, and intermarrying of races.

The principle is illustrated in plates 2 and 3 of my "Chart of the Typical Form of Constitutional Irregularities of the Teeth."

The bones and teeth are formed largely from the phosphates of calcium, sodium, etc., which also afford material

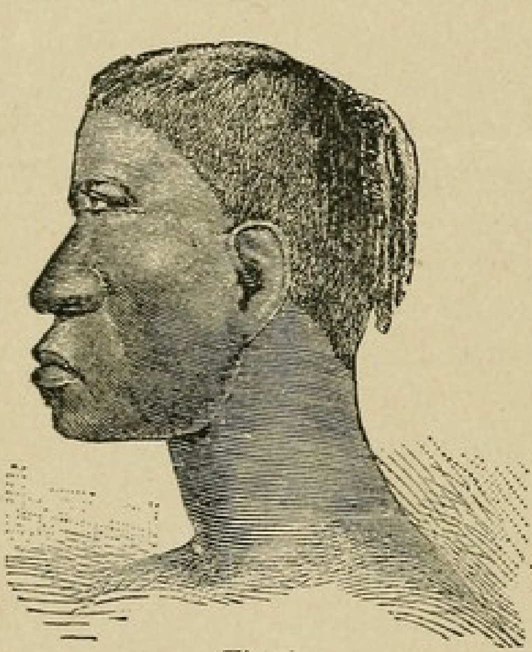


Fig. 6.

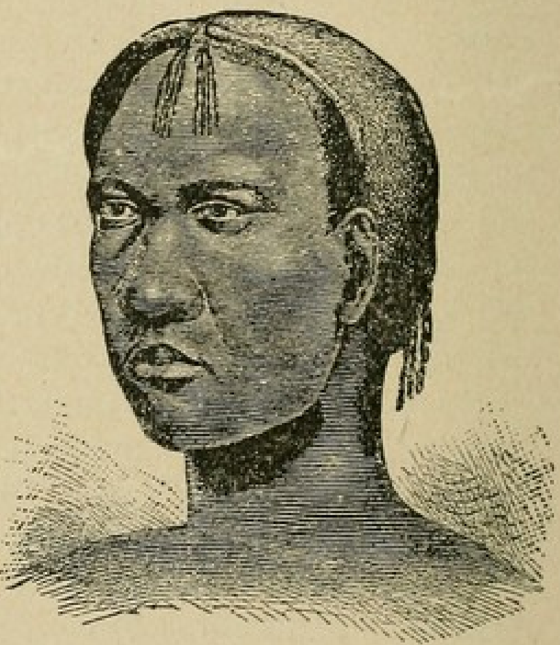


Fig. 7.—From Serpa Pinto.

for the brain growth. If the compounds circulating in the blood are consumed by an active brain, the teeth and bones will suffer in consequence, and ossification will take place slowly, the bones being found to be less massive at maturity, and, as is generally the case when there is great mental activity, there is less muscular activity, and the muscles are retarded in their development, being slight and requiring slight attachments; the ridges and protuberances on the bones are likewise but slightly developed, and we note their absence in the external expression. The vomer ossifies in different races at varying periods of life. In the white person it remains cartilaginous until comparatively late in life, about puberty, when the characteristic nasal formation is accomplished. But in the negro, and among some Mongolians, ossification of the septum takes place much earlier, and the nose being thus bound down to the maxilla the alæ spread out sideways on the further facial growth, and the so-called flat nose results (see Figs. 6 and 7). These illustrations also show excessive and arrest of development of the lower jaw.

Darwin notes that the high cheek bones of the American Indian (Fig. 8) were due to the animal ancestral persistence

Fig. 8.

of extra development of the zygomatic arch. Clevenger,* mentions the larger size of the temporal muscle in ferocious animals, and the insertion of this muscle inside the zygoma, and claims that if the phylogenetic degeneration of the muscle from lower animals to savage and thence to civilized man is not kept pace with by the "cheek bones," then prominence of the latter is produced.

In the development of the bones of the head and face, climate, soil, and intermixture of races, and hereditary peculiarities, enter into the formation of each distinct type of

*The American Naturalist, July, 1888, in an article entitled "Cerebrology and Phrenology."

beings. Leave out any one of these and the type will soon become fixed. In a country like America, where the climate is so diversified, where different nationalities congregate and intermarriage is so common, deformities of the face and jaws must necessarily result, and many generations must have passed by before it is possible for a fixed type to be produced in this country like those of European countries.

There is, however, another factor which must be considered in connection with the development of the human race, that is not confined to America, but can be seen among all civilized nations, and one that has considerable weight in the development of the modern races—that is, Developmental Neuroses. This question is of more importance to us than any other, both from a social standpoint and also as regards the welfare of posterity. We shall see, in the chapter on Developmental Neuroses, that there is a tendency to produce atavism, or a return to the negro, Mongolian, or Indo-European types, and also that deformities of the nose, face, jaws and teeth result.

CHAPTER VI.

DEVELOPMENT OF THE JAWS.

The author does not consider it necessary in this chapter to enter into the details of the embryonic development of the jaws for two reasons. First, he can add nothing to what has already been written upon this subject, and, second, he does not believe, from an experience of twenty years' study, that the causes which produce constitutional deformities of the jaw antedate the sixth year of the individual, except in the part which heredity controls.

It is a well-known fact that those nations or races which do not intermarry rarely, if ever, have irregularities or deformities. This illustrates well the advantage of marriage within the same type. Irregularities of the teeth and jaws are seldom found among pure Africans, Chinese, Italians and Jews; but in those countries where all nations of the world congregate and intermarry, irregularities of the jaws and teeth must necessarily follow.

A good illustration of this mixture of races is found among the people inhabiting the borders of different countries. Farrar says: "The women of Albania, and those of Biscay and Galicia, who, from religious scruples and national prejudice decline to intermarry with their neighbors, are much more beautiful than those of Piedmont or Fruili."

In the Puritans of New England the jaws were in proportion to the remainder of the body, but after foreign nations began to pour into America and intermarriage to take place, very little of the Puritan stock remained, and the jaws and teeth became degenerated in their development.

The largest normal jaws are found among a few African races, and the smallest among the Bushmen, Hottentots and the people who inhabit the mountainous plateaus between Spain and Portugal.

Mr. John R. Mummery, in a paper before the Odontological Society of Great Britain, gives as the result of the examination of 3,000 skulls of modern and ancient races, that the average width of the arch between the first molars in ancient races was about $2\frac{3}{8}$ inches, and modern uncivilized races $2\frac{1}{2}$ inches, while the greatest diameter was $2\frac{3}{4}$ inches.

I cannot do better at this point than to quote from my work on "Degeneracy of the Jaws and Teeth of the Human Race":

"Evolutionists and scientists have frequently mentioned the fact that the jaws are changing in shape and size, but they have never produced data to show just what changes have taken place. I have therefore collected a large number of measurements for the purpose of obtaining facts in regard to these changes. The measurements of the skulls of the early races, as well as modern people, were made from specimens in the museums and crypts of churches in Europe, where large collections of skulls have been placed. In many of the museums the skulls have been classified and tabulated in such a manner that an examination of them is easily made. The large Hunter collection of skulls at the College of Surgeons in London was examined by the late Mr. John Mummery; Dr. Betty, of Cincinnati, examined the large collection of skulls at the Smithsonian Institution in Washington; Dr. C. N. Peirce, of Philadelphia, crania in the Academy of Natural Sciences of that city; Dr. Schuhmann, of Chicago, crania in Rome, Italy; Dr. Barrett, of Buffalo, crania in his private collection and in the Buffalo Academy of Natural Sciences; Dr. Pratt, crania in the Academy of Natural Sciences of Davenport, Ia.; and I have made examinations of many skulls in different parts of Europe and also of the collection of Peruvian skulls in the Michigan University at Ann Arbor and the Peabody Museum, Harvard College.

"Measurements of the jaws of living individuals of different countries and nationalities have been taken by the following dentists, as well as by myself: Dr. Caracatsanis, Athens, Greece; Drs. Franz Berggren and Elof Forberg, Stockholm, Sweden; Dr. A. Scheller, Warsaw, Poland; Dr. Johan Kier, Copenhagen, Denmark; Dr. Sturpenick, Brussels, Belgium; Dr. Ed. Wagner, North China; Drs. Perkins and Ivy, Shanghai, China; Dr. D. D. Bode, India; Dr. A.W. Baker, Dublin, Ireland; Drs. W. Barrett and Wm. Hern, London, England; Dr. I. N. Demorest, Santiago, Chile; Dr. Geo. Warren, Philadelphia, Pa.; Dr. R. B. Winder, Baltimore, Md.; Dr. S. D. Hodge, Burlington, Vt.; Dr. W. E. Page, Boston, Mass.; Dr. C. Sill, New York, N. Y.; Drs. Geo. Crisup, Ira Cressiman, Volini and V. D'Elia, Chicago, Ill. I wish at this point to thank those gentlemen who so kindly assisted me in the very laborious work of obtaining these measurements, thus contributing their part to the progress of science. The people whose mouths have been examined comprise individuals in the different walks of life, a part of them composing the patients of practitioners of dentistry

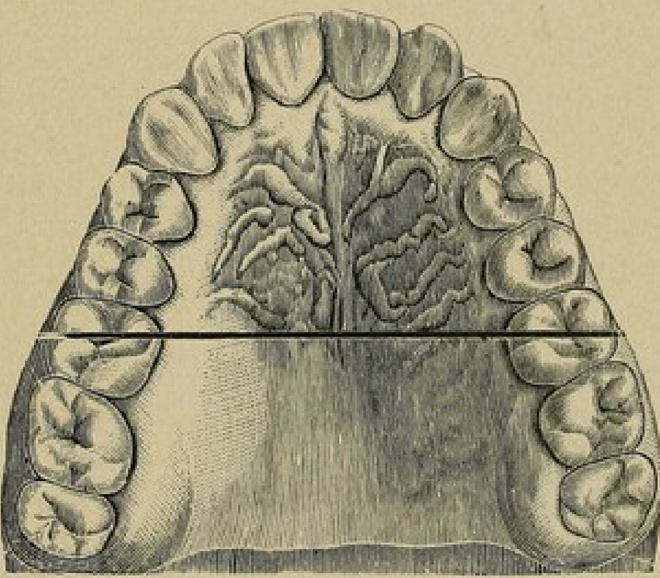


Fig. 9.

and constituting the better classes, while others are dispensary patients and from the middle and poorer classes.

"The measurement was made across the upper jaw, from the outer surface of one first molar to the outer surface of the corresponding molar of the other side (Fig. 9). These points were taken because these molars are the first teeth of the permanent set to develop, and from the fact that, developing posterior to the temporary ones, they erupt independently of and are not interfered with by any of the other teeth which are in the jaw. The point of the jaw where these teeth are situated is the widest part that is normally developed and is not influenced by local causes; therefore this position was the most accessible for the object required. The measurements were made in the mouths of persons over twenty-five years of age, irrespective of the exact age, for the reason that at this period, or nearly at this period, the individual has completed his growth. After this period the development of the skeleton is very slow, and at the age of thirty to thirty-five ceases altogether.

"In securing this large collection of measurements of crania and living individuals, the compilation of which has extended over a period of eight years, I have endeavored to show by actual demonstration that the jaw of the human race is diminishing in size.

"The following is the table of measurements:

EXAMINATION OF THE CRANIA

Of Modern Races and Ancient Races in the Hunterian Museum by Dr. Mummery. Also crania in the Oxford University Museum, and in a number of private collections.

MODERN RACES.	No.	LATERAL DIAMETER.					
		MINIMUM.		MAXIMUM.		AVERAGE.	
		In.	Mm.	In.	Mm.	In.	Mm.
Esquimaux	69	2.375	60.32	2.750	69.85	2.562	65.07
N. Americans (Coast)	56	2.375	60.32	2 750	69.85	2.562	65.07
N. Americans (Interior)	23	2.375	60.32	2.625	66.68	2.500	63.50
S. Americans (Chile)	19	2 500	63.50	2.750	69.85	2.625	66.67
Fiji Islanders	38	2.500	63.50	2.875	73.02	2.687	68.26
Polynesians (Various)	79	2.375	60.32	2.625	66.68	2.500	63.50
Sandwich Islanders	21	2.375	60.32	2.625	66.68	2.500	63.50
New Zealanders	67	2.500	63.50	2.875	73.02	2.687	68.26
Australians	132	2.375	60.32	2.750	69.85	2.562	65.07
Tasmanians	33	2.375	60.32	2.625	66.68	2.500	63.50
Malays	24	2.375	60.32	2.750	69.85	2.562	65.07
Chinese	27	2.250	57.14	2.625	66.68	2.437	61.91
East Indians (North)	152	2.250	57.14	2.750	69.85	2.500	63.49
East Indians (South)	71	2.125	53.97	2.500	63.50	2.312	58.73
Africans (East)	33	2.125	53.97	2.750	69.85	2.437	61.91
Caffres	49	2.375	60.32	2.875	73.02	2.625	66.67
Bosjesmen and Hottentots	29	2.125	53.97	2.375	60.32	2.250	57 14
Africans (West)	236	2.250	57.14	2.750	69.85	2.500	63.50
Ashantees	92	2.500	63.50	2.875	73.02	2.687	68.26
Ancient Britons (Dolichocephalic)	68	2.125	53.97	2.625	66.68	2.375	60.32
Ancient Britons (Brachycephalic)	32	2.125	53.97	2.500	63.50	2.312	58.73
Ancient Britons (Canon Greenwell's Explorations)	59	2.125	53.97	2.500	63.50	2.312	58.73
Ancient Britons (Miscellaneous)	44	2.125	53.97	2.500	63.50	2.312	58.73
Romano-Britons	143	2.125	53.97	2.625	66.68	2.375	60.32
Anglo-Saxons	76	2.250	57.14	2.625	66.68	2.437	61.91
Ancient Egyptians	36	2.125	53.97	2.625	66.68	2.375	60.32

EXAMINATION OF CRANIA

In Peabody Museum, Harvard University; Academy of Natural Sciences, Philadelphia; Davenport Academy, Army Museum; Roman, French, and English Crania in European museums, and private collection of Barrett. Miscellaneous crania by Drs. Peirce, Newton, Schuhmann, Barrett, Pratt, Betty, and Talbot.

RACE.	No.	SEX	LATERAL DIAMETER.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
EUROPEANS — Ancient and Modern Romans, Italians, French, English........	276	?	1.94	49.19	2.69	68.26	2 34	58.84
	36	M	2.06	52.32	2.37	60.30	2.20	55.95
	30	F	1.88	47.62	2.44	61.90	2.08	52.81
SANDWICH ISLANDERS....	26	M	2.13	53.95	2.50	63.50	2.29	58.17
	26	F	2.06	52.32	2.37	60.30	2.20	55.95
	8	?	2.22	56.35	2.50	63.50	2.30	58.45
ANCIENT PERUVIANS......	137	M	2.00	50.80	2.63	66.67	2.30	58.45
	124	F	1.88	47.62	2.56	65.08	2.22	56.34
	117	?	2.00	50.80	2 56	65.08	2.30	58.45
ANCIENT CALIFORNIANS, from Santa Cruz Islands, Coast of California; Santa Catalina Island, Brazil; Nicaragua, St. Miguel..	34	M	2.06	52.32	2.63	66.67	2.31	58.84
	38	F	2.06	52.32	2.44	61.90	2.25	57.14
MEXICANS................	27	?	1.94	49.19	2.50	63.50	2.31	58.84
CALIFORNIAN INDIANS....	29	M	2.06	52.32	2.50	63.50	2.31	58.84
	26	F	2.06	52.32	2.37	60.30	2.22	56.34
MOUND BUILDERS, Mounds in Kentucky and Tennessee..................	56	M	2.06	52.32	2.63	66.67	2.33	59.48
	47	F	2.00	50.80	2.50	63.50	2.28	57.92
	57	?	2.06	52.32	2.69	68.26	2.39	60.70
STONE GRAVE PEOPLE, Cumberland Valley, Tennessee; Illinois River, Indiana; Arkansas, Michigan and various places......	87	M	2.13	53.95	2.69	68 26	2.42	61.90
	89	F	1.88	47.62	2.50	63.50	2.28	57.92
	11	?	2.13	53.95	2.44	61.90	2.28	57.92
INDIANS—North American. Different Tribes........	17	M	2.13	53 95	2.50	63.50	2.30	58.45
	11	F	2.13	53.95	2.31	58.84	2.23	56.69
	191	?	1.88	47.62	2.63	66.67	2.31	58.84
NEGRO—Rio de Favino.....	1	..	2.19	55.56	2.19	55.56	2.19	55.56
FLAT HEADS from Oregon, Washington, Gulf of Georgia, Peru..........	3	M	2.25	57.13	2.50	63.50	2.45	62.31
	2	F	2.13	53.95	2.44	61.90	2.28	57.92
	18	?	2.25	57.13	2.75	69.85	2.53	64.29
CRANIA from San Lorenzo Cave, Mexico..........	4	M	2.25	57.13	2.37	60.30	2.30	58.45
	3	F	2.13	53.95	2.37	60.30	2.20	55.95
CRANIA from Caves in Tennessee, Kentucky, Mexico	4	M	2.13	53.95	2.19	55.56	2.14	54.38
	9	?	....	.....	....	.....	2.23	56.69
	3	F	2.06	52.32	2.25	57.13	2.19	55.56
ESQUIMAUX from Labrador, Norton Sound..........	40	?	1.75	44.46	2.63	66.67	2.23	56.69
	2	M	2.25	57.13	2 31	58.84	2.28	57.92
HINDOOS................	1	M	2.13	53.95	2.13	53.95	2.13	53.95
	1	?	2.22	56.35	2.22	56 35	2.22	56.35
	3	F	2.06	52:32	2 37	60.30	2.25	57.14
HERNEY ISLANDERS......	3	M	2.19	55.56	2.50	63.50	2.33	59.13
	1	?	2.13	53.95	2.13	53.95	2.13	53.95
HAWAIIAN ISLANDER........	1	M	2.31	58.84	2.31	58.84	2.31	58.84

EXAMINATION OF CRANIA—CONTINUED.

In Peabody Museum, Harvard University; Academy of Natural Sciences, Philadelphia; Davenport Academy; Army Museum; Roman, French, and English Crania in European museums, and private collection of Barrett. Miscellaneous crania by Drs. Peirce, Newton, Schuhmann, Barrett, Pratt, Betty, and Talbot.

RACE.	No.	SEX	LATERAL DIAMETER.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
NEGROES, African Negroes.	2	M	2.13	53.95	2.50	63.50	2.31	58.84
	79	?	1.88	47.62	2.47	62.70	....	57.58
	1	F	2.25	57.13	2.25	57.13	2.25	57.13
ZULUS, South Africa......	1	F	2.25	57.13	2.25	57.13	2.25	57.13
	1	M	2.44	61.90	2.44	61.90	2.44	61.90
PROBABLY AFRICANS........	2	F	2.00	50.80	2.25	57.13	2.13	53.95
NEGRO GILES, executed at Richmond, Va.........	1	M	2.31	58.84	2.31	58.84	2.31	58.84
ALEUTIAN ISLANDER.......	1	F	2.13	53.95	2.13	53.95	2.13	53.95
GUANCHE.................	1	F	2.06	52.32	2.06	52.32	2.06	52.32
PEGU, Burmah.............	1	F	2.19	55.56	2.19	55.56	2.19	55.56
MAURITIAN DWARF.........	1	?	2.19	55.56	2.19	55.56	2.19	55.56
UNKNOWN..............	3	M	2.31	58.84	2.44	61.90	2.37	60.30
	5	F	1.88	47.62	2.31	58.84	2.13	53.95
FIJI ISLANDERS............	2	?	2.31	58.84	2.44	61.90	2.37	60.30
LOO CHOO ISLANDER........	1	?	2.37	60.30	2.37	60.30	2.37	60.30
BURMESE.................	1	?	2.47	62.70	2.47	62.70	2.47	62.70
MARQUESAS ISLANDERS.....	4	?	2.28	57.92	2.44	61.90	2.36	59.91
ASSINIBOIN...............	3	?	2.28	57.92	2.37	60.30	2.31	58.84
KANKAKEE................	5	?	2.16	54.75	2.31	58.84	2.25	57.14
MALAY....................	13	?	2.16	54.75	2.53	64.29	2.37	60.30
TAHITIAN.................	2	?	2.25	57.13	2.47	62.70	2.36	59.91
TATLIT KOOCHIN...........	2	?	2.22	56.35	2.34	59.57	2.28	57.92
LAPLANDERS...............	2	?	2.37	60.30	2.50	63.50	2.44	61.90
JAPANESE.................	1	?	2.37	60.30	2.37	60.30	2.37	60.30
PARSEE...................	2	?	1.97	50.07	2.00	50.80	1.98	50.40
AUSTRALIANS..............	10	?	2.09	53.13	2.69	68.26	2.31	58.84
ARMENIANS................	4	?	2.00	50.80	2.09	53.13	2.06	52.29
SAMOAN ISLANDER.........	1	?	2.25	57.13	2.25	57.13	2.25	57.13
ANCIENT EGYPTIAN (Egyptian Type)............	18	?	1.88	47.62	2.50	63.50	2.20	55.95
ANCIENT EGYPTIAN (Negroid Type)............	11	?	2.13	53.95	2.69	68.26	2.37	60.30
COPT.....................	1	?	2.13	53.95	2.13	53.95	2.13	53.95
EGYPTIAN NEGROES........	3	?	1.88	47.62	2.13	53.95	2.01	51.05
ANCIENT EGYPTIANS........	27	?	1.88	47.62	2.22	56.35	2.06	52.59
ARAB.....................	2	?	2.19	55.56	2.31	58.84	2.25	57.14
CHOCTAW and NEGRO......	1	?	2.19	55.56	2.19	55.56	2.19	55.56
HISPANO-PERUVIAN.........	2	?	2.13	53.95	2.22	56.35	2.17	55.16
DUTCH...................	1	?	2.56	65.08	2.56	65.08	2.56	65.08
ANGLO-AMERICAN..........	1	?	2.50	63.50	2.50	63.50	2.50	63.50
RECENT CRANIA, Pa. (?)....	22	?	1.97	50.07	2.50	63.50	2.30	58.45
Total................	1840		1.88	47.62	2.69	68.26	2.28	57.94

EXAMINATION OF THE MOUTH.

Of Living Persons, Showing Measurement of the Superior Maxilla.

RACE.	No.	SEX	LATERAL DIAMETER.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
Residents of Athens, Greece	15	M	1.75	44.46	2.13	53.95	1.98	50.40
	14	F	1.75	44.46	2.02	51.30	1.90	48.23
Stockholm, Sweden	393	M	1.88	47.62	2.63	66.67	2.26	57.37
	194	F	1.75	44.46	2.60	66.00	2.15	54.60
Copenhagen, Denmark	250	M	1.75	44.46	2.56	65.00	2.24	56.82
	50	F	1.75	44.46	2.46	62.50	2.18	55.72
Brussels, Belgium	148	M	1.97	50.02	2.56	65.00	2.25	57.05
	158	F	1.75	44.46	2.60	66.00	2.18	55.57
Warsaw, Poland	150	M	2.02	51.30	2.60	66.00	2.31	58.84
	150	F	1.94	49.25	2.40	61.00	2.17	55.16
China	72	M	2.00	50.80	2.44	62.00	2.26	57.37
	22	F	2.00	50.80	2.52	64.00	2.19	55.56
Typical People of India	46	M	1.94	49.25	2.37	60.30	2.13	53.95
	3	F	1.94	49.25	2.07	52.50	2.00	50.80
Italians	666	M	1.94	49.25	2.63	66.67	2.17	55.16
	189	F	1.88	47.62	2.44	62.00	2.00	50.80
Santiago, Chile	106	M	1.75	44.46	2.40	61.00	2.11	53.57
	154	F	1.75	44.46	2.34	59.57	2.04	51.78
London, England	203	M	1.88	47.62	2.63	66.67	2.28	57.92
	187	F	1.88	47.62	2.44	62.00	2.09	53.19
Dublin, Ireland	86	M	1.88	47.62	2.63	66.67	2.25	57.13
	126	F	1.88	47.62	2.52	64.00	2.11	53.52
American-born Negroes	128	M	2.07	52.50	2.52	64.00	2.32	58.98
	108	F	1.97	50.02	2.31	58.84	2.20	55.90
Dispensary patients of Philadelphia, Baltimore and Boston	463	M	1.88	47.62	2.56	65.00	2.14	54.33
	241	F	1.75	44.46	2.63	66.67	2.01	50.90
Residents of Burlington, Vermont	52	M	1.97	50.02	2.37	60.30	2.19	55.56
	50	F	1.88	47.62	2.20	56.00	2.02	51.31
Boston, Mass.	896	..	1.94	49.25	2.31	58.84	2.04	51.80
New York City	47	M	1.75	44.46	2.52	64.00	2.18	55.72
	56	F	1.75	44.46	2.52	64.00	2.10	53.36
Chicago and Illinois	1696	M	1.75	44.46	2.52	64.00	2.12	53.76
	1116	F	1.75	44.46	2.52	64.00	2.02	51.31
Marshpee Indians	55	M	2.00	50.80	2.52	64.00	2.24	56.90
	6	F	2.07	52.50	2.07	52.50	2.07	52.50
Total	8296		1.87	47.54	2.41	62.08	2.14	51.19

EXAMINATION OF THE CRANIA.

In Peabody Museum, Harvard University; Academy of Natural Sciences, Philadelphia; Davenport Academy, Army Museum; Roman, French, and English Crania in European museums, and private collection of Barrett. Miscellaneous crania by Drs. Peirce, Newton, Schuhmann, Barrett, Pratt, Betty, and Talbot.

RACE.	No.	SEX	ANTERO-POSTERIOR DIAMETER.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
EUROPEANS — Ancient and Modern Romans, Lake Dwellers, French prior to nineteenth century......	31	M	1.69	42.86	2.00	50.80	1.86	47.23
	30	F	1.56	39.69	2.06	52.32	1.83	46.43
SANDWICH ISLANDERS....	26	M	1.63	41.28	2.19	55.56	1.91	48.38
	29	F	1.63	41.28	2.03	51.56	1.83	46.43
ANCIENT PERUVIANS......	122	M	1.56	39.69	2.13	53.95	1.88	47.62
	104	F	1.56	39.69	2.13	53.95	1.79	45.64
	2	?	1.69	42.86	1.94	49.14	1.84	46.83
ANCIENT CALIFORNIANS...	26	M	1.63	41.28	2.13	53.95	1.89	48.02
	32	F	1.69	42.86	2.06	52.32	1.86	47.23
	130	?	...	...	...	...	1.83	46.40
CALIFORNIAN INDIANS....	32	M	1.69	42.86	2.13	53.95	1.91	48 38
	30	F	1.69	42.86	2.00	50.80	1.83	46.43
MOUND BUILDERS........	157	M	1.56	39.69	2.31	58.69	2.00	50.80
	83	F	1.63	41.28	2.13	53.95	1.89	48 02
	1	?	2.00	50.80	2.00	50.80	2.00	50.80
STONE GRAVE PEOPLE—Cumberland Valley.....	83	M	1.63	41.28	2.25	57.03	1.97	50.00
	80	F	1.63	41.28	2.06	52.32	1.91	48.41
	7	?	1.88	47.62	2.00	50.80	1 94	49.21
INDIANS................	110	M	1.75	44.46	2.31	58.69	1.99	50.55
	58	F	1.38	35.09	2.31	58.69	1 87	47.44
	3	?	1.81	46.04	2.00	50.80	1.91	48.38
NEGRO—Rio de Favino......	1	?	2.06	52.32	2.06	52.32	2.06	52.32
FLAT HEADS from Oregon, Washington, Gulf of Georgio, Peru..........	3	M	1.88	47.62	2.25	57.13	2.00	50.80
	2	F	1.88	47.62	2.00	50.80	1.94	49.21
	1	?	2.00	50.80	2.00	50.80	2.00	50.80
CRANIA from San Lorenzo Cave, Mexico..........	4	M	1.69	42.86	2.00	50.80	1.83	46.43
	3	F	1.75	44.46	1.94	49.14	1.83	46.43
CRANIA from Caves in Tennessee, Kentucky, Mexico..............	4	M	1.69	42.86	1.88	47.62	1.79	45.64
	..	?	...	...	...	...	...	...
	3	F	1.75	44.46	2.00	50.80	1.83	46.43
ESQUIMAUX from Labrador, Norton Sound..........	..	?	...	...	...	...	...	...
	7	M	1.69	42.86	2.13	53.95	1.72	43.65
HINDOOS...............	4	M	1.69	42.86	2.00	50.80	1.69	42.86
	..	?	...	...	...	...	...	...
	2	F	1.81	46.04	1.81	46.04	1.81	46.04
HERNEY ISLANDERS.......	3	M	1.88	47.62	2.00	50.80	1.92	48.81
	..	?	...	...	...	...	...	...
HAWAIIAN ISLANDER........	1	M	2.00	50.80	2.00	50.80	2.00	50.80
NEGROES, African Negroes.	2	M	2.06	52.32	2.13	53.95	2.09	53.18
	..	?	...	...	...	...	...	...
	..	F	...	...	...	...	...	...

EXAMINATION OF THE CRANIA—CONTINUED.

In Peabody Museum, Harvard University; Academy of Natural Sciences, Philadelphia; Davenport Academy, Army Museum; Roman, French, and English Crania in European museums, and private collection of Barrett. Miscellaneous crania by Drs. Peirce, Newton, Schuhmann, Barrett, Pratt, Betty, and Talbot.

RACE.	No.	SEX	ANTERO-POSTERIOR DIAMETER.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
ZULUS, South Africa	1	F	1.94	49.14	1.94	49.14	1.94	49.14
	1	M	2.00	50.80	2.00	50.80	2.00	50.80
PROBABLY AFRICANS	..	F	...	...	...	...	...	...
NEGRO GILES, executed at Richmond, Va.	1	M	2.19	55.56	2.19	55.56	2.19	55.56
ALEUTIAN ISLANDER	1	F	2.13	53.95	2.13	53.95	2.13	53.95
GUANCHE	1	F	1.63	41.28	1.63	41.28	1.63	41.28
PEGU, Burmah	1	F	1.88	47.62	1.88	47.62	1.88	47.62
MAURITIAN DWARF	1	?	2.13	53.95	2.13	53.95	2.13	53.98
UNKNOWN	3	M	1.81	46.04	2.06	52.32	1.95	49.60
	5	F	1.69	42.86	2.00	50.80	1.91	48.41
FIJI ISLANDERS	1	M	2.28	57.92	2.28	57.92	2.28	57.92
	1	F	2.09	53.19	2.09	53.19	2.09	53 19
BAVARIAN	1	M	2.13	53.95	2.13	53.95	2.13	53.95
	1	F	1.81	46.04	1.81	46.04	1.81	46.04
NEW ZEALANDERS	3	M	1.56	39.69	2.13	53.95	1.92	48.76
	3	F	1.75	44.46	2.03	51.56	1.93	49.00
AUSTRIANS	3	M	1.94	49.25	2.01	51.05	1.96	49.78
	3	F	1.75	44.46	2.13	53.95	1.94	49.25
CHINESE	1	M	2.09	53.19	2.09	53.19	2.09	53.19
	1	F	1.94	49.25	1.94	49.25	1.94	49.25
JAPANESE	1	M	1.91	48.23	1.91	48.23	1.91	48.23
	1	F	2.06	52.32	2.06	52.32	2.06	52.32
AUSTRALIANS	1	M	2.25	57.13	2.25	57.13	2.25	57.13
	2	F	1.75	44.46	2.28	57.92	2.01	51.05
SAMOAN ISLANDER	1	M	1.94	49.25	1.94	49.25	1.94	49.25
GALLO-ROMAN	1	M	2.00	50.80	2.00	50.80	2.00	50.80
	1	F	1.88	47.62	1.88	47.62	1.88	47.62
ROMANO-BRITISH	1	F	1.84	46.74	1.84	46.74	1.84	46.74
WHITES	3	M	1.75	44 46	2.13	53.95	1.98	50.29
	1	F	2.19	55.56	2.19	55.56	2.19	55.56
EGYPTIAN	1	F	1.81	46.04	1.81	46.04	1.81	46.04
AMERICAN NEGROES	3	M	2.03	51.56	2.19	55.56	2.13	53.95
	3	F	2.06	52.32	2.13	53.95	2.08	52.73
MARSHPEE INDIANS	34	..	1.75	44.46	2.07	52.29	1.98	50.27
Patients and Friends of Author	712	..	1.56	39.69	2.19	55.56	1.84	46.74
....	...	...	...	...	...	...	...	...
....	...	...	...	...	...	...	...	...
....	...	...	...	...	...	...	...	...
....	...	...	...	...	...	...	...	...
Total	2015		1.66	45.84	2.04	51.42	1.78	49.33

EXAMINATION OF THE CRANIA—CONTINUED.

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RACE.	No.	SEX	HEIGHT OF VAULT.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
EUROPEANS—Ancient and Modern Romans; Lake Dwellers; French prior to nineteenth century......	34	M	.25	6.35	.69	17.52	.53	13.46
	30	F	.31	7.65	.63	16.00	.48	12.19
SANDWICH ISLANDERS	25	M	.37	9.39	.75	19.05	.55	13.97
	26	F	.31	7.62	.69	17.52	.52	13.21
ANCIENT PERUVIANS......	137	M	.25	6.35	.81	20.57	.57	14.47
	124	F	.37	9.39	.75	19.05	.57	14.47
	17	?	.44	11.17	.63	16.00	.49	12.45
ANCIENT CALIFORNIANS...	34	M	.44	11.17	.69	17.52	.55	13.97
	38	F	.44	11.17	.75	19.05	.55	13.97
CALIFORNIAN INDIANS....	29	M	.41	10.45	.69	17.52	.54	13.71
	26	F	.44	11.17	.69	17.52	.52	13.21
MOUND BUILDERS........	56	M	.44	11.17	.72	18.29	.55	13.97
	47	F	.44	11.17	.69	17.52	.56	14.23
	7	?	.41	10.45	.66	16.78	.51	12.95
STONE GRAVE PEOPLE—Cumberland Valley.....	87	M	.41	10.45	.88	22.35	.60	15.02
	89	F	.37	9.39	.75	19.05	.55	13.97
	11	?	.37	9.39	.56	14.23	.50	12.70
INDIANS	17	M	.44	11.17	.69	17.52	.57	14.47
	11	F	.41	10.45	.59	14.98	.47	11.93
	3	?	.50	12.70	.63	16.00	.56	14.23
NEGRO—Rio de Favino.....	1	....	. .	.....	. .	.....	.50	12.70
FLAT HEADS from Oregon, Washington, Gulf of Georgia, Peru..........	3	M	.50	12.70	.75	19.05	.65	16.51
	2	F	.50	12.70	.56	14.23	.53	13.46
	1	?	.50	12.70	.50	12.70	.50	12.70
CRANIA from San Lorenzo Cave, Mexico..........	4	M	.50	12.70	.69	17.52	.60	15.02
	3	F	.44	11.17	.66	16.78	.54	13.71
CRANIA from Caves in Tennessee, Kentucky, Mexico	3	M	.53	13.46	.53	13.46	.53	13.46
	...	?	. .	.....	. .	.....	. .	.....
	3	F	.47	11.93	.53	13.46	.51	12.95
ESQUIMAUX from Labrador, Norton Sound..........	...	?	. .	.....	. .	.....	. .	.....
	2	M	.50	12.70	.56	14.23	.53	13.46
HINDOOS	1	M	.50	12.70	.50	12.70	.50	12.70
	...	?	. .	.....	. .	.....	. .	.....
	3	F	.44	11.17	.69	17.52	.60	15.02
HERNEY ISLANDERS	3	M	.44	11.17	.63	16.00	.57	14.47
	...	?	. .	.....	. .	.....	. .	.....
HAWAIIAN ISLANDER.......	1	M	.63	16.00	.63	16.00	.63	16.00
NEGROES, African Negroes.	2	M	.53	13.46	.63	16.00	.57	14.47
	...	?	. .	.....	. .	.....	. .	.....
	1	F	.44	11.17	.44	11.17	.44	11.17
ZULUS, South Africa......	1	F	.50	12.70	.50	12.70	.50	12.70
	1	M	.75	19.05	.75	19.05	.75	19.05

EXAMINATION OF THE CRANIA—CONTINUED.

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RACE.	No.	Sex	HEIGHT OF VAULT.					
			MINIMUM.		MAXIMUM.		AVERAGE.	
			In.	Mm.	In.	Mm.	In.	Mm.
Probably Africans	2	F	.44	11.17	.50	12.70	.47	11.93
Negro Giles, executed at Richmond, Va.	1	M	.50	12.70	.50	12.70	.50	12.70
Aleutian Islander	1	F	.31	7.62	.31	7.62	.31	7.62
Guanche	1	F	.44	11.17	.44	11.17	.44	11.17
Pegu, Burmah	1	F	.50	12.70	.50	12.70	.50	12.70
Mauritian Dwarf	1	?	.50	12.70	.50	12.70	.50	12.70
Unknown	3	M	.53	13.46	.56	14.23	.54	13.71
	5	F	.53	13.46	.69	17.52	.57	14.47
Marshpee Indians	46	....	.41	10.45	.63	16.00	.52	13.22
Total	954		.44	11.36	.62	15.48	.51	13.57

[The averages in table on page 58 are made up from the maximum and minimum figures alone, while those in the other tables are deduced from the total of all the measurements.]

"While one would naturally expect to find discrepancies in the figures in a work like this, in which so many different individuals have been engaged, great care was exercised in selecting gentlemen (most of whom are personal friends of mine and well known in the profession) who possessed skill and who had also attained prominence in their calling.

"In comparing the measurements of living individuals with those of the crania, an allowance of .06 of an inch should be made for thickness of the mucous membrane.

"The difference in the number of measurements of the antero-posterior and the lateral diameter is due to the fact that in many cases the antero-posterior diameter was taken from the first and second molars instead of from the third; it was necessary to reject all such measurements.

"We must therefore look upon these figures as being nearly correct in each individual case, because the work is positive in its nature, and the figures are simply a matter of record as presented by the instrument.

MOUTHS OF LIVING PERSONS—LATERAL DIAMETER.

"A careful study of the table will show that the diameter of the jaws depends to a great extent upon the size of the skeleton; thus a small person will possess a small jaw, a large person a large jaw. This, however, is not invariable. We frequently find small people with large jaws, like the cretins of Switzerland, and large people with small jaws, as is frequently observed in limestone countries. This condition is also frequently due to excessive or arrested development of the maxillæ. We notice that there is as marked a difference between the size of the jaws of the male and female as there is in the size of the skeleton of the two sexes. This difference ranges from .02 to .16 of an inch, and is characteristic not only of living individuals, but it was also observed in the measurements of the crania of the ancient races.

"We also note that the lateral diameter of the jaws of living persons in the old country is greater, with the exception of the Athenians, than it is in this country at the present time, and the jaws of the native Indian races of this country are much larger than the jaws of the white people at the present time. The jaws of the people in older parts of this country are smaller than the jaws of people in the newer parts, as illustrated in the measurements of the jaws of the residents of Boston and those of Chicago.

"There is also a marked difference between the diameters of the jaws of dispensary patients and poorer patients, and those observed in private practice among the wealthier classes. This is well illustrated in the measurements of patients by Dr. Cressiman and those measured by the author.

"This is also well illustrated in measurements by the author of patients in the office of Dr. Shepard, of Boston, and those made by Dr. W. E. Page, of Boston; Dr. Winder, of Baltimore, and Dr. Warren, of Philadelphia, who made examinations of dispensary patients. A very interesting point to be noticed is that the purer and more clannish the race, the smaller the range in the figures representing the diameters of the jaws.

"Thus we see in the measurements of the jaws of the Chinese the range is only from 2 to 2.44, with one measurement at 2.52; the people of India, 1.94 to 2.37; the negro, 2.07 to 2.50; the Marshpee Indians, 2 to 2.50; while in the mixed races the range is from 1.50 to 2.75, extending over a much greater latitude than in the pure races. Thus in the Swedes we notice that the range is from 1.88 to 2.63; in Dublin from 1.88 to 2.50; in London from 1.88 to 2.44; while the range of the white people in America is from 1.50 to 2.63. This disparity in the size shows that in mixed races and those of a nervous temperament the arrest of development and excessive development of the jaws are very common; while on the other hand, in those races whose customs have been the same for hundreds of years, where the soil, climate, and environments have been unchanged, who have intermarried among themselves, very little difference in the size of the jaws is noticed. There is also a difference noticed in people who live at different heights of the same country, as in Northern and Southern Italy, and in different parts of America.

"It is not necessary to take measurements of different nationalities to show that the jaws are diminishing in size, but simply compare the measurements of the jaws of the same nationality at different periods of its history. Thus the early Britons possessed jaws which measured from 2.12 to 2.62 in their lateral diameters, while the jaws of the present English people measure from 1.88 to 2.44 inches. It will be noticed that the minimum diameter has decreased more than the maximum. Again, by comparing the ancient Romans with the modern Italians of Southern Italy, we find that the jaws of the early Romans measured from 2.12 to 2.62, while the jaws of the present Southern Italians measure only 1.94 to 2.69.

"In comparing the measurements of the uncivilized races with those of the civilized, it will be observed that the jaws of the former are much larger than those of the latter. In the majority of cases the size and shape of the jaw are commensurate with the osseous structure of the individual. The Bosjesmen and Hottentots present the smallest range in the size of the jaw, 2.12 to 2.37 inches. As is well known, they are the most inferior of races (with the exception of the Australians), mentally and physically. They are nomadic in habit, and are often driven from place to place by stronger tribes. Their food often consists for some time of herbs, roots, berries, plantain, etc. The meat consists chiefly of rats, dogs, etc., and they are obliged sometimes to feed upon locusts, ants, lizards, and frogs. This mode of life is as artificial in one direction as is the life of the present highly civilized races in the opposite direction. The people dwell along the banks of rivers, near marshes, where hygienic surroundings are wanting.

"The Chinese live under artificial conditions also, and the size of their jaws range from 2.25 to 2.62 inches. Of the East Indians, those living in the north are of tall stature and well developed. They live on the high plateaus, while those in the south live in valleys. The physical development of the latter is less, and their maxillæ are smaller than the former.

"The Esquimaux are of short stature, but of remarkably well-developed physique. Their maxillæ are large in proportion to the osseous development.

"The Australians are the lowest types of mankind, and their jaws range from 2.37 to 2.75 inches. The jaws are very large in proportion to the size of the cranium. The Fiji Islanders and the New Zealanders are among the best developed, physically, of any of the races, past or present. Their jaws are large, ranging from 2.50 to 2.75 inches. Very few cases of caries were found by Dr. Mummery. The Polynesians and Sandwich Islanders are slightly inferior to the former, and we find this inferiority marked in the jaws also.

"The South Americans from Chile, occupying the western side of the Andes, are descended from Spanish and Indian ancestors. Their teeth are very large. The North American Indians present very large jaws. They are well developed physically also. Among the ancient Britons we would expect to find that the dolichocephalic maxillæ were narrower in proportion to the length, and the brachycephalic maxillæ broader. The length of the maxillæ has not been given, consequently the relative proportion of length and breadth cannot be determined, but we notice that the maximum brachycephalic jaw is 2.50 inches, while that of the dolichocephalic is 2.75 inches. The brachycephalic Britons were more civilized than the former, and lived under more artificial conditions, which fact will help sustain the theory advanced by me that the higher civilization is attended with lessened development of the maxillæ.

"Comparing the ancient races with the modern races, we find the range of the former is 2.12 to 2.62 inches, while that of the modern is 2.12 to 2.87 inches. Only three of the modern races, however, have a minimum of 2.12, while the minimum of all the ancient races, with the exception of the Anglo-Saxons, is 2.12 inches. The maximum of the ancient races is less than that of the former. This fact, that the jaws of these people are smaller than those of the modern races, is another proof of the truth of the theory that civilization is accompanied by decrease in the size of the jaw; for these ancient races were possessed of a higher civilization than the modern races, who, with few exceptions, are in a state of barbarism.

ANTERO-POSTERIOR DIAMETER.

"The antero-posterior diameter was taken from the alveolar process at a point between the central incisors extending backward in the median line and meeting a line drawn at right angles to the posterior surface of the third molar, as illustrated in Fig. 10.

"It is a singular fact that the same laws hold good for the development of the antero-posterior diameter that were laid down for the lateral diameter. Although these examinations were made by different persons, in different parts of the country, we find that the antero-posterior diameter of the jaw of the female is less than that of the male by from .02 to .24 of an inch. This disparity, as compared with that of the lateral diameters, is a natural one. After the temporary teeth are all in place, the natural development of the jaw is in an antero-posterior direction, and the natural changes that are taking place in the evolution of the face and jaws consist of a shortening of the antero-posterior diameter. The great range of difference is due to the fact that it is quite common to find in some individuals an entire arrest of development of the posterior part of the body of the jaw. This is always the case when permanent molars have been extracted, thus allowing the third molar to come forward, or when the individual

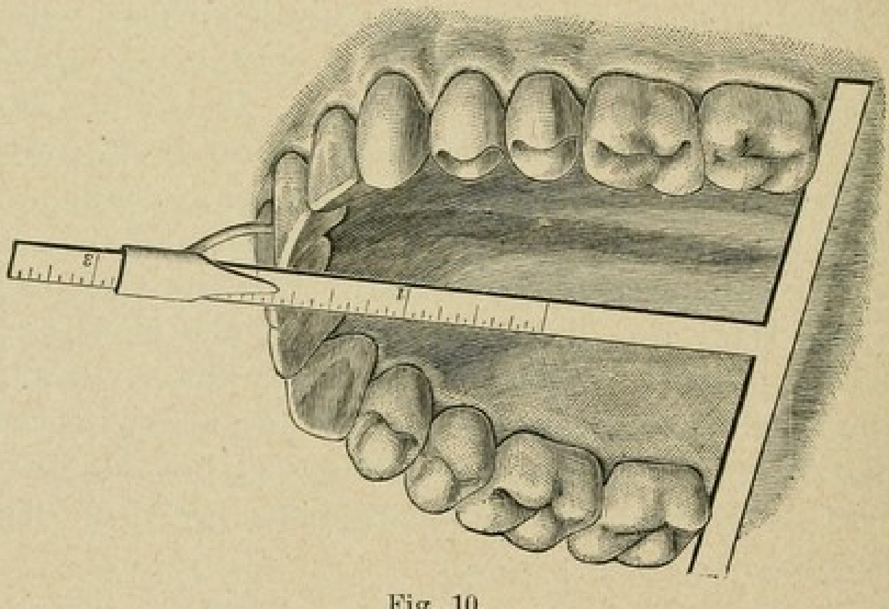

Fig. 10.

has inherited the large jaw of one parent and the small teeth of the other parent, or when the jaws have become arrested in development from constitutional disease. In comparing the antero-posterior diameter of the jaws of people of one nation with those of another nation, we must take into consideration the character of the skull. In the brachycephalic type of the Chinese we find the broad jaw, and in the dolichocephalic type of the negro, the long jaw. This difference, however, is only applicable to the pure races, and can be noticed only by comparing the external condition of the head or skull with the jaw. If we were to examine two or three thousand plaster casts of the mouths of a mixed class of people, we would be unable to say that this one belonged to a brachycephalic individual and that one belonged to a dolichocephalic individual. The local conditions so modify the shape of the jaw that in the mixed classes there is not that correlation between the shape of the skull and jaw which we find in the pure races. The fact that the jaw develops or lengthens from before backward would naturally impress one with the fact that if the jaws were not exercised by mastication, or if any of the permanent teeth had been extracted, or if a third molar failed to make its appearance, the length required would necessarily be much less than that required by a jaw full of teeth and one that had been well exercised. Therefore nature developed only the posterior part of the jaw, that which is actually necessary, and hence the short lower jaw.

HEIGHT OF VAULT.

"The height of the vault in most cases is far below the average of the present day. In 4,614 measurements of normal individuals, made by the author, it was found that the average height of the arch was .58 of an inch; the measurement was made from the alveolar border between the second bicuspid and the first permanent molar to the height of the arch. Fig. 11 illustrates an instrument invented by me for the purpose of measuring these cases; it also shows the position of the instrument upon the model when the measurement is made.

"It was necessary to group both male and female, because some of the measurements were taken from plaster casts, so that I was unable to determine the sex.

"In comparing the width of the jaws of people whose ancestors have lived in this country for many years, it will be seen that there is not such a great difference in the width of the jaws. Thus, private female patients in Burlington, Vt., Boston and Chicago, show that there is only about .30 mm., while in male patients only about 1 mm.

"By comparing these measurements with the ancient English, as made by Mr. Mummery and Mr. Coleman, we find a

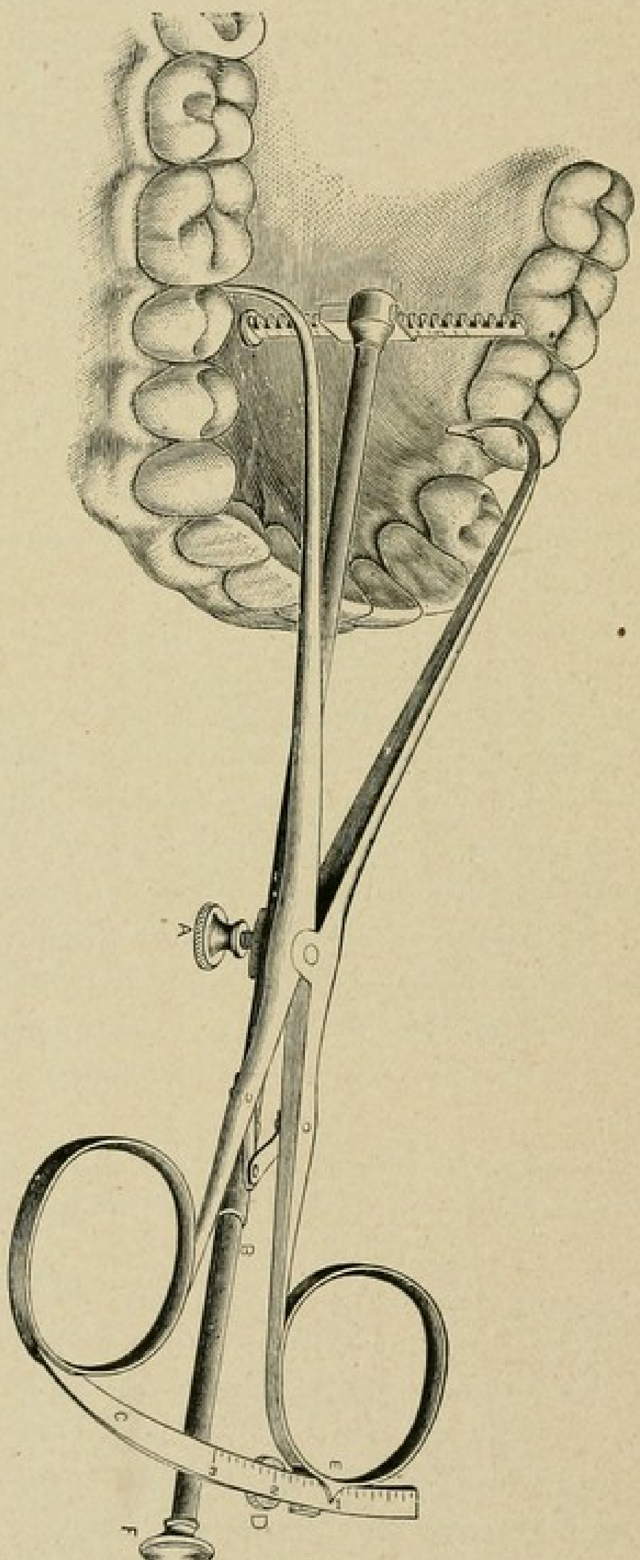

Fig. 11.

difference of about 12 mm., and the difference between ancient Romans about the same. The difference between the ancient English and the English of today is about 8 mm., and the ancient Romans and present Italians of Southern Italy 10.50 mm.

"The antero-posterior diameter of the present size of the jaws is about as low as the lowest of any of the measurements.

"By comparing my measurements of New England stock with the ancient Britons, as made by Mr. Mummery and Mr. Coleman, I find a difference from 7.79 to 12 mm.; between ancient Romans and New England stock 10.97 mm.; between the Anglo-Saxons and New England stock 9.38 mm.; and between New England stock and present English 3.02 mm.

"There would be a much greater difference shown in the width of the jaw of New England stock of today, and that of the skulls of early races, if the measurements had been taken from the first or second bicuspid region, because the greatest contraction is anterior to the first permanent molar.

"I have frequently made the statement that the teeth are the same size today that they were three thousand years ago. These measurements bear me out in that statement. While the lateral diameter of the jaws is considerably smaller, the antero-posterior diameter shows only a slight variation as compared with those of other tribes and nationalities. In order that the teeth may come into the arch uniformly, the anterior alveolar process is pushed forward. If the anterior alveolar process were as unresistible as the lateral alveolar process, more deformities would result.

"That the wisdom-tooth grows smaller as we ascend the scale of civilization is upheld by many writers. But even in the lower races, although the wisdom-tooth does not present the variations that are found in more civilized races, we find that it is far inferior to the teeth of the ape and chimpanzee, although among these animals we find the first indication of the step toward the degradation and subsequent disappearance of this tooth.*

*Thompson, "Care of the Wisdom-Tooth," etc.

"But the tooth in all these cases is as serviceable as the other molars. Among some of the monkey tribes the third molar is of equal size to the first and second, while again in others it is larger, and in some others is smaller.*

"Mr. Darwin maintains that these teeth are rather larger than the other two molars in the orang and chimpanzee.†

"Mr. C. S. Tomes says: ‡ 'In macaques the third molar is larger than the first two, and is quinquicuspid below; the upper quadricuspid. It is generally said that in man the molars decrease in size from before backward; that the first molar is largest, while in the anthropoid apes the contrary is the case. This is true on the whole, but requires some qualification, as in the Australian the second and third molars are not smaller than the first, and of the chimpanzee the same thing may be said to be true. In the anthropoid apes the wisdom-tooth is nearly or quite as large as the other molars, and shows no variability, while it comes into place almost simultaneously with the canine. In the higher apes, such as the gorilla, the third molar is in every respect a well-developed tooth, sometimes even larger than the first or second molar, but instead of a spongy, softened crown, it has a crown on which the cusps are arranged according to the typical pattern.' He also says § that 'the wisdom-tooth (in lower races) has ample space to range with the other teeth, and is a characteristic molar. In the lower races of mankind the wisdom-tooth appears to vary but little, is of large size, and is never misplaced. In the more civilized races it is quite exceptional for the lower wisdom-tooth to have the four cusps distinctly developed. This is one of the things which pointed to its disappearance.' Mr. Mummery says: 'Among the stronger African tribes the third molar was always present in the lower jaw, but in the enfeebled races it was frequently absent.' Professor Allen describes the third and fourth molars of an Australian skull, which show a tendency to the

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* Professor Owen.
† "Descent of Man."
‡ "Dental Anatomy."
§ Proceedings of the Odont. Society of Great Britain.

bicuspidate type.* But still more marked differences are found between the savage and civilized races than between the savage races and animals. In civilized man the degraded condition of this tooth in its degeneracy and imperfection is very great, as compared with the nearly perfect condition of the same organ in the lower primates.†

"I have shown, in chapter upon alveolar process, that the jaw proper and the alveolar process are two distinct structures; that the bone proper was a natural development, while the alveolar process depended entirely upon the wedging of the teeth against each other for its size and shape. Now, these measurements do not accurately show the deviation of the jaw proper in either diameter of the people of the present day. The diameter of the jaw is frequently much smaller laterally and antero-posteriorly than the diameter of the teeth and alveolar process, which every observing dentist can substantiate.

"The average height of vault of four thousand six hundred and fourteen measurements was .58 of an inch, while the average of two hundred and fifty-one skulls of ancient and modern Romans, Indians, etc., was .56; allowing for the thickness of the mucous membrane, the average height of the vault of the present people would be a little below that of the Indians, negroes, ancient Britons and Romans.

"In investigating the subject of the effects of disuse of the jaw upon its development, one's attention is naturally directed to the results arising from disuse of any organ of the body, and I will therefore present to the reader some data collected by me upon this exceedingly interesting subject.

"The disuse of the jaws as the weapon of attack, evident in the large canines of the male anthropoid apes, exercised an influence in reduction of the size of the jaw itself as well as on the teeth. The Neanderthaloid jaw is a type of jaw from the standpoint of the anthropoid apes, and the few weapons of the Neanderthal types of man indicate that biting, as among rowdies of today, played no small part in battle, and

* Dental Cosmos.
† Thompson, "Care of the Wisdom-Tooth," etc.

particularly in duels for female favor. With the development of weapons of offense this employment of the jaw rapidly fell into disuse. The physiological factors underlying this element are similar to those detailed.*

"The chief agents in causing organs to become rudimentary seem to have been disuse at that period of life when the organ is chiefly used (and this is generally during maturity), and also inheritance at a corresponding period of life. The term disuse does not relate merely to the lessened action of muscles, but includes a diminished flow of blood to a part or organ, from being subjected to fewer alterations of pressure or from becoming in any way less habitually active.

"Rengger attributes the thin legs and thick arms of the Paraguay Indians to successive generations having passed nearly their whole lives in canoes, with their lower extremities motionless. Other writers have come to a similar conclusion in analogous cases. It is asserted that the hands of English laborers are at birth larger than those of the gentry.†

"From the correlation which exists, at least in some cases, between the development of the extremities and of the jaws, it is possible that, in those who do not labor much with their hands and feet, the jaws would be reduced in size from this cause. That they are generally smaller in refined and civilized men than in hard-working men or savages, is certain; but with savages, as Herbert Spencer has remarked, the greater use of the jaws in chewing coarse, uncooked food would act in a direct manner on the masticatory muscles, and on the bones to which they are attached.*

"It is familiar to everyone that watchmakers and engravers are liable to be short-sighted, while men living much out of doors, and especially savages, are generally long-sighted. Short-sight and long-sight tend to be inherited.‡

"It is a singular fact that sailors are inferioı to landsmen in their mean distance of distinct vision. This is probably due to the fact that the ordinary range of vision in sailors is

* Darwin.
† Walker.
‡ Ibid.

restricted to the length of the vessel and the height of the mast.*

"The inferiority of Europeans, in comparison with savages, in eyesight and in other senses, is no doubt the accumulated and transmitted effect of lessened use during many generations.† Europeans who have been brought up and spent their whole lives with the wild Indians do not equal them in the sharpness of their senses. The cavities in the skull for the reception of the several sense-organs are larger in the American aborigines than in Europeans. This probably indicates a corresponding difference in the dimensions of the organs themselves.‡

"The Mongolians of the plains of Northern Asia are characterized by great breadth of the skulls across the zygoma. This follows from the highly-developed sense-organs.§ In the lower jaw of many pigeons the articular surface is proportionably smaller than in the rock pigeon, and the vertical diameter, more especially of the outer part of the articular surface, is considerably shorter. May not this be accounted for by the lessened use of the jaws, owing to nutritious food having been given during a long period to all highly-improved pigeons?†

"One of the chief factors conducive to arrest of development of the jaws, and one which acts in a threefold ratio, is the want of maxillary exercise. This operates in the following manner: First, by lack of exercise, the blood, which nourishes the bones, is not carried to the part; second, the blood does not carry sufficient material to the teeth, hence the enamel formed is defective, and as a result we have early decay; third, by lack of lateral motion, the mechanical development of the alveolar process is wanting. It has been shown that the jaws of today are not so large as those of prehistoric races, and that they are steadily growing smaller. The early races lived upon coarse food, such as roots, herbs, corn, and

* B. A. Gould.
† Darwin.
‡ Rengger and Blumenbach.
§ Prichard.

uncooked meats. This coarse food required considerable mastication in order to be prepared for the chemical changes which are necessary before assimilation can take place. As a result of use, the muscles of the jaw were dense and hard, and when contraction took place they stood out upon the sides of the head like large cords. The bones were well developed; they were also of dense and hard structure; the processes for the attachment of muscles were prominent and large, and the teeth were large and set deep in the alveolar process.

"These physical conditions are noticeable only in those persons who use their masticatory apparatus a great deal, as tobacco-chewers, and are also seen in public speakers and singers. To such an extent has the art of mastication become obsolete that the food is now swallowed whole, or in a semi-masticated condition. The muscles have become flabby, the jaws more slender, and the processes for the attachments of muscles are almost, if not quite, obliterated. The difference in the size of the superior and inferior maxillæ is a marked illustration of the result arising from the use and disuse of these bones. It is a singular fact that the greater number of irregularities of the teeth occur upon the upper jaw; when they are found upon the lower jaw, the irregularities are due to local causes.

"The upper jaw is a fixed bone, and the blood-supply is small from a lack of stimulus—*i. e.*, movement, and hence arrest of development is marked. On the other hand, the lower jaw being movable, more blood flows to the part, which thus becomes much more developed.

"As a further illustration of the results arising from the use and disuse of the upper and lower jaws, I desire to direct attention to the following fact: It is known to all dentists that the teeth upon the upper jaw are more subject to decay than those upon the lower jaw, although the environment of the teeth upon the lower jaw, especially the bicuspids and molars, renders them more subject to decay than those upon the upper. Tomes says:* 'The different teeth are not equally

* "Dental Surgery," p. 273.

subject to the attacks of caries. In the first place the upper are more frequently attacked than the lower—according to Dr. Magitot in the proportion of 3:2—whilst the yet more comprehensive tables of Dr. Hitchcock give the ratio of 1.9:1, or very nearly two to one.' A disease which is becoming a very common one among our people, and which is in a great measure due to want of proper mastication, is that called 'Riggs' disease.' The first symptom noticed is a slight redness along the margin of the gums. These afterward become swollen and bleed upon the slightest touch; then follow inflammation of the peridental membrane, absorption of the alveolar process, and consequent loss of the teeth. To such an extent has this disease become prevalent, that at least ninety-five per cent of all people over twenty-five years of age are thus more or less afflicted. Twenty-five years ago this disease was not considered of any importance by the dentist, due, no doubt, to its comparatively rare occurrence. Today it is giving him more trouble than decay of the teeth, because a dentist is frequently called upon by patients who have a partial or full set of natural teeth which are quite loose in the jaw; aside from this they are sound and healthy, and after a certain stage in the development of the disease nothing can be done to save them; while on the other hand, if decay takes place, by constant filling they can be preserved.

"These conditions are brought about by a change in the mode of living. Man first began to reduce food by cooking, in order to make it more palatable. Roots, herbs, and grains were more finely divided by mechanical means, and thus the labor of the jaws in mastication was lessened. Since these early beginnings man has studied the art of the preparation of food, and today it is prepared in such a manner that in most cases mastication is unnecessary. While these changes in the preparation of the food have taken place, man has been modified not only as regards his sense of taste and appetite, but also in the structure of muscles and jaws. 'Surely,' says Mr. Carter, in the *British Journal of Dental Science*, in speaking of the jaws and teeth, 'some law of God and nature has been outraged to bring upon our children so dire an affliction.' To such an extent has the sense of taste and refined appetite become cultivated, that, at the present day, it requires all the skill that cooks are able to display to produce dishes free from all of the peculiarities presented in the early days of cooking. Thus all coarseness has been removed from food, and by the new processes, made possible by mechanical as well as scientific discoveries, cereals are reduced to the finest of flour, while the hulls, which contain the phosphates essential to bone-building and also furnish the material for mechanical grinding by the jaw, are entirely excluded. There seems to be a growing inclination on the part of the human race to use that class of food which requires little, if any, mastication. This evolution will eventually result in the adoption of new modes of acquiring and preparing food, viz: the manufacture of foods in the chemical laboratory. Indeed, at the present time many forms of food, comprising all the nutritive elements necessary to sustain life for the sick, are being prepared in the laboratory. If these foods, prepared in a liquid form, are sufficient for the nourishment of children and the sick, it seems reasonable to expect that they will soon become the exclusive food of the laboring class, and indeed of all classes. Such being the case, the art of mastication, which is now at a very low ebb, will then become entirely lost.

"I have shown that when the teeth push their way into place they crowd one another laterally. By so doing the dental arch enlarges, and the alveolar process develops and grows about the teeth. The lateral movement of the lower jaw in the act of chewing assists greatly in producing the enlargement. The constant movement of the lower against the upper teeth causes them (in many cases of irregularities) to arrange themselves in their proper places. The teeth of tobacco-chewers are rarely irregular. Thus we see that the result of the proper mastication of food has brought about arrest of development of the jaw, and consequent irregularity of the teeth.

"As far as the jaws and teeth are concerned, they may exist in each parent in perfect symmetry: in one parent the jaws and teeth are large; in the other parent both jaws and teeth are small; but each in its way is a normal development. If, now, the small jaw of one parent and the large teeth of the other appear in the offspring, deformity is sure to follow. Benedict declares* that abnormality of structure predisposes to disease, and among abnormalities of structure he mentions particularly, pathological length and breadth of the face, pathological relations of the sutures, asymmetry, and intercalaria.

"The most convincing proof that one of the great causes of abnormalities of the jaws is due to race mixture, is the fact that these abnormalities are not found in a pure race, *e. g.*, the Chinese and negro races. By examining the figures of

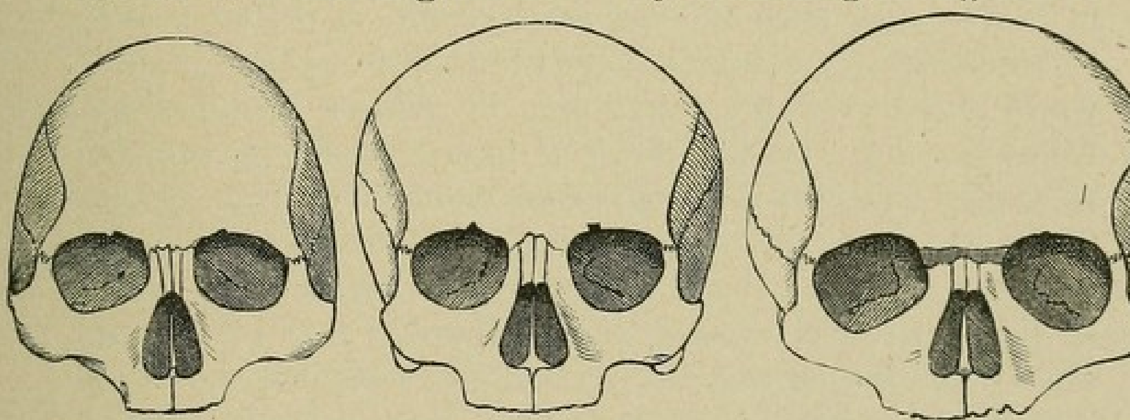


Fig. 12. Fig. 13. Fig. 14.

the dolichocephalic (Fig. 12), Sarmatic brachycephalic (Fig. 13), and the Turanic or extreme brachycephalic (Fig. 14) types, it will be seen at a glance how entirely different must be the single measurements, not only of the skull generally, but of the face, and particularly the superior maxillary bones. These types represent, to a greater or less degree, the German, Slav and Finno-Magyar skulls of the present day, though it is probable that the differences are not so sharply drawn in living specimens.

"Anthropologists agree that racial differences and peculiarities are shown more clearly by the skull as a whole than by any other portion of the skeleton. It is to be supposed, then, that in a mixture of two races with important cranial differences, an attempt by nature to mix the types, without

* Kraniometrie und Kephalometrie. Wien, 1888.

the ability to blend them harmoniously, must result in an irregularity or abnormality. This argument is borne out in man in the predominance of the cerebral and nervous functions, and of the chief individual differences being found in the face, in variations as to form, to a certain extent, temperament and cranial structure. It is simply a matter of evolution, of change and reformation of type. But in civilized communities the law of survival of the fittest is practically annulled.

"Let us suppose, for example, that a person with the form of cranium shown in Fig. 12 be married to one with the form seen in Fig. 14. It seems scarcely possible that there could be a perfectly harmonious blending of the cranial differences in these types, even if both parents were in perfect health, and the offspring remain in perfect health throughout infancy, which may be said never to obtain in civilized communities. And what must be the result if nature attempt to combine what may be called the intellectual cranium of Fig. 12 with the animal strength of face and jaws of Fig. 14? Clearly, deformity, or at the least, irregularity. Nature could never fit the superior maxilla of Fig. 14 into the face of Fig. 12. There is no incongruity involved in believing that she would attempt this. The law of inheritance—call it nature or what else—that insists upon perpetuating supernumerary digits and the like, would not stop at harmless peculiarities, as is shown by the distinct inheritance of disease, such as cancer, tuberculosis, heart disease, etc. Nor is it too much to assert that neuroses, which are distinctly hereditable, are, in a large measure, due to abnormalities in the conformation of the cranium."

It would seem, then, that from what has been said and from actual measurements of the jaws, that no matter what the views of the reader may be in regard to the degeneracy of the jaws of the human race, he must be convinced that the jaws of the human race are gradually growing smaller. Because, when we examine the mouth of an individual, we find that the teeth in both jaws are normally developed, it is no sign that the jaw is sufficiently large to accommodate them. If we raise the lip on the upper jaw or depress it on the lower, in fully 50 per cent of our patients, and pass the finger along the alveolar process at the apices of the roots of the teeth, we will find quite a depression. This shows that although the jaws are undeveloped, the teeth have wedged their way into place and have carried the alveolar process with them, thus demonstrating that those who are in the habit of using their jaws freely have the advantage of a normal development over those unfortunate individuals who do not masticate their food.

CHAPTER VII.

DEVELOPMENT OF THE VAULT.

The roof of the mouth has received several names from different authors; one speaks of it as the arch, another the dome, still a third the palate. The word arch, although used in its proper place, is so often liable to be confounded with the dental arch that one is apt to become confused. Thus we frequently read of the V or saddle-shaped arch, and we are quite unable to decide whether the writer intended to refer to the dental arch or the roof of the mouth. The author has in former papers used the term vault to distinguish it from the dental arch, and shall therefore continue its use in the present volume.

The vault of the mouth is made up of the hard palate, the soft palate, and the alveolar process. The hard palate consists of two horizontal plates of bone extending from the superior maxillary bone upon either side and uniting at the median line, and from the anterior alveolar process in front, it extends back on an average of two inches, when it unites with the soft palate. The hard palate is composed of six distinct parts; two incisive bones, two palate plates of the superior maxillæ, and two horizontal plates of the palate bones. The incisive bones, however, become so firmly united to the maxillary plate of bone so early in life that the suture becomes obliterated. The period of ossification of the median suture varies in different individuals, sometimes as early as the third and fourth years, and again as late as the fifteenth and sixteenth year.

The author, in widening the arch by means of a jack screw, has opened the suture of the median line in fourteen different cases in children from twelve to sixteen years of age. This was accomplished by very little pressure, showing that union had not taken place; these were all neurotic patients.

As a whole, the hard palate may be described as a horizontal partition, or floor, separating the nasal cavity from the mouth. The anterior part of the palate bone unites with and becomes a part of the alveolar process. The upper surface of the hard palate joins the floor of the nasal passages, which are divided in the center by the union of the vomer. This bone, which is quite thin at its middle portion and cartilaginous at the anterior part, begins to thicken as it reaches the floor of the nose, at which place it gradually produces a smooth appearance, dividing the nostril into two rounded arches.

Upon the palatal surface it is very uneven. Along the median line we frequently find a rough ridge of bone, resembling a section of rope, running its entire length, about the size of a slate pencil. Such a condition is frequently observed in Peruvian skulls. Out of 228 examined at the Peabody Museum, Harvard College, sixteen had this peculiar appearance. In more modern skulls we find knots, or rough lumps of bone, at intervals along the suture. Again, we will observe a thick band of bone from .25 to .50 of an inch in width, extending part way or the entire length of the suture. This thickness, or prominence, commences at the alveolar border and becomes the widest at the second bicuspid and first permanent molar, where it gradually narrows to a mere point at a line drawn across the vault at the posterior surface of the second molar.

The hard palate varies in thickness in different localities and differs in thickness in different individuals. Around the edge where it unites with the maxillary bone and alveolar process it is quite thick, and also at the median line; while about midway between these two parts the bone is as thin as tissue paper. I have also observed it from .12 to .18 of an inch in thickness. At the median line, and just back of the incisors, we find a fossa which transmits the anterior palatine vessels and naso-palatine nerves. At the posterior surface upon either side is a groove and an opening for the transmission of the posterior palatine vessels and nerves. Both the upper and lower surfaces of the hard palate are covered with mucous membrane, which extends backward and unites to form the soft palate. Between the two folds of mucous membrane are muscular fibres for the purpose of moving the soft palate in different directions. The shape and length of the soft palate depends upon the distance between the œsophagus and the edge of the hard palate. If the head of the individual is dolichocephalic, or long, the soft palate will curve slowly backward, thus producing quite a long space between the incisor and uvula. On the other hand, if the person possesses a brachycephalic, or short head, the soft palate will curve abruptly, thus allowing only a short distance in the vault of the mouth. I have observed mouths where the head was so

Fig. 15.

short from front to back that the soft palate descended nearly straight down without the slightest curve.

The vault, taken as a whole, presents different shapes in different individuals.

The above description of the anatomy of the vault is quite sufficient for the purpose of the student. Should he require further details, he is referred to the standard text-books.

NORMAL DEVELOPMENT OF THE ROOF OF THE VAULT.

If we will examine the mouth of a child at the fourth or fifth year, we will find a well-developed jaw. The curves are all graceful in outline, and the contour of the dental arch is well formed. This could hardly be otherwise, for the reason that the jaw is growing rapidly for the purpose of accommodating the permanent teeth, and the circle of the alveolar process is larger than that of the teeth. Spaces exist between the teeth, and therefore crowding cannot take place.

We could not expect to find two vaults alike in height, width or contour, although each is normal in itself. We shall see in the chapter upon the alveolar process, that in the development of the jaws we have two structures, the hard,

Fig. 16.

dense bone of the maxilla and hard palate, and the soft, spongy bone—the alveolar process. The maxillary bones develop and unite at the median line. The contour of the top of the vault is now established. It is held in position, on the sides, by the walls of the antrum, supported by the malar process and by the anterior alveolar process and maxillary bone. In this manner the vault is held in its natural position. The maxillary bones, like all the other bones of the head, develop in every direction in a general way, until the growth is established. Between the period of birth and two years (when all the temporary teeth are in place) and twelve or fourteen years (when all the permanent teeth are in position) great changes take place in the shape of the jaw This change is nicely illustrated in Figs. 15 and 16.

Fig. 15 illustrates the face of a girl, three years of age, the bones of the face and head all undeveloped. The bridge of the nose is sunken, the upper lip is short, as well as the jaw from the lower lip to the chin. How different the appearance of the same girl at thirteen (Fig. 16). While the width from cheek to cheek has not changed to any great extent, the length of the face from the chin to the top of the head is very marked. No part of the face has changed more than the lower—from the nose down. This change is due partly to the change in the angle of the lower jaw, and partly to the development downward of the superior alveolar process. In young life, the lower jaw presents an obtuse angle; this gradually changes until at middle life it assumes a right angle. In order that the alveolar process and teeth may compensate for this change as the second set comes into position, the alveolar process lengthens with the eruption of the teeth. This is proven by the location of the mental foramen, which is situated at the superior border of the lower jaw early in life, and at middle life just midway between the upper and lower border of the bone. The same changes take place in the upper jaw. This is quite noticeable on the sides of the alveolar process at the roots of the first permananent molar soon after it has erupted. Upon examination (see Plates 1, 2, 3 and 4), we shall observe what seems to be a depression, but by a careful examination we find that it is a lengthening of the alveolar process. When the crowns of the bicuspids are ready to advance, and absorption of the roots of the temporary molars take place, there is some irritation in the alveolar process. The first permanent molar coming into position advances further than the line of articulation of the temporary molars, and the pressure of the jaws rests upon the first permanent molars. This fact, together with the irritation already mentioned, has a tendency to lengthen the alveolar process, so that when the bicuspids come into place there is a difference in the height of the vault. There are plenty of illustrations to show this development of the alveolar process, and every practitioner of dentistry has observed this.

One of the most common illustrations is that when the molar teeth upon the lower jaw have been extracted, the molars upon the upper jaw (for want of antagonists) drop down by the lengthening of the alveolar process. The difference in the height of vault when the temporary teeth are in place and when the permanent teeth erupt is nicely illustrated in Fig. 17. This cut shows the permanent incisors and first molars in place. Note the lengthening of the alveolar process. In this manner we obtain the difference in

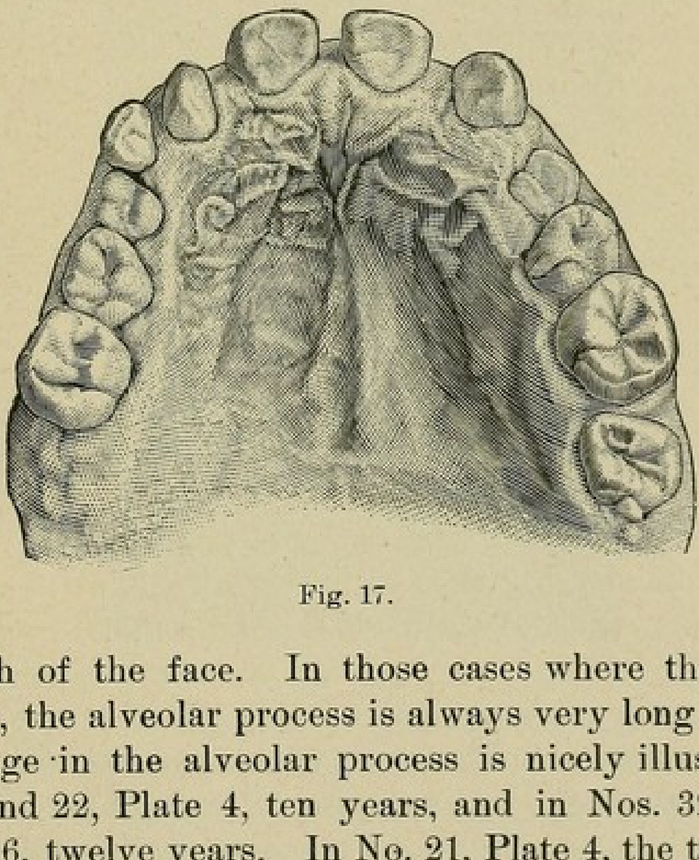


Fig. 17.

the length of the face. In those cases where the vault is very high, the alveolar process is always very long and thin. This change in the alveolar process is nicely illustrated in Nos. 21 and 22, Plate 4, ten years, and in Nos. 32, 33 and 35, Plate 6, twelve years. In No. 21, Plate 4, the temporary teeth have been extracted, and the bicuspids have not erupted, while upon the left side the bicuspid is just coming through; on this side the alveolar process is lengthening. The same is true in No. 22, but on the reverse side. This is more marked in Nos. 32, 33 and 35. The temporary teeth, however, remain in the last three cases. The depth of vault is also governed by the angle of the jaw. Thus, if from inherited constitutional disease, such as consumption, syphilis, etc., arrest of development of the maxillæ should ensue, the angle would not change from an obtuse to a right angle. It will be noticed that when the mouth is opened the anterior part has to travel a greater distance than the posterior part, hence either the anterior inferior alveolar process will elongate so that the lower incisor will articulate with the upper (Fig. 25), or the anterior superior alveolar process will elongate to meet the lower incisor and bicuspid (Figs. 117, 118, 119). Occasionally this will take place in both jaws.

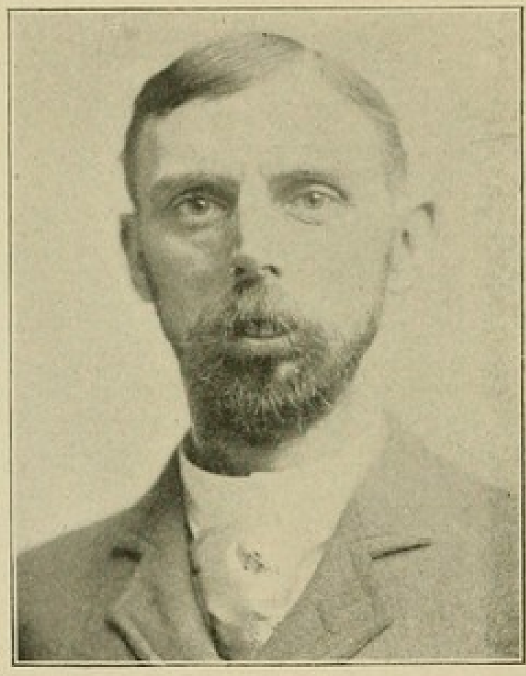


Fig. 18.

In either case the superior alveolar process becomes long and thin, and the vault is quite high. In cases of arrest of development of the bones of the nose and adenoid growths, when it is impossible for the child to breathe through the nose, and mouth-breathing is a necessity, the jaws are separated, and the teeth not having a resting place, the alveolar process elongates and a high vault is almost always noticed; hence the reason why imbeciles and all degenerates who keep the mouth open, as a rule, have high vaults. The high vaults and prominent teeth, and upper alveolar process due to this cause, are nicely illustrated in Fig. 18, etc. On the other hand, we occasionally notice the jaws brought closely together. This is due (1) to a short ramus; (2) to right angles of the rami to the body of the jaw; (3) to arrest of development of the alveolar process, and, (4) to teeth with short crowns, or teeth not fully erupted. In such cases the vault is low, the alveolar process thick, and usually the lower jaw is quite broad. The lips pout, the face is short and broad. Frequently the upper jaw is arrested in its development; the muscles of mastication are very set and rigid. Such a case is illustrated in Fig. 19.

The height of the vault, then, is not due to the roof's

Fig. 19.

being pushed or pulled up by a pressure exerted through the vomer by the development of the sphenoid bone, nor does the shape of the base of the skull in any way affect it, as I have already explained. The height is due entirely to a growth downward of the alveolar process and teeth. The extent of the development of the alveolar process depends upon Nature's becoming satisfied with her architectural figures, and harmonizing the jaws, alveolar process, and length of teeth. That the distance in height is changed from a child to a person of middle life is demonstrated by the following figures: Thus in 317 children, under five years of age, before the development of the first permanent molar and alveolar process, the lowest vault measured .17; the highest .62, with an average of .42. If, now, we notice the height of vaults in children at different ages, we find a gradual advance in the height of the vaults until, in 4,614 adult vaults, we have: lowest, .21, highest, .84, with an average of .58. It will, therefore, be observed that the height of vault develops about .25 to .33 in depth after the permanent teeth commence to erupt. In 908 measurements of the vaults of ancient and modern Romans, Peruvians, Sandwich Islanders, Mound Builders, American Indians, negroes, etc., the minimum height of vault was .25, while the maximum height was .88; average, .53. By comparing these figures with those of modern individuals, the lowest vault is a little higher—.04—than in modern, and the highest a little higher—.04. The average, however, is a little lower than in the modern vaults by .05, thus showing that the ancient and pure individuals possess more uniform and lower vaults than modern. We would conclude, therefore, that the height of the vault depends upon the length of the face from the chin to the top of the head. So far as the height of the vault is concerned, no race, type, sect, or intellect can lay claim to high, medium, or low vaults. They all exist in all classes of individuals.

NORMAL VAULT.

What constitutes a normal vault would be a difficult question to answer. I possess six skulls, obtained under difficulties from a medical college, and not selected for any particular purpose.

The lateral measurement was made between the roots of the second bicuspids, and the antero-posterior measurement between the central incisors at a point intersecting a vertical line dropped from the posterior nasal spine to the posterior border of the palate bone. The height of vault was taken from a horizontal line extending from the alveolar process on one side to the alveolar process on the oposite side, just back of the second bicuspid teeth.

The following measurements were taken:

NO.	LATERAL.	ANTERO-POSTERIOR.	HEIGHT OF VAULT.
1.	1.31 In. = 33.22 Mm.	2 In. = 50.80 Mm.	0.37 In. = 9.42 Mm.
2.	1.25 " = 31.75 "	2.12 " = 53.84 "	0.62 " = 15.74 "
3.	1.37 " = 34.79 "	2 " = 50.80 "	0.43 " = 10.92 "
4.	1.56 " = 39.51 "	2.37 " = 60.70 "	0.75 " = 19.05 "
5.	1.62 " = 41.12 "	2.25 " = 57.15 "	0.50 " = 15.24 "
6.	1.25 " = 31.75 "	2.12 " = 53.84 "	0.31 " = 7.87 "

Nos. 1 and 5 possess very much the same contour of the dental arch, while Nos. 4 and 6 are very broad, with square dental arches.

The heights of the vaults are all different, although two are flat, while the others are more or less rounding. If I were to hand you any one of these skulls, and ask if it was a normal vault, you would most likely answer yes. Yet all are normal, as I view them, while no two are alike.

I have examined hundreds of plaster casts, where the teeth were all in a fairly normal position, with similar results.

Of 372 skulls of Peruvians, California Indians, Mound Builders, and American Indians, the lateral measurement varied from 1.12 to 1.75, and the antero-posterior from 1.75 to 2.75, while the height of the vault varied from .24 to .75.

Oakley Cole made careful measurement of a number of skulls, chiefly in the museum of the College of Surgeons, London, England. The skulls examined fall into two series, viz.: those of European origin, and those of mixed races, with the following results:

EXAMINATION OF THIRTY-FOUR EUROPEAN SKULLS.

	LENGTH IN MILLIMETERS.	WIDTH IN MILLIMETERS.	HEIGHT IN MILLIMETERS.
Maximum	58	42	15
Minimum	40	31	5.5
Average	49	*35	*9

EXAMINATION OF THIRTY-TWO MIXED SKULLS.

	LENGTH IN MILLIMETERS.	WIDTH IN MILLIMETERS.	HEIGHT IN MILLIMETERS.
Maximum	65	40	18
Minimum	43	29	6
Average	54.9	*35	*12

* Taken at second bicuspid.

In each of the cases that I have examined, the dental arch was in a normal condition. I have also examined the skulls mentioned by Oakley Coles, and I have been unable to find but few contracted arches in any of them. If, therefore, in the examination of thousands of skulls having normal dental arches, no two vaults are found to correspond, we must conclude that a normal vault is one where the dental arch is regular, and the different outlines possess graceful curves, regardless of height, width and length.

BY WHAT STANDARD SHALL WE MEASURE THE VAULT?

The width of the vault depends upon two factors: *First*, the development of the jaw bone proper, and, *second*, upon the development of the alveolar process.

Narrow jaws are rarely observed among the early races or modern pure races. In the examination of the thousands of skulls of early races in the museums of Europe and this country, very few, if any, contracted vaults are found. This is also true of people who lead a quiet life, as illustrated in modern pure races. If the brain is in a healthy condition and the child properly nourished, the jaw-bone will develop in size sufficiently to accommodate all the teeth when they erupt. The teeth will crowd against one another as they come into place, and a normal width of arch will be produced. If the brain is defective, as the result of some of the constitutional diseases, and the jaw becomes arrested in its development just before sufficient room had been secured for the teeth, they will crowd against one another, the arch will become broken, and the V or saddle arch, or some of their modifications, will be formed; hence a narrow, contracted vault. The amount of contraction depends upon the size of the jaw-bone proper; if the bone has become arrested early, the jaw being small, the contraction is usually very great. The alveolar process depends entirely upon the location of the teeth for its shape and size. Occasionally the teeth, which are small, are inherited from one parent, and the jaw-bone proper, which is large, from the other parent. In such cases the alveolar process will contract until all the teeth antagonize, when a small arch will be produced. It has already been shown that the V and saddle shape arches and their modifications are observed as often among low vaults as among high ones; just as we have seen high and low vaults in normal jaws. The contraction is due to arrest of development of the jaw at the time of the eruption of the permanent teeth; the vault may be high or low. What appears to be a high vault is not in the height of the vault, but in the width. Having now explained the true cause of what appears to be a high vault, if we will refer to Clouston's classification, we will find what he calls neurotic and deformed are both one and the same. Both are neurotic, but one is more contracted than the other; both are due to arrest of development of the maxillary bones. In summing up our observation, we find that there are high and low vaults among the ignorant as well as the intellectual, among the colored as well as the white, among the brachycephalic and mesocephalic as much as among the dolichocephalic, among the deformed, or contracted, as much as among the normal. The width of the vault depends upon the development of the maxillary bones; if it develops to a size sufficient to accommodate all the permanent teeth, it will be a normal vault, regardless of height. On the other hand, if arrest of development of the jaw takes place, these deformities result in a V or saddle arch or some of their modifications. How, then, shall we classify vaults? In the measurement of the height of vaults of 8,654 ancient and modern skulls in this country and Europe, the highest was .88, the lowest, .25, with an average .53. In the measurement of 6,387 mouths of living people over twenty years of age, the highest is .84, the lowest .21, with an average of .58. In the measurement of 616 insane people at the Eastern Illinois Insane Asylum, the highest is 1, lowest .12, with an average of .54.

Taking these figures into consideration, it is safe to average the height at .55. Allowing .15 of an inch in each direction, we can call vaults which measure below .40 low vaults; those between .40 and .70, medium vaults; those above .70, high vaults. We could still classify those below .25 very low vaults, and those above .85 very high vaults. The width of vault between second bicuspids

In 8,654 ancient and modern skulls:

Maximum, - - - -	1.63
Minimum, - - - -	1.13
Average, - - - -	1.36

In 6,387 mouths of living people over twenty years of age:

Maximum, - - - -	1.50
Minimum, - - - -	.93
Average, - - - -	1.19

In 616 insane people:

Maximum, - - - -	1.87
Minimum, - - - -	.75
Average, - - - -	1.16

The vast difference in the ancient and modern skulls of this country and Europe, with those of living individuals, shows conclusively that the jaws are diminishing in size. We must, therefore, arrange a standard by which we are to compare the width of the vault as we find them today, excluding measurements of ancient and modern skulls and deformed jaws. Taking the 1.19 as the average width of vault, we will say that any jaw below 1 is a narrow vault; one between 1 and 1.40 medium width, and one which measures above 1.40 a wide vault.

CHAPTER VIII.

DEVELOPMENT OF THE ALVEOLAR PROCESS.

The alveolar processes are situated upon the superior border of the inferior maxilla and upon the inferior border of the superior maxilla. These bones are considered a part of the maxillary bones, and are so described by anatomists. They should, however, be considered and described as practically separate and distinct bones. Their structure and functions differ so completely from the structure and functions of the maxillary bones that there is little or no similarity between them. The superior and inferior maxillæ are (unlike the alveolar processes) composed of hard, compact bone-structure. The large, powerful muscles attached to them would indicate that powerful work is to be accomplished, and when fully developed they retain their full size through life. The alveolar processes are composed of soft and spongy bone of a relatively cancellous structure. As early as the eleventh week of intra-uterine life, calcification of the deciduous teeth commences, and by the twentieth week calcific material is quite abundantly deposited. Ossification is also rapidly progressing about the dental follicles. At birth the sacs are nearly or quite enclosed in their soft, bony crypts, and the crowns of the teeth upon their outer surface are composed of enamel, which is dense and hard.

The alveolar process, being soft and spongy, molds itself about the sacs containing the crowns of the teeth and about their roots after their eruption, regardless of their position in the jaw. While the alveolar processes have grown rapidly, they have, up to this time, developed only sufficiently to cover and protect the follicles while calcification proceeds. When the crowns have become calcified and the roots have begun to take in their calcific material, absorption of the borders of the processes takes place in the order of the eruption of the teeth. When the teeth have erupted, the alveolar process develops with the teeth until they attain the depth of the roots of the teeth, which extend in most instances into the superior maxillary bone, in the anterior part of the mouth at least. The depth to which they penetrate the bone differs in different mouths. The *incisive fossa*, the *canine eminence* and the *canine fossa* give evidence of this externally. These sockets are lined with extensions of the process, thus making its upper border irregular. The fact that some of the teeth are fixed in the bone as well as in the alveolar process makes the correction of some forms of irregularity more difficult, for not only does the process have to be reshaped, but the bone as well. This is quite noticeable in correcting irregularities of the teeth in the lower maxilla. The crypts of the permanent teeth are located at the apices of the roots of the temporary teeth. The permanent teeth have large crowns

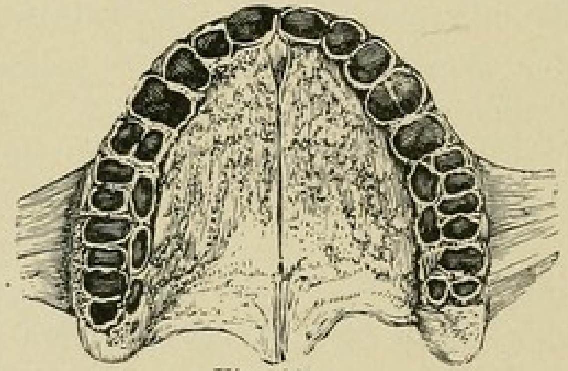


Fig. 20.

which touch each other, forming a line to the posterior part of the jaw. These teeth, as they erupt, entirely absorb the alveolar process which surrounded the temporary teeth, and, as the new set come into place, a new process is built up about them for their support. The permanent teeth require a deeper alveolar process to support their roots, which are much longer than those of the temporary teeth. Hence the difference in the depth o1 the arches of the first and second sets of teeth.

The alveolar process of each superior maxilla includes the tuberosity, and extends as far forward as the median line of the bone, where it articulates with the process upon the opposite side. It is narrow in front, and gradually enlarges until it reaches the tuberosity, where it becomes rounded.

If we examine the two articulated superior maxillary bones (Fig. 20), we see that the anterior part is curved, while the posterior part gradually diverges from the central line of ossification of the maxillary bones. The shape varies in different individuals. Some arches are small and others large; the arch is parabolic in some cases and circular in others.

The process is composed of two plates of bones, an outer and an inner, which are united at intervals by septa of cancellous tissue. These form the alveoli for the reception of the roots of the teeth. In some cases the buccal surfaces of the roots of healthy teeth extend nearly or quite through the outer body plate.

This plate is continuous with the facial and zygomatic surfaces of the maxillary bone. The inner plate is thicker and stronger than the outer, and is fortified by the palate bones. The external plate is irregular upon the outer surface, prominent over the roots of the teeth, and depressed between the roots or interspaces.

The prominence over the canine teeth, called the canine eminence, is very marked, and decidedly modifies the expression of the face. The sockets of the central incisors are conical and round; those of the lateral incisors conical and slightly flattened upon their mesial and distal surfaces, and not so large as the central sockets.

The pit for the cuspid is conical and much larger than any of the other sockets. The sockets for the bicuspids are flattened upon their anterior and posterior surfaces, and near the apex they are frequently bifurcated. The sockets of the molars are large at the openings, but at about the middle of their length they are divided into three smaller sockets for the reception of the roots. In the case of the third molar the number of sockets ranges from one large cavity to three or four of smaller size.

THE INFERIOR ALVEOLAR PROCESS.

The alveolar process of the inferior maxilla extends from the ramus of one side to the same point on the other. The outline is similar to that of the superior process, the anterior portion being much thinner.

The description given of the structure of the superior process will also apply to the inferior. The outer plate of bone opposite to the molars and bicuspids is thicker than the inner plate, while the inner plate opposite the canines and incisors is thicker than the outer.

The alveoli are arranged along the border of the bone for the reception of the roots of the teeth. They correspond in form to the roots which they accommodate. The alveoli for the central incisors are smaller than those for the lateral. They are conical in shape, and flattened upon their mesial and distal surfaces. Those for the lateral incisors are larger, and compressed on their mesial and distal surfaces. The sockets for the canines (cuspids, or stomach teeth) are larger, deeper and less compressed than those for the incisors.

The sockets of the bicuspids are considerably flattened upon their lateral surfaces, and are sometimes divided into two cavities. The sockets for the anterior roots of the molars are broad and flattened laterally, while those for the posterior roots are round. The third molar, being naturally of variable form, has sometimes one pit, and again three or four. Each alveolar pit or socket is divided from its neighbor by a small wall or septum, which is made up of cancellated bone, extending about one-eighth of an inch above the inner and outer plate.

The dental septa assist in keeping the teeth firmly in their places.

It will be observed that the septa are very thin at the margin, and gradually increase in width to the middle of the jaw, where they become thicker, and are finally lost in the substance of the jaw. Some septa are thicker than others, and where two teeth are widely separated, the width of the septa naturally corresponds to the space between the teeth.

The sockets are lined with a thin plate of compact bony substance, extending from the outer and inner plate of the alveolar process to the apex, where there are small openings for the entrance of nerve and blood-vessels for the nourishment of the teeth.

This bony plate has upon its inner surface the elastic peridental membrane, which acts as a cushion for the teeth, while upon the inner surface it is surrounded by spongy bone.

The teeth are held firm in their alveolar sockets by a union called gomphosis, which resembles the attachment of a nail in a board. Teeth with one conical root, and those with two or more perpendicular roots, are retained in position by an exact adaptation of the tissues. Teeth having more than one root, and those bent or irregular, receive support from all sides by reason of their irregularity. The teeth are also held

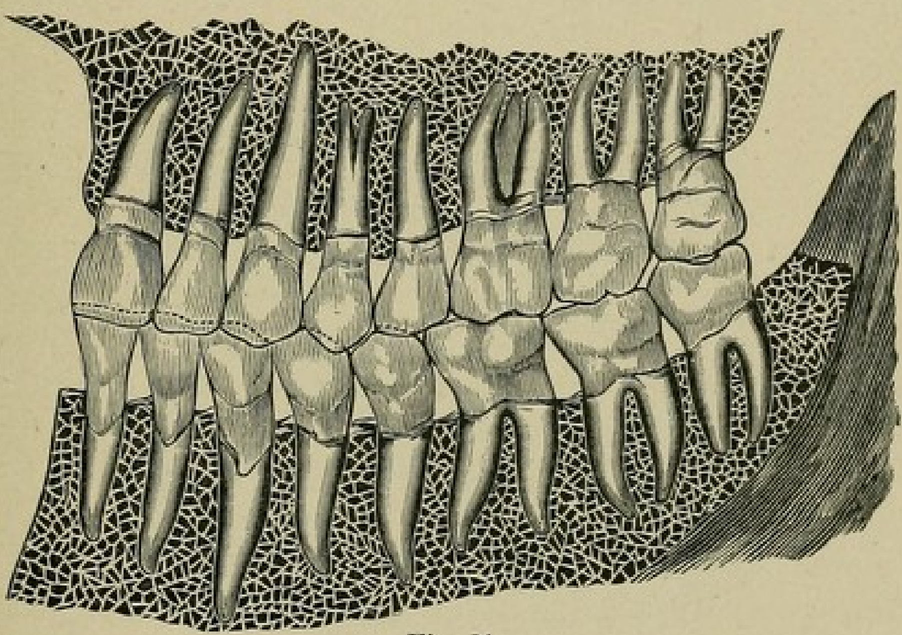


Fig. 21.

in position by the peridental membranes. Fig. 21 illustrates the position of the teeth in the jaws. The peridental membrane lines the alveolus and covers the roots of the teeth. It is a fibrous tissue, which admits of a slight motion of the teeth, and acts as a cushion to protect the jaws from severe blows and concussions while in the act of tearing and grinding food.

After the removal of the permanent teeth the alveolar process is entirely absorbed. Fig. 22 shows how absorption takes place. The teeth have all been removed from the superior maxilla, as has also the alveolar process. The molars on the lower jaw have been extracted, and absorption of the alveolar process has resulted, showing a marked contrast in connection with the anterior alveolar process, which remains intact and holds the teeth firmly in place. Thus it will be observed, from the changes which occur from the first development of the teeth to their final extraction, that the alveolar process is solely for the purpose of protecting the teeth in their crypts during their development and after their eruption. When the temporary teeth are in place the alveolar process remains unchanged (except a gradual enlargement in harmony with the growth of the maxillary bones) until about the sixth year, when the second set of teeth appears. The crowns of the

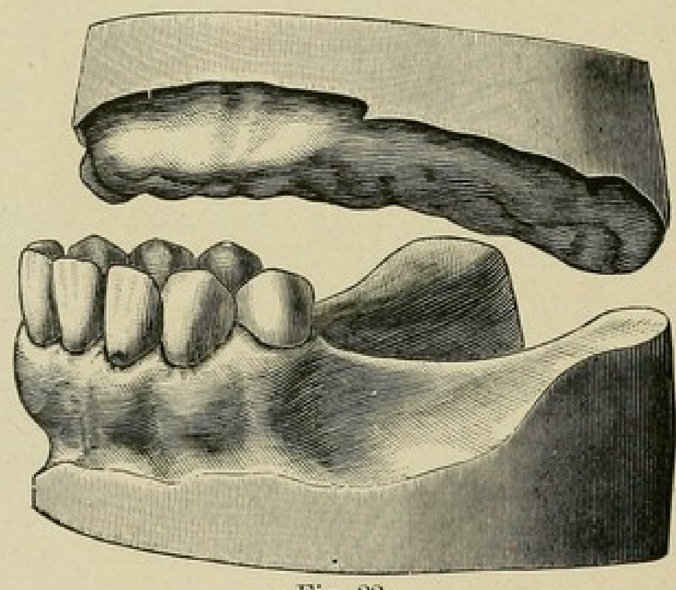


Fig. 22.

permanent teeth require more space than those of the temporary set; and the alveolar process must necessarily enlarge to accommodate them. This enlargement of the alveolar process is doubtless caused by the formation of the crowns of the permanent teeth before eruption, and to a limited extent by the growth of the maxillary bones, which may cease developing at any period in the life of the individual, or continue as late as the thirty-sixth year. The diameter of the crowns of the permanent teeth forming a larger circle than that of the maxillary bones, the alveolar process must necessarily increase its diameter. It is often forced outside of the superior maxilla by the crowns of the permanent teeth crowding and wedging themselves into positions anterior to the first permanent molar teeth. This enlargement of the alveolar process usually takes place anterior to the first permanent molars. We expect to find the process corresponding in size to the jaws. Fig. 23 shows a comparatively small superior maxilla, the inferior being much larger. This is the result of arrested development, including the bones of the face. To allow for the deficiency in bone-structure, and allow the upper teeth to extend over the lower, the upper teeth have forced the alveolar process forward. The space shows where a tooth was extracted after all the teeth were in position. The teeth of

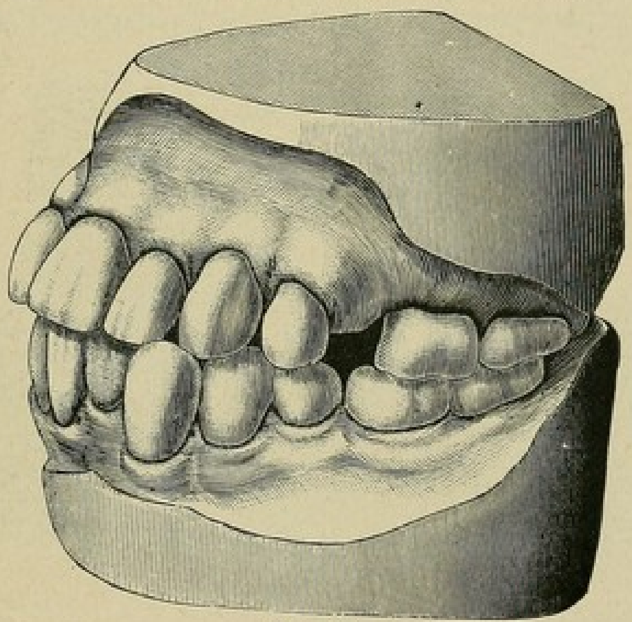


Fig. 23.

today are nearly if not quite the size they were 3,000 years ago; on the other hand, the jaws are growing smaller. To compensate for this difference, the alveolar process has to expand, or enlarge, to allow the teeth to come in evenly. If the teeth antagonize uniformly the arch will enlarge around evenly. If the molars are fixed the alveolar process will expand anteriorly. Again, if the teeth should not antagonize evenly, a break will take place at that point, producing a V or saddle arch.

Fig. 22 shows a similar case where all the upper teeth have been removed and absorption has entirely obliterated the alveolar process. The relations of the superior maxillary bones to the alveolar process and teeth on the lower jaw are well illustrated. When the alveolar process and teeth were intact they presented an appearance like illustration No. 23.

The position and shape of the processes and their relation to each other are governed entirely by the location and size of the teeth and roots, and not by the shape of the jaw-bone proper. The dental follicles containing the crowns may be located upon the outer border of the jaw-bone on one side, in which case the alveolar process will be situated upon the outer border, and assume an irregular arch. If the crowns of the teeth are located upon the inner border, or if one jaw be smaller than the other, the teeth will articulate and the

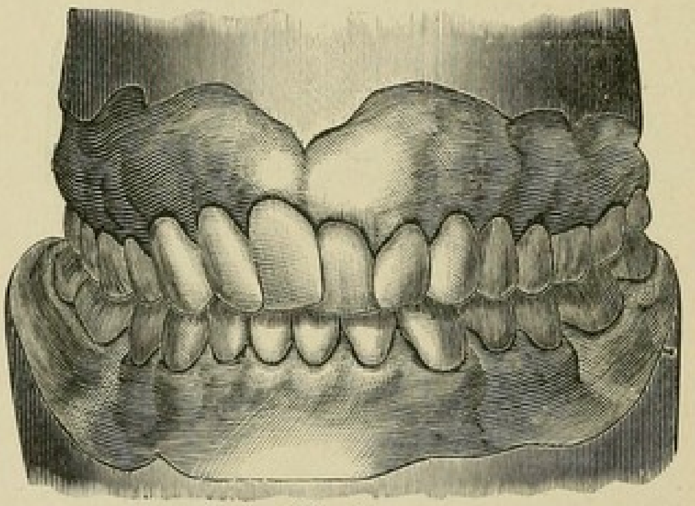


Fig. 24.

process will form a smaller circle than the jaw-bone proper. Such a case is illustrated in Fig. 24. The superior maxilla is much larger than the inferior, and, as a result, the articulation of the teeth and the muscles of the cheeks and lips have carried the teeth and alveolar process on the upper jaw inward. The teeth on the lower jaw are regular and appear to have sufficient room, while those upon the upper jaw are crowded and overlap each other. The teeth on the left side of the upper jaw are more regular than those on the right side. Upon examining the mouth, or model, the arch on the left side will be found full and regular, while the arch upon the right side has a perfect semi-V-shape.

The alveolar process on the right side extends considerably over the border of the maxillary bone, and the teeth (especially the cuspid) have taken quite an incline in order to articulate with the teeth upon the lower jaw, thus crowding the alveolar process to the inner border of the maxillary bones.

The process is solely for retaining the teeth, and if for any reason the dental follicles should not be present and the tooth should not erupt, or if it should have been extracted early, the process would not be developed at that point. In my collection of models may be seen cases of arrested development of the alveolar process, caused by the lack of bicuspid and lateral incisor germs, and by the extraction of the deciduous and permanent teeth.

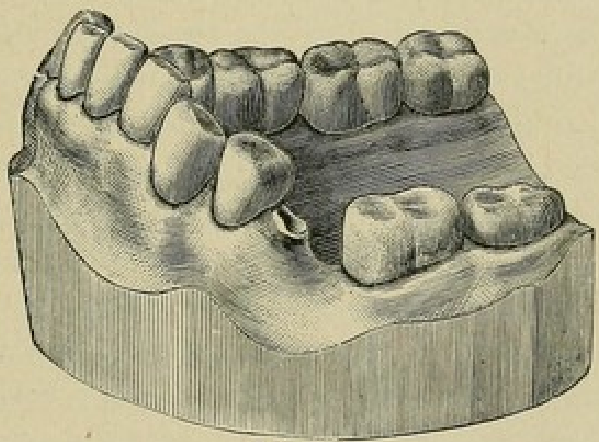


Fig. 25.

If one or more teeth should not antagonize, the alveolar process would extend beyond the natural border, carrying the teeth with it. A marked illustration of this is seen where the molars are decayed to the gum and the roots remain. The vascularity of the process is such that its development results. Excessive development of the alveolar process is frequently observed by every practitioner in connection with the anterior inferior teeth. When the articulation is normal, occlusion of these teeth never takes place. We frequently find (especially in patients from six to twelve years of age) these teeth extending to and occluding with the mucous membrane of the hard palate, making one of the most difficult forms of irregularities to correct. Such a case is illustrated in Fig. 25. This model is taken from the jaw of a person thirty-seven years of age, but I venture the statement that this excessive development took place between the ages of six and twelve, because at that period the vascularity of the tissues is more vigorous and the development of the process more formative than at any period subsequent to the development of the first permanent teeth.

I recall a case in practice in which the incisors and cuspids, together with their alveolar process, were situated upon the external surface, while the bicuspids, molars and their alveolar process are located upon the inner border of the jaw. Another case is one in which the alveolar process failed to cover the roots of the bicuspids and molars upon the outer surface, the teeth having forced themselves into a larger circle through the alveolar process by the contact of the crowns. The roots in this case can be easily outlined by the finger through the mucous membrane; the outer plate of the alveolar process barely, if at all, covering them. Mr. Tomes mentions and illustrates a case in a late work, of faulty development of the outer plate of the alveolar process exposing the crowns of all the temporary teeth. The case was a child who had suffered from hydrocephalus. I have a number of models showing the anterior alveolar process projecting beyond the normal position by the forward movement of the molars. This may be due to a natural movement of the molars forward, or the process may be forced forward by the improper occlusion of the jaws. The teeth are moved from one position to another simply by the force consequent upon absorption and deposition of bone. This is noticeable in the spaces between the centrals, when the alveolar process develops to a larger circle than is necessary to accommodate the teeth. The alveolar processes are influenced in one direction or the other by the pressure of articulation. This abnormal condition is the result of inharmonious development of the jaws. The teeth may come together in such a manner as to throw the alveolar processes either to the right or left, thus producing a full round arch upon one side of the jaws and a perfectly flat or straight arch upon the other. (See Fig. 24.)

The greatest deformity is that in which the teeth of the upper jaw and alveolar process are forced forward, causing a protrusion of the anterior superior part of the mouth. Occasionally we find both upper and lower alveolar processes carried forward in the same manner. The alveolar process upon the lower jaw is more liable to be found upon the inner border of the jaw than is the upper alveolar process, as the inferior maxilla is larger and more dense than the superior, and when the teeth are once in position upon the lower jaw they are not liable to subsequent change. As the jaws become smaller and more delicate, the anterior alveolar process becomes thinner and less liable to resist the forward movement of the molar and cuspid teeth, thus producing anterior protrusion and V-shaped irregularities. Owing to this fact the teeth of the superior maxilla do not form so great a circle, causing the teeth upon the sides of the jaws to conflict and the lower teeth and alveolar processes to be carried in, while the anterior teeth of the lower jaw are held inside of the superior anterior teeth, thus carrying the alveolar process inward.

The teeth are continually changing their positions in the mouth. This is beneficial as often as it is detrimental. That the teeth may perform their full function, they should not only remain firmly fixed in the alveolar process, but they should also antagonize. The teeth may be compared to the bricks in an arch; remove a brick and the arch falls to pieces. It is frequently found that the teeth do not articulate properly, and by cutting away the approximal surfaces a better articulation may be secured. When this operation is performed the teeth move in their sockets by absorption and deposition of bone, demonstrating the fact that the process changes in shape and substance.

The tendency of the alveolar process to develop between the sixth and twelfth year is something marvelous. This seems to be the period of its greatest activity.

Physiological excessive development, however, is governed entirely by the eruption of the teeth. The air passages may become filled by excessively developed bones or mucous membrane, by adenoid vegetation or other causes; as a result mouth-breathing will take place.

The lower jaw drops, and the pressure is taken away from the teeth.

In idiocy, and imbecility, and other degenerate conditions, mouth-breathing is also very common.

In these cases we find a long, thin alveolar process. The teeth continue to erupt, and the alveolar process elongates.

Occasionally when the mouth is closed the six anterior teeth will elongate, and the lower incisor will penetrate the superior alveolar process.

In such cases the superior incisors protrude and separate. This deformity will continue until the upper incisors cease to develop, owing to the pressure of the alveolar process upon the lower incisor teeth.

If, now, we wish to correct this deformity the first thing to do is to place a plate in the mouth, to allow the lower incisors to rest upon the plate.

In this manner the pressure is taken from the bicuspids and molars. In two or three weeks' time the posterior teeth and alveolar process will elongate from .12 to .16 of an inch; thus showing the possibility of the development of the alveolar process in a short time by removing the pressure.

In some cases this excessive development of the alveolar process goes on very rapidly, especially in the case of an epileptic.

This, however, takes place at the time of the development of the first teeth.

HYPERTROPHY OF THE ALVEOLAR PROCESS.

From what has already been said of the vascularity of the alveolar process, we may expect to find hypertrophy of the tissue ensuing from simple irritation of varying degree. The irritation consequent upon the eruption of the teeth, together with the excessive blood-supply, are both primal causes of over-building of tissue, *i. e.*, hyperplasia.

The ragged roots of the temporary teeth, produced by absorption, the gases from the putrescent pulps, and the pressure of the permanent crowns against the tissues, produce sufficient stimulation to excite physiological action. Tissue-building generally is seen in connection with the teeth posterior to the cuspid, rather than with the teeth anterior to that tooth. It seems accountable only from the fact that the incisors have sharp cutting-edges, the roots of the teeth are single and nearly always shed before the permanent teeth are in place, and they erupt at an age when there is less vitality. *Per contra*, the crowns of the teeth posterior to the cuspid are broad, the roots of the temporary teeth posterior to the cuspids are more numerous than those anterior to them, and, with the exception of the first permanent molars, they erupt

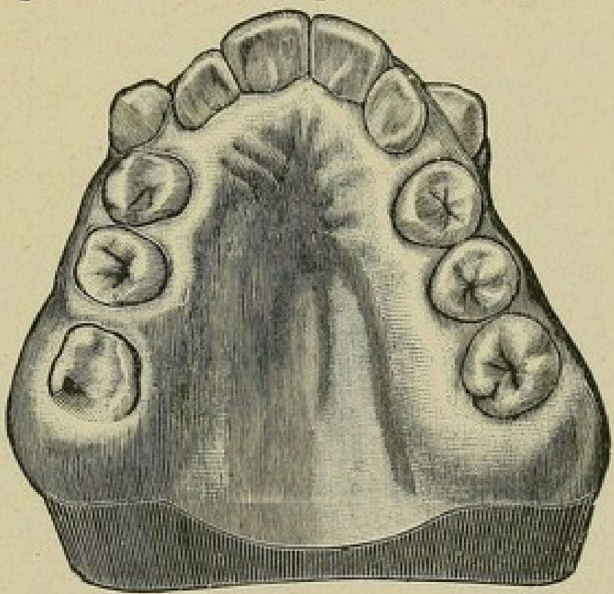


Fig. 26.

at the age of greatest vitality. Epileptics of all the degenerates are the class who possess these stigmata. Excessive development of the alveolar process is unusually common among them, as is also the case with the muscles of the body. The process becomes unnaturally thick, the bicuspids and molars are carried in one direction and another, effecting a variety of irregularities. I have frequently observed hypertrophy in connection with epilepsy. This is owing to the unstable tissue-building, as noticed among degenerates. A common form is shown in Fig. 26. Similar irregularities are also seen in Cole's "Deformities of the Mouth," Figs. 12, 13, and 27; and in Tomes' "Dental Surgery," Fig. 90. These deformities all take the contour of the saddle-shaped arch. This may be accounted for from the fact that the permanent molars, being the first teeth to erupt, become fixed before the deposit commences. The crowns of the bicuspids are also held in a small circle by the retention of the temporary molars. When these teeth do not antagonize they are liable to be carried inward.

The cuspids, with their long roots, meet resistance either in connection with the teeth adjoining or with those upon the opposite jaw, and are thus held in position. It will be

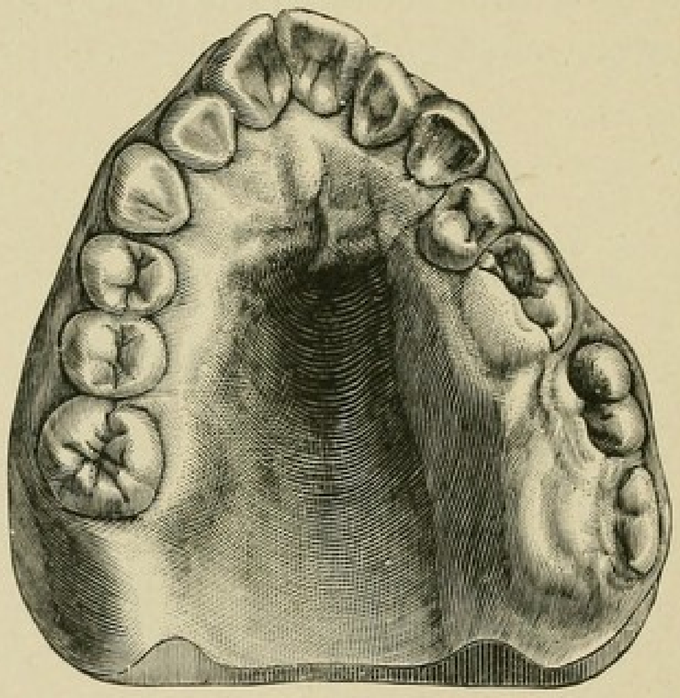


Fig. 27.

observed that, in all of these cases, the enlargement seems to be associated with the inner plate of the alveolar process. My observation in these cases has been that with most of them the inner plate is the part of the alveolar process affected. The outer plate, although quite irregular from the arrangement of the teeth, is usually normal in thickness. This disparity in the two plates of the alveolar process may be accounted for from the fact that the inner plate of the alveolar process possesses a large blood-supply—the posterior or descending palatine arteries furnishing the ossific material. The author has observed a few cases where the hypertrophy has extended to and included the outer plate. When the outer plate becomes involved the alveolar process assumes a very thick condition. Occasionally, hypertrophy will affect one side only or one distinct locality. Fig. 27 illustrates such a case. In this case the enlargement is upon the left side and extends from the first bicuspid posterior to, and including, the maxillary tuberosity. Instead of the force being directed inward, as is generally the case, the process is forced outward and backward. This enlargement occurred previous to the development of the second and third molars. The alveolar process extends downward and occludes with the teeth upon the lower jaw, thus preventing the molars from erupting.

CHAPTER IX.

DEVELOPMENTAL NEUROSES.

Dr. Langdon Down, of the Earlsworth Asylum (London), first called the attention of the profession, in 1871, to the fact that after observation of the mouths of a large number of congenital idiots, he found that in nearly every case there was a contracted arch at the second bicuspid region and an inordinate vaulting of the palate, and that irregularities of the teeth were very common among this class of patients. Dr. W. W. Ireland, in confirming this, says that by an examination of the mouths of eighty-one congenital idiots, he found two cases of cleft palate and thirty-seven deeply vaulted, keel shaped palatine arches.* Dr. Kingsley examined the jaws of 200 idiots on Randall's Island, but found very few contracted arches at the bicuspid region, and no case of pronounced V-shaped arch. Drs. J. W. White and Stelwagen, after an examination of one hundred and eighty-four idiot children, found that large and well-formed jaws were the rule, and that idiots would "compare fair in this respect with the same number of similarly neglected people of ordinary intelligence." Dr. Kingsley concludes that "taking the idiots as a class and comparing them with the lower order of society, as found in this country, there were no more irregularities in the one than in the other."

Such seemingly conflicting reports by men of equal ability in their several specialties upon both sides of the Atlantic, led the author to take up the special study of the etiology of the deformities of the jaws and teeth, in 1881, with a view of obtaining the true cause, if possible, of the abnormal conditions. This desire was strengthened by the fact that he had observed, like Dr. Kingsley, marked deformities (but perhaps not so many) among some of his best patients (well-to-do people), and bright business men and women. It was thought best to examine the jaws of the idiots first and study

*British Odontological Society's Trans., 1871.

the subject from that standpoint. The result of this investigation was a paper read before the International Medical Congress, held in Washington in 1887, in which it is noted that only 55.3 per cent. of all the inmates of the asylum examined possessed normal jaws. Subsequent study and investigation by the author has shown that all defective classes possess an unusually large number of deformities of the jaws and teeth, and a little later he published in The Dental Cosmos the result of his investigations. It now seemed necessary to take up the subject of the development of the brain and its diseases, with a view of tracing the different mental conditions of those suffering with deformities. An oral report of this work was accepted as a thesis for admission to the Chicago Academy of Medicine, in 1890. Before taking up the subject in detail, a paper written by Mr. Cartwright, bearing upon these points, will furnish a suitable text for some remarks. Mr. Cartwright, in a paper read before the Odontological Society of London, May 2, 1864, among other things, remarks: "Irregularity is common in most highly civilized communities, and especially so among the upper and middle classes, and it is more constant among the inhabitants of towns than it is among the inhabitants of agricultural districts. * * * * Now, it appears to me to be a question of much interest and importance to consider whether the form and size of the jaws in civilized countries, in some instances, may not be accounted for as resulting from a process of breeding. We know that with animals and birds what is called high breeding is arrived at and maintained by the constant selection of birds and animals possessing particular points and characteristics; and Mr. Darwin has shown, and Mr. Huxley and others have added the weight of their sanction to the truth of Mr. Darwin's facts, that with birds—take the pigeon, as he has, as an example—by selective breeding the bones as well as the plumage, become altered, and changed from the original type. * * * Thus, we may reasonably argue, that small jaws may be characteristic of breed in certain conditions of life, or may express symptoms of deteriorated growth, under some circumstances of society. And whether it be high breeding, or close breeding (I mean where marriages of near consanguinity occur and recur), diminished capacity in the jaws is generally a prominent feature, and irregularities of the teeth a common phase.

"What constitutes high breeding? Is it not selective breeding confined principally to a particular class or classes? Take the aristocracy and families who date their names and descent from antiquity, who, as a rule, intermarry among themselves, from political or family reasons, and to a more modified extent, other classes of the community--modified because they represent much greater numbers—and I am convinced that we find, as a result of that selective breeding, peculiarities of form and organization not differing from what we find to be the case with high breeding among animals, which is maintained by the constant and careful selection of animals possessing particular points and characteristics. Take the horse and consider the points which make up a thoroughbred animal. The small head and ears, the thin legs, small fetlocks and feet, the necks and bodies finely and symmetrically proportioned, and then the narrowness and comparative smallness of the maxillæ."

Within the past few years great advancement has been made in differentiating the various forms of insanity, but even now classification is admittedly imperfect. Patients admitted to public and private insane hospitals do not, as a rule, bring with them complete and reliable data as to the causes of their malady. While the attending physicians may be generally anxious to obtain a very accurate anamnesis of the case, the patients and relatives are loth to answer questions, or through ignorance are unable to answer them correctly. In public institutions especially, it is often impossible to get at a true history of the previous condition of the patient. Alienists have, however, been able to classify certain marked forms of insanity and degeneracy, so that other specialists can, from their standpoints, add materially to knowledge already obtained, and by putting together the different fragments so obtained, eventually derive facts of scientific value.

The study of the human body has become so scientific and so complicated, that no one individual can grasp the whole, but by becoming proficient in some one specialty, he can add materially in solving the great question of cause by adding his mite to the grand total. Alienists have divided certain conditions of the brain into two great classes—neurotics and degenerates.

A neurotic is one whose brain and nervous system (spinal and peripheral nerves included) are unstable from acquired taint, or often from inherited tendencies.

A degenerate is a being who has imperfectly undergone the changes from a higher to a lower type in tissue or organs.

Authors and specialists differ in regard to these definitions, and also differ as to the cases that should come under the head of one and the other. The inherited element in both leads to this confusion, especially as the neurotic at most has often but latent heredity.

The doctrine of degeneracy, explanatory of these conditions, may be tersely stated as follows: There are local degeneracies of tissue function, but this is not the sense in which the term is used by the disciples of Morel, the founder of the doctrine of human degeneracy. As Morel and his later disciples have shown, alcoholism, skull fracture, spinal diseases, etc., in the ancestor may produce an hereditary taint showing degenerative stigmata in the child. Degeneracy is used in the evolutionary sense as implying an atavism, which necessitated at least two generations. The doctrine of evolution is that everything proceeds from a simple homogeneous to a complex heterogeneous with a loss of expenditure of force. Thus, in the nutritive reversions, a tissue may, by degeneracy, regain a power of reproduction which it had in the fœtal state, such reproduction extending beyond mere repair. Vertebrates never, or rarely, reproduce lost limbs, while the phenomenon is far from infrequent in invertebrates. This condition of degeneracy underlies certain tumors; reproduction exceeding a required rate of repair. Cohnheim is of the opinion that this tendency underlies all cancer formation, but later researches somewhat modify this view. Degeneracy, furthermore, implies a latent instability of tissue which constitutes the hereditary predisposition to disease exemplified in neurotics, as well as other systemic diseases. All these may present stigmata or signs of degeneracy; most frequent and numerous in the intellectual and ethical atavism, and least in the nutritive atavisms, spinal degeneracies and local reversions. The nutritive atavisms may appear as stigmata in the other types, and so may the spinal and local reversions.

Degeneracy may involve the entire system, or only a part, or merely a function of a part. Gout is the reversion of a mammalian liver to an areptilian function. Degeneracy may seem to be acquired, since it appears only at the periods of involution, or at the periods of evolution, but the degeneracy is in the tissue instability present, which is not evoked until the epochs of stress on function. Weissmann denies transmission of acquired defect, but his attempt to explain hereditary epilepsy on any other theory fails completely. He charges epilepsy to microbes, but admits that it may be produced in the first generation by non-microbic agencies. There is no proof existent of the microbic origin, and Weissmann's explanation fails, as Eimer has shown.

Weissmann, however, admits (which emphatically settles the question) that disturbances of the nutrition of the ovum may cause the inheritance of acquired defect. He therefore admits that acquired defects sufficient to affect the nutrition of the ovum can be inherited.

The following table represents the views of the lucid, logical disciples of Morel:

- Cerebral.
  - Ethical Degeneracy
    - Crime.
    - Prostitution and Sexual Degeneracy.
    - Moral Insanity, Pauperism and Inebriety.
  - Intellectual Degeneracy
    - Intellectual Degeneracy.
    - Paranoia.
    - Adolescent Insanity.
    - Periodical Insanity.
    - Hysteria.
    - Epilepsy.
    - Neurotics.
    - Genius.
    - Idiocy.
  - Sensory Degeneracy
    - Deaf Mutism.
    - Congenital Blindness.
  - Nutritive Degeneracy
    - Lymphoid Degeneracy.
    - Tissue Instability.
    - Plural Births.
    - Bleeders.
    - Excessive Fecundity.
    - Gout.
- Spinal
  - Various Congenital and Hereditary Disorders.
- Local Reversional Tendencies.
  - Jaws.
  - Cleft Palate.
  - Teeth.
  - Primitive Uteri, Cloacal Conditions, and Allied Male States.
  - Horse-shoe Kidney, and Allied States.
  - Cyclopian Monstrosities.
  - Ameliac and Polymeliac States, Club Feet, etc.
  - Plural Mammæ.
  - Simian Muscular and Bony States.
  - Liver, and other Organ Reversion.

As a result of defective cerebral and spinal development, we have three great classes of brain degeneracies—ethical, intellectual and sensory—resulting from defective nutritive and local deformities.

Among the local manifestations which seem most apt to appear as stigmata, owing to the great tendency of variation in structure of the body, in evolution, are those in the cranium, nose, face, jaws and teeth. The author does not mean, however, to infer that other parts of the osseous system or organs of the body are not so often affected (indeed, he is of the opinion that they are), but that there is no one organ or part of the body which is so often affected as these. Thus, as we shall see, taking a given disease of the brain, such as paranoia, epilepsy, etc., from seventy to ninety per cent will possess deformities of the cranium, face, jaws and teeth; but it would not be possible in a given disease to find seventy to ninety per cent of primitive uteri, horse-shoe kidneys, or liver reversion. We shall, however, in almost every case, where the jaws are deformed, find some one or more of the conditions of the organs or tissues of the body named under the head of *local reversion*. We shall also be able to find the missing link which seems to unite our every-day patients with those confined in our public and private asylums. In order to accomplish this we have only to study those conditions which come under the head of cerebral reversions, resulting in deformities of the cranium, nose, face, jaws and teeth. We shall, therefore, take up each subject in the order in which they appear in the table, and see what relation they bear to each other and to deformities of the osseous system (the part of the body in which we are most interested). It will be well, however, before doing so, to give the reader an idea of what we expect to find beforehand, so that he will be able to follow each case, and thereby comprehend the results as the brain presides over it. If the brain is deformed we expect to show that one of two conditions must naturally follow—excess or arrest of development—or physiological hypertrophy and atrophy, and not pathological hypertrophy and atrophy, as the terms are usually used. We also expect to find degeneracy of the soft tissues as well.

CHAPTER X.

CRIME.

According to Lombroso, crime, or its equivalent, is found among the lower animals and some few plants as well as in man, but in man it assumes a more serious nature, from the fact that man is able to discriminate between right and wrong. This discrimination, however, is also found among some of the higher animals, but it is of such a modified type that most thinkers are inclined to call it instinct. There are only a few species of what might be called criminal plants, the most common being the fly-trap, found in Southern United States. Should a fly, or other insect, happen to settle upon one of its leaves, it is certain death to the insect, for no sooner than it alights, the leaves close, holding the creature firmly until its small life has ended.

Crime in animals, however, has more of the conditions of man. In the animal, we find conceit, theft, swindling, laziness, and even premeditated crime. The habits of the dog and cat for theft and slyness are common to all; generally, the theft is to appease hunger, and not confined to useless articles so characteristic of the thefts of magpies, crows, rats and monkeys. This latter is allied to the element of kleptomania so common in man.

Animals are conscious of their own deceit, as shown by the fact that they operate secretly and with precautions to avoid discovery. Thus we know that savage animals approach their prey as noiselessly as possible, and if discovered before springing steal away and lie in wait for a better opportunity.

Among some of the African tribes and those people inhabiting the Eastern Archipelago, crime is the rule—in fact, in some parts of Borneo a young man cannot marry unless he has killed at least one man. The ancient Greeks sought to calm the winds by human sacrifices, and mythology tells us that crime was triumphant in heaven. By the laws of the middle ages, theft by a common man was considered much worse than if committed by a chief; but through the increase of invasions and despotism, thefts by chiefs became a greater crime than assassination. The chiefs, however, who were both judges and executive magistrates, sought to maintain laws which would be advantageous to themselves, and it may be that through this selfishness morality penetrated society.

The germs of crime are met with in infancy. It is no uncommon thing for a child to strike at its parents or nurse at the age of one year, and frequently in a fit of anger to snatch at or break small articles near it. This is crime in an embryonic state. Mendacity in children usually arises from the ways in which their parents deceive them to render them quiet.

Cruelty among children is found in all classes and nations, and especially among boys; they take delight in breaking articles, or killing small animals, insects and worms; indeed, there seems to be an element of destructiveness in their nature, which is only overcome by a strict moral training.

McDonald says: "Murder, no less than anger, vengeance and cruelty, is found in children. Caligula, at 13, had a slave cast into an oven for a slight offense. Two children, the one 13, and the other 10 years of age, having a spite against a comrade of 7 years, met him in an out-of-the-way place, threw him into a deep hole, and stoned him to death. A boy in the state of Iowa (11 years of age) went early in the morning into the room where his grandparents were sleeping, and shot them both; seeing his grandfather move, he finished him with an ax. He told the boys afterward: 'I did it all alone.' The occasion of his deed seems to have been a refusal to allow him to do something. Another boy of 13 stabbed his comrade in the heart because he refused to pay a debt he owed him for a game. Such crimes in the case of children, if less cruel than in the case of adults, are so from the lack of force rather than ferocity." This is also nicely illustrated in the familiar circumstance of the epileptic Pomeroy, of Boston, who was in the habit of spending his leisure moments amusing himself by sticking his knife into his playmates, and finally enticed one of his comrades into a belfry and killed him in the same manner.

From a sociological standpoint, war is but universal murder, and in primitive times its terrible character even surpassed the ferocity of wild beasts. In these early times the enemy was mutilated and tortured, but modern war has done away with torture, and at the present time inventive genius is striving its utmost to discover how to kill and disable the enemy at great distances, and in this achievement they have almost, if not quite, succeeded, much to the disgrace of the enlightened nineteenth century. We look upon the cannibal with horror, yet the words of Montaigne come most vividly back to us: "It is more barbarous to kill a live man than to roast and eat a dead one."

A minute and careful analysis has been made of the history of each individual hereafter cited, to show the different crimes under which each person was sentenced, and also to show that no two are exactly alike. It has also been shown that the deformities of the osseous system (excess and arrest of development) are unusually common and differ in each individual. This collection of skulls of criminals and degenerates is certainly the most interesting that can be found in this country, and the author was very fortunate to be able to secure them for the purpose of obtaining these illustrations. It would not be possible to obtain skulls of as many degenerates of any other class, but the author is free to assert that as marked deformities can be found among the other classes of degenerates.*

"Lombroso, Ferri and Manouvrier claim certain peculiarities of development in the criminal jaw. Exaggerated development of the zygomæ and lower jaw is the especial feature commented upon by Lombroso. Ferri has found the greatest diameter of the jaws among homicides and petty criminals; the smallest among professional murderers and pickpockets.

* The following on the subject of Crime, is from a joint paper on "Studies of Criminals," by G. Frank Lydston and the author, taken from the *Alienist and Neurologist*, St. Louis, October, 1881.

The jaws, according to Ferri, are not well developed among the insane, save those who are the subjects of impulsive monomania. This does not agree with Dr. Talbot's observations.

In our studies of criminals we have found that the most marked variations from the average normal type of cranial development occur among the habituals. We have made no attempt to select special cases bearing out this assertion, but have studied each case as it has been taken at random. We append a series of observations upon criminals, selected by a convict orderly from among the habituals and murderers in the Joliet penitentiary. In reply to his inquiry as to what kind of cases we wished to study, we remarked that we wished to see old-timers or habituals. He therefore selected the prisoners according to their criminal, with an entire disregard to their physical status, with the possible exception of several who happened to be on sick call. All complaints of subjective ailments were verified by the resident medical officers.

I present the history and description of several of these, selected from the original paper.

Obs. I.—White, male, American, aged thirty years. Has been committed twice for burglary. Was first committed at the age of twenty-two, since which time has been a confirmed criminal. Hereditary influences as a possible cause of delinquency not probable. Intemperance is admitted, and is claimed to have had much to do with his moral degradation, and as he is markedly neurotic this is highly probable. Syphilis is denied. Never experienced an injury until two years ago, when he received a severe fall, with contusion of of the head. This was followed by epilepsy, severe headaches, insomnia, deafness, defective vision in the right eye and pronounced right hemiplegia. Hearing normal. Mentality impaired. He is thin, anæmic and badly nourished. Was formerly right-handed, but has acquired left-handedness since the accident. The jaws, especially the inferior, are quite asymmetrical and the nose deflected, not from traumatism. Features very asymmetrical. Ears small, protuberant, pointed and asymmetrical, the left being the larger and more prominent. The septum nasi is thickened and greatly deflected. Cranium of medium development, of sub-brachycephalic type and rafter shaped calvarium. Jaw, orthognathous. Occipital region very prominent and asymmetrical, the protuberance being markedly deviated to the left of the median line. Pronounced asymmetry of parietal development, the left eminence being very prominent and the right perceptibly flattened. Palate imperfectly developed with a V-shaped arch.

Obs. II.—White, male, Irish, aged twenty-seven years. Sentenced for arson. Committed for the second time, the first offense being robbery. Has led a criminal life since childhood, being addicted to petty and minor delinquencies for which he escaped punishment. Knows nothing of his parentage or family. Has never been addicted to drink. Admits syphilis. Is thin, anæmic and poorly nourished; says that he was never very strong. Right-handed. No lameness or deformity. Slightly deaf. Vision normal. Perceptive faculties somewhat blunted and mental processes sluggish. Is a melancholiac, and suffers from severe headaches. Features noticeably asymmetrical. Nose perceptibly deflected and flattened, not traumatically. Septum thick, crumpled and on the right side enchondromatous, the right nostril being occluded. The ears are peculiarly deformed, the right being small, thick and crumpled, the left of medium size and very protuberant, handle-shaped. Cranium large, ultra-brachycephalic, with platycephalic vertical index, and resembling in its general outline the skull shown in Fig. 33. To the left of the vertex the calvarium is flattened, but the left parietal protuberance is very prominent, the entire left side bulging in outline. The right side is flattened and the parietal prominence slightly marked. The body of the occipital bone is very straight and flat, but the protuberance is disproportionately prominent. The facial outline is orthognathous, the jaw being of a pronounced retreating type and very asymmetrical. Palatal arch V-shaped.

Obs. III.—White, male, American, aged forty years. Serving second sentence for burglary. Prior to first commitment had been sentenced for numerous petty delinquencies, and had been tried on charges of burglary and acquitted on several occasions. History shows a bad heredity. Mother healthy, but father died of consumption, and a sister is subject to fits. Has been addicted to liquor. Says that liquor is responsible for his life of criminality (?). Contracted syphilis eighteen years ago, which has troubled him off and on ever since. General appearance very fair, is well nourished and of good color. Right-handed. No lameness or deformity, but plentifully supplied with syphilitic scars. Is quite deaf, and vision is so defective that he reads with difficulty. Suffers from tinnitus aurium. The facial contour of this man is very striking. There is such a marked disparity and asymmetry of the two sides of the face that it has the appearance of two halves of faces of different sizes joined together and by a bad artisan. Nose deflected markedly and septum twisted and malformed so that the left nostril is completely blocked. The ears are very asymmetrical and situated on different planes, the right ear being much the smaller and situated several lines higher than the left. Cranium sub-microcephalic and very asymmetrical. The right side of the cranium is very perceptibly flattened and the parietal prominence feebly marked. The left prominence is very marked. The forehead is low and retreating. The narrow and contracted skull in this case is directly noticeable, but the index is sub-brachycephalic on account of the markedly sloping frontal region, which compensates in a measure for the narrow transverse diameter. The facial type is orthognathous. On examining the mouth, a high palatal vault of partial V-shape, with pronounced saddle contour on the right and full curve on the left, are noted. There is marked faucial and pharyngeal asymmetry. There is a lateral curvature, which accounts, in a measure, for the pharyngeal and faucial deformity. An interesting feature of this case is that the subject suffered from constant and severe headaches until fifteen years of age. They then stopped, but were developed later in life by liquor. Has had them steadily for the last fifteen months, and is suffering from insomnia—possible pachymeningitis syphilitica or alcoholica suggests itself in this connection.

OBS. IV.—White, male, German extraction, age forty-one years. Serving time for murder. This case is most interesting as an example of illogical dispensation of law and of the physical basis of crime. The subject is typically neurotic; heredity bad, mother having died of cancer and her branch of the family being subject to various forms of nervous disease. Cause of father's death unknown, but he was known to have been a dissolute character. The subject under consideration was struck in the head with a hatchet when a child. Since the age of eight he has had epilepsy, the fits occurring sometimes every three or four days and at others at very long intervals. Has at times escaped them almost entirely for a year or two, and has then brought them on by indulgence in liquor, to which he was addicted; subject to violent paroxysms of fury at all times under slight provocation; has been committed to the asylum several times; history would seem to point to the furor epilepticus as a cause for the murder which this man committed. The noteworthy fact is that this man is very artistic and spends much of his time in making artificial flowers. Syphilis is denied, and no evidences of the disease are perceptible; subject is pale and anæmic; is right-handed; vision normal, but is quite deaf in left ear; no deformity or lameness. Features very asymmetrical, the right side of the face being much larger than the left. The nose is markedly deflected to the left, the septum being thickened, crumpled and deviated in the same direction. Ears very asymmetrical, the left being the larger, higher situated and badly formed. The right ear is very protuberant, imperfectly developed and crumpled. Cranium of medium size, quite round and dome-shaped. Vertical index oxycephalic. Index markedly brachycephalic. The skull shows the same asymmetry as the face, the right side being disproportionally developed and the right parietal eminence very large. The left side is flattened and the parietal prominence barely distinguishable. The arch of the jaw in this case is normal, but the development of the palate is defective and the rami defective in development.

Obs. V.—White, male, American, aged thirty-seven years. Committed for the third time for burglary. Family history unknown save as regards mother, who died of cancer. Has had syphilis, and has been intemperate since youth. Was hurt in a railroad accident in 1881. Prior to this time he had worked tolerably steadily, but since the accident he had drank harder than ever and had developed an uneasy, restless disposition, which made honest labor irksome and criminality attractive. General appearance fair, is well nourished. Right-handed and has no lameness or deformity. Complains of tinnitus in the right ear, referable he thinks to the railroad accident. Vision and hearing normal. Face very asymmetrical, the right side being much the larger. Right malar prominence exceptionally marked. Left eye so disproportionally small as to attract the attention of the casual observer. Nose deformed and septum deviated to the left, but as the organ has been broken this point is not of great importance. Ears very small, crumpled and closely set, the left being much the larger and lower. The skull is submicrocephalic in capacity, oxycephalic in its vertical and brachycephalic in its cranial index. The right half of the cranium is the smaller, with the exception of right occipital and mastoid regions, which are excessively developed. The left parietal eminence is very prominent. None of the aberrations noted were referable to the injury, except possibly the nasal deformity. The superior maxilla is V-shaped.

Obs. VI.—White, male, Irish, aged fifty years. Serving a five-year sentence for horse stealing. Served a six-year sentence twenty years ago for the same offense. Acknowledges repeated offenses for which he has never been punished. Family history not clear, but says that father died of old age and mother of "fever sore" on her leg; has been intemperate since youth, and has had severe syphilis; has had severe small-pox, with resulting great disfigurement, not shown in cut; general appearance fairly healthy; is very awkwardly built, "slab-sided" as the orderly expressed it; his gait is of the shuffling or shambling variety; is right-handed; is lame as a consequence of syphilis; hearing normal; vision has been impaired for many years; features very asymmetrical; the face is long and narrow and the chin pointed, but not prognathous; the left eye much smaller than the right, not properly shown in cut, and the entire left side of the face imperfectly developed; the nose is slightly flattened and the septum deviated to the left, the nostril being nearly occluded; the ears are asymmetrically developed, the left being the larger, most thickened, irregular and deformed; cranial index brachycephalic; vertical index platycephalic; the large size and disproportionate

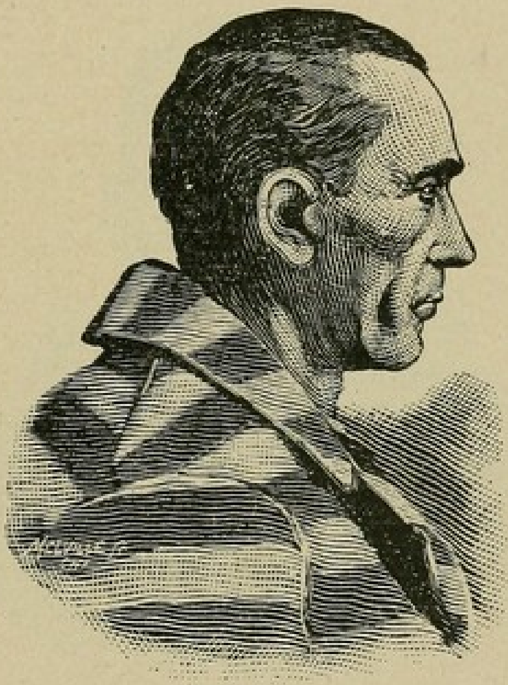


Fig. 28.

breadth of the cranium are very noticeable. The cranium is asymmetrically developed. The right frontal eminence is very prominent. The left parietal prominence is very large. The calvarium is depressed at the right of the vertex. There is also a well-defined depression at the bregma. The right occipito-mastoid region is excessively developed (Fig. 28). The generally twisted appearance of cranium already alluded to is well shown in this subject. The jaws are saddle-shaped, and the palate irregular and unevenly developed. The actions and garrulous conversation of this subject showed him to be a paranoiac of a pronounced type. A glance at the physiognomy of this man, as shown in Fig. 29, is suggestive to the neurologist in this connection. A marked sunken condition is noticed under the eyes, extending down to the lower jaw, showing arrest of development of the bones of the face.

OBS. VII.—White, male, American, aged fifty-three years. Sentenced for horse stealing. Had several sentences elsewhere, and is serving a second term in Joliet. Family history not obtainable; had been occupied in farming and horse dealing, alternating with horse stealing most of his life; no history of syphilis or alcoholism; general appearance bad, pallor and

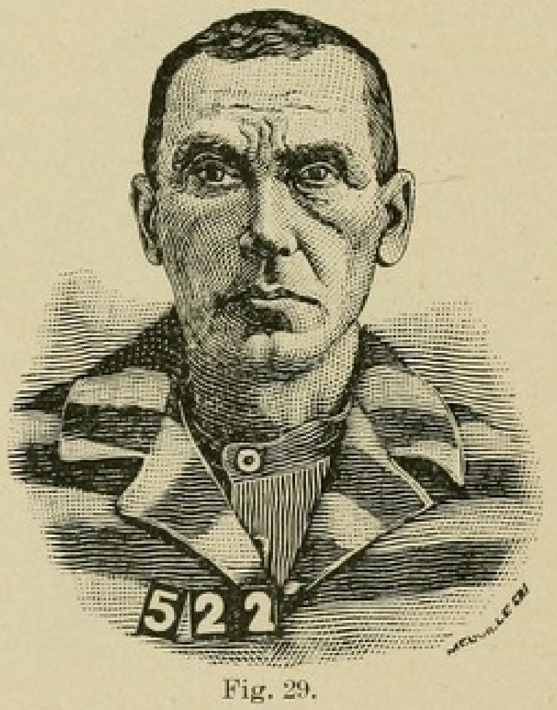


Fig. 29.

cachexia being pronounced; is right-handed; presents no lameness or deformity; vision and hearing normal; the features are very asymmetrical; the nose is quite straight, but the septum is deviated to the left, producing partial occlusion; the eyes are small, deep-set and somewhat of the slanting type peculiar to the Mongolian. This peculiar slant is most evident upon the right side; the right eye is also smaller and on a higher plane than the left. The difference in development of the two sides of the face is very marked, the right being the smaller. The left half of the inferior maxilla is much longer and straighter than the right. Hair has been very gray since quite a young man. The right ear is of moderate size, of fair form and very closely set; the left is flattened, flabby and protuberant, "handle-shaped" and lower than the right. Cranial capacity is mesocephalic and cranial index sub-brachycephalic. The vertex is pointed, oxycephalic, with marked depression upon each side of the median line. The left occipito-mastoid region is exceedingly prominent, the right being deficiently developed. The left parietal eminence is very prominent and the right poorly marked. Semi-V-shaped superior maxilla; lower maxilla well developed. This subject is an apt illustration of the irony of

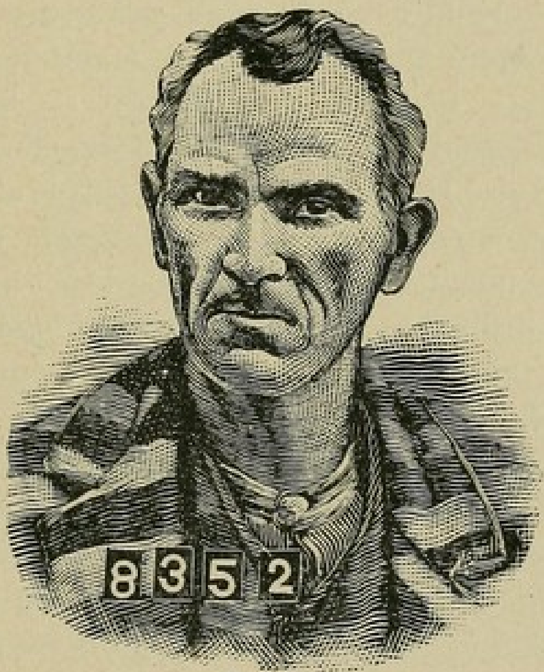


Fig. 30.

fate and the unintelligent administration of law. He is a paranoiac and affected with monomania of the religious delusional type. At times imagines himself Jesus Christ. He preaches in his cell to imaginary spirits, over which he imagines that he has control, and regales his fellow-convicts with an occasional sermon on their wicked ways. His conversation is characterized by egotistical garrulity; is particularly desirous of impressing us with the idea that his magnificent head was designed for some great purpose which "died a-bornin'." Like the preceding case, the physiognomy of this subject (Fig. 30) is to the alienist confirmatory of the foregoing remarks. Here is also noticed arrest of development of the face at the alae of the nose—showing the prominent cheek bone and lower jaw of Lombroso. Right eye much higher than left.

Obs. VIII.—White, male, Swede, aged thirty years. Up for larceny, second conviction, and acknowledges offenses for which he was never punished; has worked at different trades and occupations, but labored steadily until he received the injury herewith described. Family history obscure; mother had some skin disease of a severe type; has been a moderate drinker; syphilis is denied; general condition fair; is somewhat anæmic; is right-handed; some years ago was caught in a railroad smash-up and sustained a fracture of the skull; several years ago had his arm caught in machinery and received a compound fracture of the forearm; was in hospital seven months. Hearing greatly impaired; vision normal. The face is very asymmetrical, the right side being the better developed, and the right half of the jaw especially prominent; nose of normal type; no deflection of septum; ears very asymmetrical, the left being the larger and more closely set and decidedly pointed; the right is of medium size and normal outline, but situated lower than the left; jaws square and well formed, but the hard palate is very asymmetrical; left palatal process much broader than the right. The cranium is large, horizontal index brachycephalic; vertical index platycephalic; the frontal region is asymmetrical, the right prominence bulging decidedly; the parietal prominences are exceptionally well marked, the left being much the larger; the entire right half of the cranium is disproportionately well developed, with the exception of the parietal eminence; depression at site of old injury in parietal region. This subject, like the foregoing, should not be in prison. He is a paranoiac—has delusions of persecution, quarrels with imaginary enemies in his cell, and has on one occasion attempted suicide by cutting his throat.

Obs. IX.—White, male, American, aged fifty-nine years. Fourth commitment; offense, horse stealing; committed three times before on "general principles;" does not deny that said commitments were for the public good; heredity bad; father died of cancer of the stomach, mother was insane and died of comsumption; says he does not give a "fake" history for the purpose of exciting sympathy—says his motto is: "Sympathy be d—d!" He has never been intemperate; says that he feared to drink on account of the insanity in his blood; syphilis is denied; had his head cut by a rock in Chester penitentiary years ago. General appearance quite bad; is anæmic and poorly nourished; was originally right-handed, but on account of lameness in joints of right hand has acquired the use of left; left arm is also lame from injury; joints are generally crippled by arthritis deformans; vision presbyopic; hearing normal. The face is very asymmetrical, the right side being the larger; nose malformed and deflected to the right; septum deflected and presents a large perforation; ears of average development and symmetry; right ear a little lower than left; dental arches normal but inferior maxilla greatly flattened at angles and quite asymmetrical; cranium of average development; sub-brachycephalic index. Since the injury to his head this man states that he has "wild spells" when his mind is aberrated. These "spells" follow severe headaches. This man, although uneducated, is quite talented, very bright and logically argumentative. His moral obliquity is evidently due to a bad heredity and lack of mental discipline. Under more favorable auspices he would have made a valuable member of society. Arrest of bones of the face.

Obs. X.—White, male, German, age thirty-one years. Serving sentence for grand larceny. Has been in prison five times, this being his third term in Joliet. Heredity bad; father healthy but intemperate, quarrelsome and subject to violent fits of passion, which made him a "dangerous customer" at times; an only brother, though honest, is intemperate and a ne'er-do-well; paternal grandfather said to have been a martyr to scrofula. Has not been intemperate; syphilis denied, but states that he was very scrofulous as a child; extensive scrofulitic scars visible on neck and face; is still quite sickly, looks cachectic and badly nourished; is right-handed; no lameness or deformity; vision and hearing normal; facial asymmetry quite marked, the right side being much the larger. The nose is markedly deviated to the left and the septum much deformed and deviated to the right, producing almost complete occlusion. The left palpebral fissure much smaller than right; left eye perceptibly smaller than right; ears fairly symmetrical and well formed; cranium very large, index ultra-brachycephalic, vertical index platycephalic; fair degree of symmetry; left parietal eminence very prominent. This subject has been affected with severe stammering since childhood; is frequently under treatment for severe cephalalgia, and has had since childhood what he terms "dumb spells," which we interpret as mental depression, probably associated with disturbed circulation. The inferior maxilla in this case was poorly developed, orthognathous and very pointed; upper jaw presents a marked saddle-shaped arch. Arrest of bones of the face.

Obs. XI.—White, male, Swede, aged twenty-seven years. Acknowledges habitual criminality, though serving first sentence; is in for highway robbery; heredity not shown; mother died of dropsy and father of pneumonia; intemperance and syphilis both admitted; no history of injury; general appearance fair; right-handed; somewhat lame in left leg (thinks that he always was weak in this limb); vision and hearing normal; face asymmetrical, left side much the larger—left side of the lower jaw being extraordinarily prominent; left palpebral fissure and eyeball much smaller than the right; nose deflected to the right, with marked corresponding deviation of septum; ears very large, long, pointed and closely set; cranium sub-microcephalic, with sub-brachycephalic index; oxycephalic vertical index. Development of average symmetry. In his general characteristics this subject is a weakling, and the crime for which he is doing time is inconsistent with his physique. The jaws in this case are markedly deformed, the upper presenting a semi-V and the lower a marked saddle, with arrest of bones of the face.

Obs. XII.—White, male, half-breed Egyptian, age thirty-five years. Serving sentence for horse stealing. Says that it is his first commitment, but his statements are contradictory, and he has either been committed before or has led a criminal life without punishment; the family history is imperfect, as he was born in Egypt of a native mother and an American father. One brother is known to be insane but not criminal; has drank periodically after he has had one of the "fits," to be described; syphilis denied; when quite a young man he enlisted in the American navy and served for some years; was finally discharged for disability, having been sunstruck while in the foretop, falling to the deck and sustaining severe head injuries, the scars of which still remain. After his discharge he suffered from epileptic fits at intervals of from a few days to a few weeks; is still suffering from these attacks and from severe headaches; criminal career began since injury (?). General appearance excellent; right-handed; no lameness or deformity; head badly scarred from old wounds; vision and hearing normal; face fairly symmetrical; eyes equally developed; right side of face slightly the larger; nose not deformed, but septum deviated to the right, with partial occlusion of nostril; ears very small, closely set and crumpled. Cranium large and index sub-brachycephalic; development asymmetrical; right side much the larger; occiput unequally developed, right half being very prominent; left parietal eminence very large as compared with the right; jaws normal. Degeneracy of physical type is not very pronounced in this subject. We consider the history of injury a very important point.

Obs. XIII.— White, male, American, aged twenty-six years. Committed for the first time for forgery; acknowledges petty delinquencies before sentence for forgery; family history bad; father delicate, scrofulous and affected all his life with sore eyes; mother died of consumption; has been a steady but moderate drinker; syphilis denied; general appearance good; right-handed; vision and hearing normal; face quite asymmetrical, left half much the larger; left eye much smaller than right; nose straight and symmetrical, but septum markedly deformed; ears symmetrical, but very small and closely set; cranium of medium size and asymmetrical; index mesoçephalic; left occipito-parietal region disproportionately developed; right half of occiput flattened; protuberance situated seven mm. to the left of the median line; left parietal eminence very prominent; facial development marked; pronounced prognathism of inferior maxilla.

Obs. XIV.—White, male, Irish (typical imported criminal), aged fifty-four years. In for bank robbery on long sentence. This is one of the toughest specimens that ever broke into jail; he has done time in a number of prisons in America, and served several sentences in England before being exported to this country by the generous British authorities; family history bad; father intemperate; both parents died of consumption while subject was very young; one brother died of consumption; has always been a hard drinker; has had syphilis; general appearance very bad; is thin, sallow and badly nourished; has a chronic cough; is somewhat crippled by rheumatism, otherwise no lameness or deformity; hearing normal; vision impaired by age; face very asymmetrical, left side being disproportionately developed; left eye perceptibly the larger; right frontal prominence, however, is bulging and prominent; nose badly deformed; septum enchondromatous and deflected, and so badly deformed that it is visible externally; ears very prominent and pointed; the left is badly crumpled; cranium sub-microcephalic; index subdolichocephalic; fairly uniform development on each side, but right side much the larger; lower jaw small, prognathous and left half much the larger; upper jaw large, with low arch.

Obs. XV.—White, male, Dane, aged forty-two years. Serving life sentence for murder; family history good; has never been intemperate, and, until the commission of the crime for which he is under sentence, he was an honest, hardworking farmer, distinguished only by a violent temper; the murder for which he is doing time was the result of a quarrel; has never had syphilis; general appearance excellent; right-handed; vision and hearing normal; no lameness or deformity, features asymmetrical, the preponderance of development being on the left side; nose deformed and deflected to the right; septum shows a corresponding deflection; ears asymmetrical, the right being pointed, closely set and of medium size, the left large, protuberant and lower set than the right; cranial capacity mesocephalic; index sub-brachycephalic; pronounced asymmetry, the left side being the larger, the development of the left occipito-parietal region being especially disproportionate; the right parietal eminence is much larger than the left; the forehead is low and retreating; frontal prominence slightly marked on left side, and absent on right; upper jaw excessively developed and prominent; arch semi-V-shaped; lower jaw prognathous and heavy, and disproportionately developed on the left side.

Obs. XVI.—White, male, American, aged forty-two years. Serving a life sentence for a murder which had been committed in a quarrel. Prior to this crime had been an industrious farmer. Family history unknown; alcoholism and syphilis denied; general appearance fair; right-handed; no lameness or deformity; is lame at times from rheumatism; vision impaired; hearing normal; nose well shaped; no deflection of septum; ears small, thin and closely set; cranium above the average capacity and fairly symmetrical; index brachycephalic; some flattening at the bregma and in the occipital region; upper jaw excessively developed and partial V-shape; lower jaw massive and prognathous.

Obs. XVII.—White, male, aged seventeen years. This is one of the most melancholy cases which have come under our observation—the prisoner, a bright, handsome boy, having been sentenced for life for a murder committed while under the influence of liquor. The lad was raised on a farm and his family history is unexceptionable. Habitual intemperance denied; no history of syphilis; general appearance excellent, but subject is plainly neurotic; is right-handed; no lameness or deformity; vision and hearing normal; facial development quite symmetrical, save a little excess of development of the right half of the inferior maxilla; nose slightly deviated, with some deflection of septum; ears large and protuberant (*oreilles a anse*); capacity of cranium mesocephalic. Practically no asymmetry, the form of the cranium being better than the average normal type. The lower jaw is asymmetrical, as above noted, and the upper jaw presents a partial V, with arrest of the facial bones.

Obs. XVIII. White, male, American, aged sixty-one years. Doing time on fourth commitment. Last offense burglary and arson. Family history unknown. Was evidently a vagabond in early life, but was never convicted of crime, and he states was never delinquent until 1871, since which time he has been in jail off and on—in fact, for the greater part of the time. Intemperance and syphilis is denied. Drifted into the army in his early manhood and was several times wounded. Is lame from a saber cut in the left leg, and head shows a large scar from a saber cut received in '63. General appearance excellent; vision and hearing normal; right-handed; has been gray for many years; face fairly symmetrical; nose slightly deflected, but septum well formed; ears well formed; cranial capacity mesocephalic; index brachycephalic; asymmetry not very pronounced; left parietal eminence disproportionately prominent; occipital region exceptionally flat; mastoid prominences excessively developed; normal arch in upper jaw; lower jaw very prominent, heavy and prognathous.

The foregoing cases might be multiplied from the material at our command, but they are amply sufficient as indicative of what may be found among the degenerate classes met with in our American prisons. A glance at these cases plainly shows the physical degeneracy and often the bad heredity of the subjects. A noteworthy fact is that the cases which most nearly approximated the normal type of development were in sporadic criminals, of which the young lad (Obs. XVII.) is an example. It will be noted that a number of the series were of foreign birth. As before remarked, it will be found that the most markedly aberrant types are seen in the imported criminal. This is instructive as explanatory of some of the apparently dogmatic claims of European criminal anthropologists. We have found that left-handedness is not so common among American and foreign-American criminals as has been claimed by these authorities. Among 400 criminals in the Joliet penitentiary but one per cent were found to be left-handed. Dr. Lydston found but about two per cent among the criminals in the New York City prison. Obviously a much larger number of observations would be necessary to determine this point.

It is our fortune to be able to present in this work a series of illustrations of specimens showing the aberrant types and asymmetry found in degenerate skulls, and especially those of criminals. These specimens are exceptionally interesting from the fact that they have not been selected from among a large number, but have been picked up here and there by non-scientists solely for their morbid and

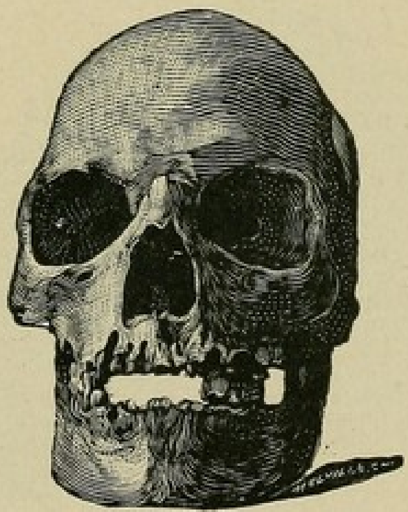


Fig. 31.

historic interest, having subsequently fallen into Dr. Lydston's hands quite by accident. It is worthy of comment that even the remarkable series depicted in Lombroso's "Atlas" does not present such markedly aberrant types as this comparatively small series of studies; indeed, a search among several thousand skulls would not be apt to bring to light such peculiar types of conformation as the crania which we present. The illustrations are from photographs, and are exceptionally accurate.

The specimen first to be described (Fig. 31) is one of the most interesting crania which we have had the privilege of studying. The subject was a negro criminal of the petty class, who spent most of his time in correctionary institutions. As might be inferred from the extremely degenerate type of cranial development, which is here exhibited, he was of a very low grade of intelligence. After a very precarious existence this negro committed suicide.

In viewing this skull from the front, one is at once struck by the immensely powerful maxillary and malar development as contrasted with the remainder of the cranium. The orbits are relatively very capacious. The superior maxilla is relatively poorly developed, at least as compared with the lower jaw. Rarely, indeed, is such an inferior frontal devel-

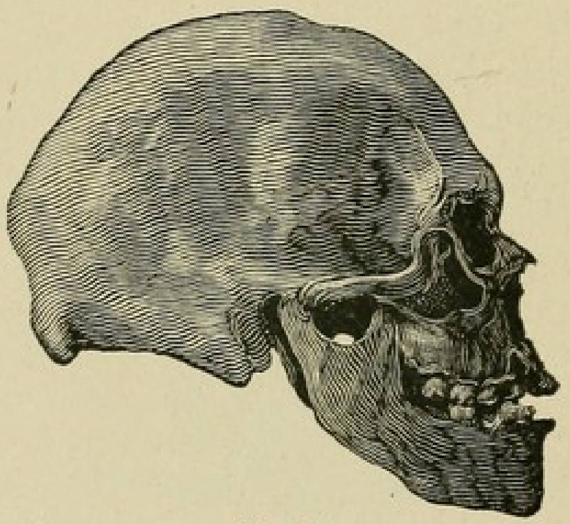


Fig. 32.

opment found associated with such a pronounced facial development.

As will be seen in connection with the specimen of brachycephalic degeneracy, shown in Figs. 48 and 49, the frontal development in this narrow type of skull may be vastly better than some specimens with a decided tendency to the brachycephalic type. The skull at present under consideration is the most marked specimen of the dolichocephalic cranium which we have seen. As the horizontal index in this case is 59.9, the extreme variation, according to Isaac Taylor, and others, being from 58 to 98, the extreme type of this skull is at once obvious.

On viewing this skull laterally (Fig. 32), its strong similarity to the anthropoids is very striking. This is especially marked with respect to the development of the mastoids and the occipital protuberance; the position of the latter is quite an anomalous one, and the occipital bone is almost horizontal. Despite its extraordinary development, the occipital is relatively small, both transversely and in its vertical measurement. The distance from the posterior border of the foramen magnum to the superior occipital angle is only 103 mm.

On contrasting with any of the other crania of the series, the relative shortness of the occiput is very noticeable. For example, Fig. 39, which is a rather small specimen, distinguished rather by the symmetry than the extent of its devel-

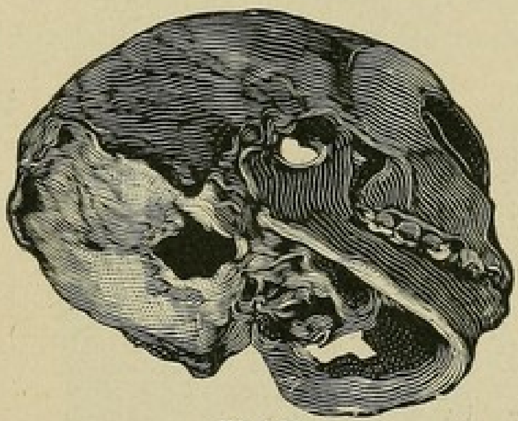


Fig. 33.

opment, shows an occiput measuring 130 mm. from the foramen magnum to the superior angle of the occipital bone.

Fig. 33 shows the inferior surface of this dolichocephalic specimen and brings out the massive development of the processes and muscular attachments at the base of the skull. It is evident that the muscles of the neck in this case were immensely powerful, a *sine qua non* where the leverage for muscular action is so short as in this particular occiput. The facial type in this specimen is markedly prognathous as regards both upper and lower jaws.

The *tout ensemble* in this case is strongly suggestive of a reversion to the anthropoid type, which is often the distinguishing characteristic of the degenerate Ethiopian type, criminal or otherwise.* The following are the measurements of this exceedingly interesting cranium:

Horizontal index,	59.9
Circumference,	48.4 c.
Anterior demi-circumference,	21.3 c.
Posterior demi-circumference,	26.9 c.
Bi-zygomatic diam.,	13.3 c.
Longitudinal diam.,	196.5 mm.
Transverse diam.,	122 mm.
Vertical diam. (vertex to foramen magnum),	132 mm.
Occipito-mental diam.,	241.5 mm.
Bi-frontal diam.,	95 mm.
Bi-mastoid diam.,	114 mm.
Over vertex, from ear to ear,	317 mm.
Ant. bord. foramen mag. to sup. occipital angle,	103 mm.

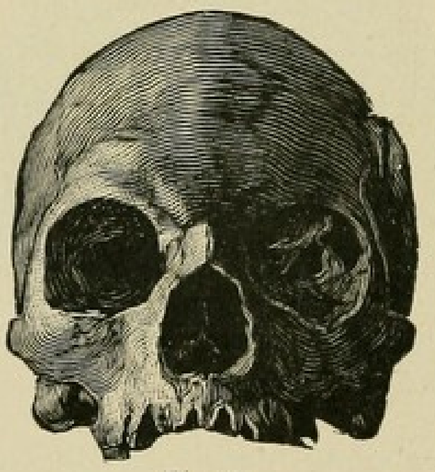


Fig. 34.

The excessive development of the jaws and alveolar processes in this specimen are such as are generally observed in the negro races, in whom the jaws are usually well developed and rarely deformed. The only noticeable feature of this particular specimen is a high palatal vault.

* Dr. Lydston has found in comparative studies of crania that the plane of the occipital bone is of some importance as bearing upon differentiation. In the anthropoids the relative shortness and horizontal direction of the occipital bone is very striking—especially is this true of the basilar process. In the degenerate types of human crania, or, at least, in the atavistic types, there seems to be a direct relation between the length and angle of the basilar process and intelligence. Dr. Clevenger called attention to the angle of the medulla as bearing upon intelligence, years ago, but Dr. Lydston's observations, although confirmatory of those of Clevenger, were made independently, as he had not had access to the work of the latter.

The next specimen (Fig. 34) presents some extraordinary features. It is the skull of a celebrated negro panel-worker, confidence-operator and desperado, who, at the time of his death, was the consort of a notorious courtesan who flourished in Chicago some years ago.

This individual, after some years' dalliance with the law without especial harm to himself, was finally knifed in a brawl. A front view of the cranium shows the ordinary and characteristic negro facial type, with the exception, perhaps, that the bones are exceptionally massive and well developed. A marked difference is noticed in the orbits. The right is

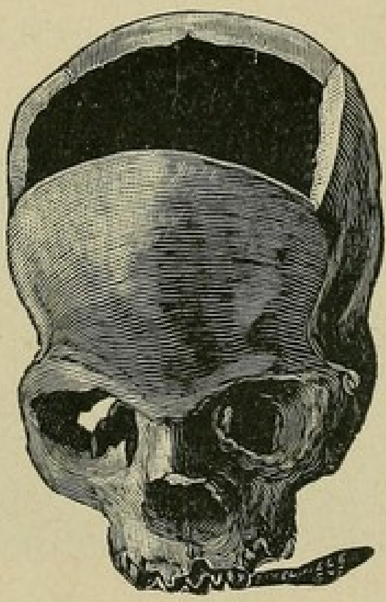


Fig. 35.

nearly round, while the left is quite deformed at its outer lower corner. Unfortunately the inferior maxilla is absent, a fact which we greatly deplore, as the general cranial development suggests to us the probability that the missing part presented some very interesting features for consideration. A lateral view of this cranium shows the ordinary dolichocephalic negro type. The cranial index is low, being 72.1. A comparison with Fig. 31, however, shows the extreme degeneracy of type in the latter to great advantage.

A view of this skull (Fig. 35), after a section of the calvarium has been removed, shows its most interesting features. Skulls of such extreme thickness, even among negroes, are rarely met with. The consistency of the bone in this cranium is very dense and hard, and traditionally this negro, while alive, was noted for his butting propensities. Violent contact with such a skull would be apt to damage the fist of a Sullivan. Indeed, it is said that this fellow rather enjoyed the impact of a policeman's club.

We will state at this point that we are of the opinion that the massiveness of bony development in this case is not due to disease. The general character of the overgrowth, and the consistency of the bone, would seem to support this view. Syphilis may produce thickening of the cranial bones, as some of Virchow's specimens show, but syphilitic bone does not present the characters and uniformity present in this case.

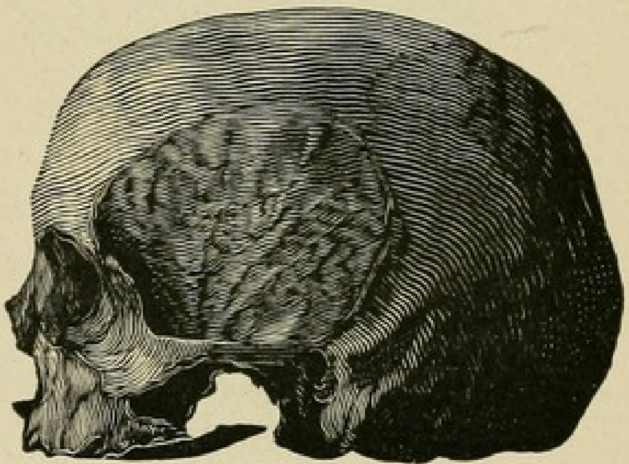


Fig. 36.

At the densest part of the calvarium this specimen measured 13 mm. in thickness, its average thickness being 11 mm. A comparison with Fig. 38 readily shows how phenomenal the osseous development in this case is. The cranial measurements are:

Horizontal index, - - - -	71.1	
Circumference, - - - - - -	47.8	c.
Anterior demi-circumference, - -	25.4	c.
Posterior demi-circumference, - - -	22.4	c.
Longitudinal diam., - - - -	181.5	mm.
Transverse diam., - - - -	131	mm.
Vertical diam. (vertex to foramen magnum),	128	mm.
Bi-frontal diam., - - - -	95	mm.

Bi-mastoid diam., - - - -	113	mm.
Bi-zygomatic diam., - - - -	126	mm.
Anterior border of foramen magnum to sup. occipital angle, - - -	117	mm.

The upper jaw and alveolar process in this skull is well developed, the only peculiarity being a low palatal vault.

Figs. 36 and 37 show the skull of a once notorious member of the Chicago *demi-monde.* She was a very tall woman of mixed Indian and white blood. The cephalic index shows (what might be inferred from the appearance of the cuts) a decidedly dolichocephalic type, and a peculiar outline. This specimen is the most symmetrically developed of the series, with the exception of the Sioux squaw next to be described,

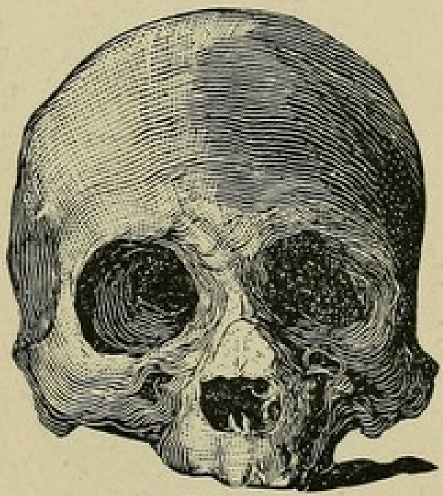


Fig. 37.

and whether coincidental or not, the fact remains that this subject presented a higher type of intellectuality while living than any of the other subjects embraced in this essay. The skull is, nevertheless, of a degenerate type, as shown by its extreme tenuity and its markedly dolichocephalic index. The occipital portion, however, is excessively developed.

Fig. 38 shows the extreme thinness of the calvarium, which was at the point of section only 3 mm. in thickness. A striking feature of this skull is its freedom from prominences, its surface being uniformly smooth and rounded. In this respect the specimen differs greatly from another cranium of a prostitute in the same series which we have examined, but of which, unfortunately, we have no illustrations. In this case there was an excessive development of the occipital bone, the enlargement being symmetrical and most marked upon the left of the median line. The right parietal eminence was excessively and disproportionately developed. The cranial index was markedly dolichocephalic.

The principal measurements of the skull at present under consideration are:

Horizontal index, - - - - -	67.09
Circumference, - - - -	51.2 c.
Anterior demi-circumference, - - -	22.9 c.
Posterior demi-circumference, - -	27.3 c.
Longitudinal diam., - - - -	190 mm.

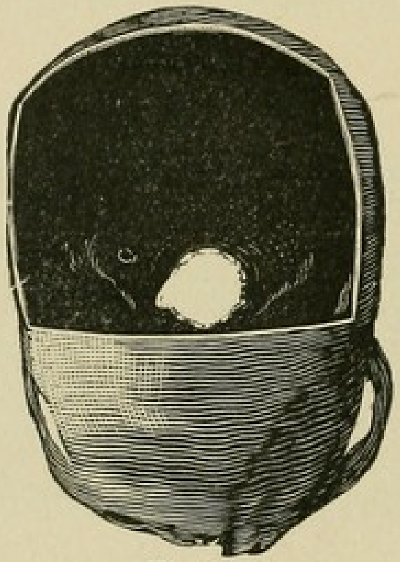


Fig. 38.

Transverse diam., - - - -	130.5 mm.
Vertical diam., - - - - -	128 mm.
Bi-frontal diam., - - - -	88.5 mm.
Bi-mastoid diam., - - - - -	71 mm.
Bi-zygomatic diam., - - - -	130 mm.
Anterior border foramen magnum to ant. sup. occipital angle, - - - -	116 mm.

The jaw in the case is poorly developed, but fairly well formed. In regard to the extreme tenuity of the skull, we do not believe that it is the result of pathological change. The general lightness of the bones, and the symmetry of the skull, are not consistent with the existence of such bone changes as might produce absorption and thinning. The markedly dolichocephalic type of this skull is interesting in view of the strain of Indian blood in the subject. As has already been observed, the degenerate type in dolichocephalic crania is in the direction of a still lower index, and in this instance the admixture of Indian blood evidently determined the degenerative type. This observation would appear to be contradicted by the case outlined in Figs. 31, 32 and 33. In this case, however, there was an admixture of negro and Mexican blood, with a resultant degeneracy of form in general as well as in the cephalic index. This case, in fact, partakes in some respects of the character of a teratological rather than

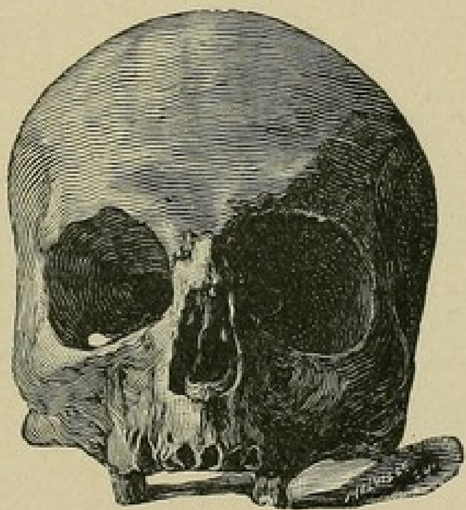


Fig. 39.

an atavistic type, *per se*—at least as far as the facial development is concerned.

A comparison of the prostitute's skull with the female Indian type next presented shows a marked difference in the cranial index, the disparity being 7.07. Even the negro in Fig. 34 is less dolichocephalic than this specimen. The next specimen, the cranium of a full-blood squaw of the Uncpapa Sioux, who was the wife of one of the leading malcontents in the recent Indian outbreak, and consequently of the better type of Indian development.

This specimen (Fig. 39) is exceptionally symmetrical and moderately dolichocephalic. Aside from the purposes of contrast, there is little of interest to be said of it in connection with the present series. The subject was as intelligent as the better class of her people average, and there is nothing to be said regarding her from the moral standpoint. Indeed, as the saying goes, the shoe might be on the other foot, as the Indian estimate of the Caucasian grave-robber is not a high one, as evidenced by his treatment of the desecrator of the Indian burial places when the latter happens to be caught. However, as our connection with the aforesaid desecration is very remote, we trust that our red brother will extend his forgiveness.

Fig. 40 shows the same skull in lateral view. Its symmetrical outline is quite evident. The measurements are as follows:

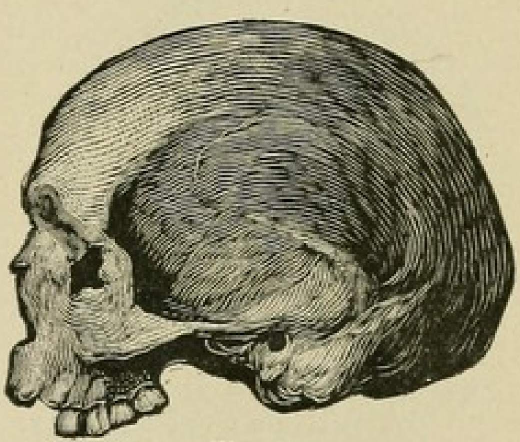


Fig. 40.

Horizontal index,	74.16
Circumferential,	51.2 c.
Anterior demi-circumference,	26.6 c.
Posterior demi-circumference,	23.8 c.
Longitudinal diam.,	161 mm.
Transverse diam.,	152 mm.
Vertical diam.,	140 mm.
Over vertex from ear to ear,	318 mm.
Occipital protub. to root of nose,	293 mm.
Bi-mastoid diam.,	121.5 mm.
Bi-frontal diam.,	96 mm.
Anterior border foramen magnum to superior occipital angle,	130 mm.

The superior maxilla presents arrested development, as well as the bones of the face. The vault is of medium height, and the alveolar processes well developed. It will be found that in the Indian, as in all primitive races, a well-formed palate and regular teeth are the rule. It would be interesting, at some future time, to study the effects of civilization of the Indian in this regard.

The next cranium (Fig. 41) which we will describe is the most remarkable of the series, and in many respects presents phenomenal characters.

The subject was a half-breed Mexican and negro, who had left Mexico, his native country, for the good of his com-

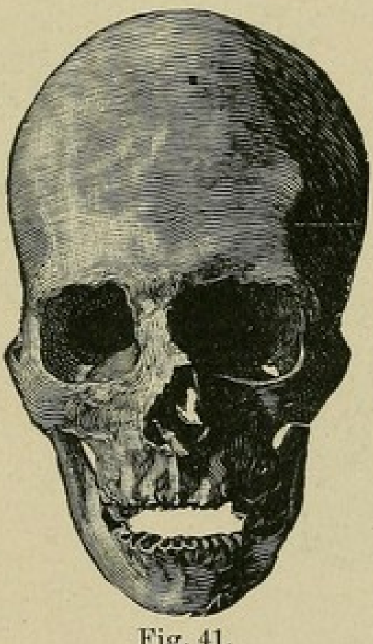


Fig. 41.

patriots. While he had never distinguished himself by any startling act of criminality, and had managed to keep himself out of the clutches of the law, he was identified with the petty criminal class which forms a prominent portion of all social systems, and with which Mexico is especially infested. He finally died in a public hospital, as a result of some acute disease, with cerebral complications. The general physique of this man was very fair, although he presented a generally overgrown and loose-jointed appearance. When alive he was a very peculiar looking specimen indeed, the dome-shaped appearance of his cranium being exaggerated by a luxuriant crop of kinky wool, several inches in length, that stood straight out from his head. From a mental standpoint he was up to the average of the negro race, but, morally speaking, he was decidedly degenerate. One of his prominent characteristics was a very irritable and irascible temper.

The cranium, as is well shown in the appended illustrations, is most markedly brachycephalic; indeed, its circumferential outline is almost perfectly round, its longitudinal and transverse diameters being nearly equal. The term

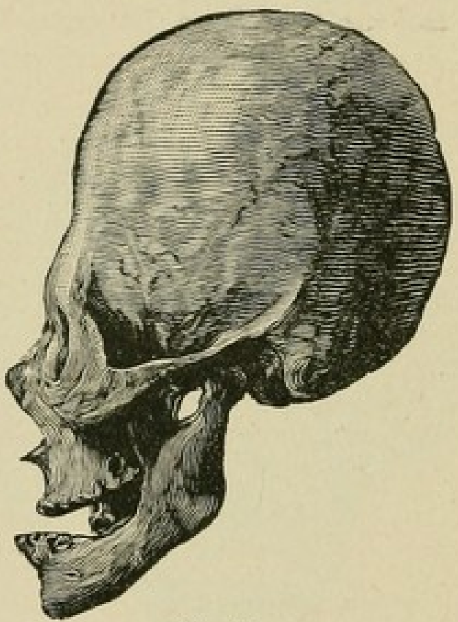


Fig. 42.

dome-shaped is as nearly accurate as possible from a descriptive standpoint. It is a singular fact that the degenerate type of the African skull often presents the oxycephalic, or rafter-headed type, even when the dolichocephalous index is pronounced. These rafter heads are often seen.

The skull at present under consideration is, as already remarked, a distinctive dome shape, which corresponds not at all with the rafter head.

The peculiar conformation in this case is evidently not the result of pathological conditions or mechanical pressure. The vault of the cranium is quite symmetrically developed, although the base of the skull is decidedly asymmetrical, as will shortly be shown. We know of no mechanical means which might have caused the peculiar dome-like form of this specimen, and we have been unable to find mechanically deformed crania of a similar type. Such deformities as those presented by the Chinook, or flat-head, Indians are quite familiar types of skulls mechanically deformed. Certain specimens found in ancient Peruvian graves are almost precisely identical with the characteristic Chinook type, and show a probable common origin of the two races.

There are several interesting features in connection with the skull under consideration. One of the most striking is the extreme shallowness of the orbits. This is well shown by comparison with some of the other types already described, the measurements being one and three-quarters inches from the upper margin of the orbit to the optic foramen, while in the Indian and negro skulls in this series the orbits measure two inches in depth. The outer walls of the orbits encroach upon the cavities, giving a still more marked appearance of shallowness. The form and index of the orbit is given considerable weight by anthropologists as a criterion of racial type. It is claimed by Dr. Lydston, and verified by him by comparative studies of orbital development, that the form of the orbit is of even greater importance as bearing upon the question of degeneracy of type. That marked variation of the form and measurements of the orbit is incidental to differentiation is seen by observation of the anthropoids. There is a striking difference between the members of the Simian group in this respect, and a still greater difference is noticeable between the *simiidæ* and *lemuridæ*. The shallowness and obliquity of the orbits in Fig. 41 is strikingly similar to the characters observed in the gorilla and chimpanzee, which are quite different from those noted in the orangs. The general outline of the orbits, and their proportionate relation to the facial development, in Fig. 31, are also decidedly Simian in character.

The inferior maxilla also presents some peculiarities. The coronoid processes are very small and short, the body long, and the angles very oblique. The anterior alveolar process is excessively developed. The same is true of the alveolar process of the superior maxilla, it being so situated on the outer surface of the jaw that the teeth were necessarily tipped in to facilitate occlusion with the lower teeth. The central incisors were evidently lost in early life, the alveolus being absorbed, and the border of the jaw only one-eighth of an inch in thickness at this point. The palatal vault is very low, and the general development of the jaws imperfect.

There is a marked deflection of the vomer and *ossæ nasi*, evidently of non-traumatic origin, and due to excessive development of the osseous and cartilaginous structures of the *septum nasi*. The nasal spine is enormously developed.

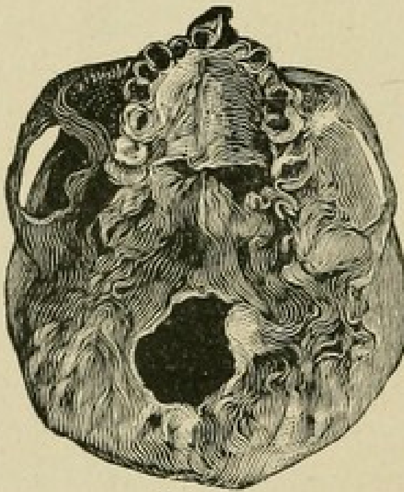


Fig. 43.

The cranial index in this case is extraordinarily high, being slightly above the maximum given by most anthropologists. The type is as marked in the direction of a brachycephalic index as is Fig. 32 in the direction of a low, or dolichocephalous index.

Fig. 43 shows the inferior surface of the skull under consideration. A glance suffices to show its remarkable asymmetry. The foramen magnum is almost entirely to the left of the median line. A line drawn through the center of the foramen traverses the median line of this surface at an angle of about forty-five degrees. The center of the anterior border of the foramen is situated at 76.5 mm. from the left and 58 mm. from the right mastoid. The center of the posterior border of the foramen is 64 mm. and 61 mm. from the left and right mastoids, respectively. The margin of the foramen is extremely thin and the occipital ridges very prominent.

The measurements are:

Horizontal index, - - - -	98.1
Circumference, - - - - -	46.5 c.
Anterior demi-circumference, - -	22.6 c.
Posterior demi-circumference, - - -	23.9 c.
Longitudinal diam., - - - -	146 mm.

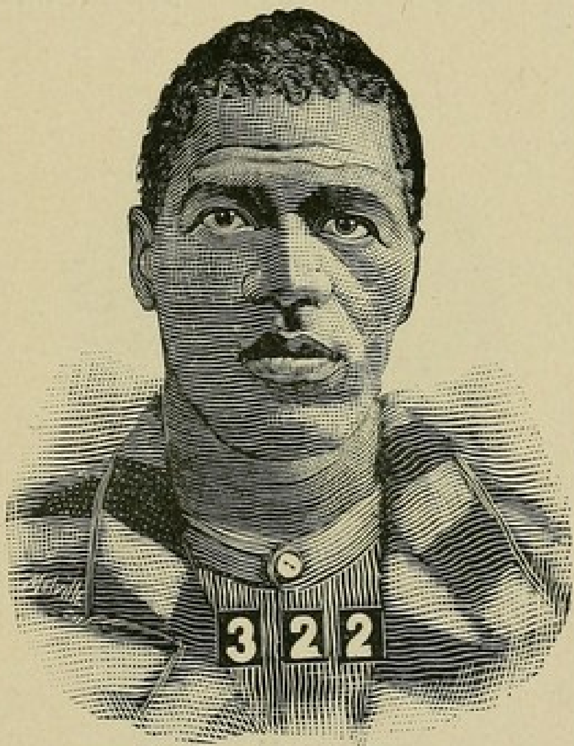


Fig. 44.

Transverse diam., - - - - -	143 mm.
Vertical diam., - - - -	148.5 mm.
Root of nose to occipital protuberance, - -	313 mm.
Anterior border foramen mag. to sup. occ. angle,	91 mm.
Bi-mastoid diam., - - - - -	115 mm.
Occipito-mental diam., - - -	248.5 mm.
Bi-frontal diam., - - - - -	95 mm.
Bi-zygomatic diam., - - - -	133.5 mm.
Over vertex from ear to ear - - -	350 mm.

On comparing the longitudinal, vertical and transverse diameters of this remarkable skull with those of some of the others of the series, the relatively great height of this dome-like cranium is made very apparent. Thus the diameters are:

	Trans.	Long.	Vert.
Fig. 31, - - -	122 mm.	196.5 mm.	132 mm.
Fig. 34, - - -	131 mm.	181 mm.	128 mm.
Fig. 36, - - -	130.5 mm.	190 mm.	128 mm.
Fig. 38, - - -	152 mm.	161 mm.	140 mm.
Fig. 47, - - -	140.5 mm.	180 mm.	136.5 mm.
Fig. 48, - - -	149 mm.	168 mm.	118 mm.

Fig. 45.

Those of the specimens under consideration being transverse 143 mm., longitudinal 146 mm. and vertical 148.5 mm.; a comparison with Fig. 48 is especially interesting.

While making some observations at the Joliet penitentiary we discovered an example of the dome-shaped brachycephalic cranium which strongly resembles the extraordinary specimen just described.

This subject (Figs. 44 and 45) is a mulatto, about twenty-three years of age, who is doing time for attempted murder. He is a surly, truculent fellow, of a low grade of intelligence, and inclined to be unruly. He is at present suffering from a mild type of syphilis. The form of the cranium is well worthy of remark, the more especially as it so nearly approximates the type shown in Figs. 41 and 42.

The facial bones, jaws and teeth in this case were extremely well developed, and the palatal vault normal. There was no history of mechanical compression, and as the subject was born in Tennessee such a cause is improbable, if not impossible.

The measurements were not complete. As far as taken they were:

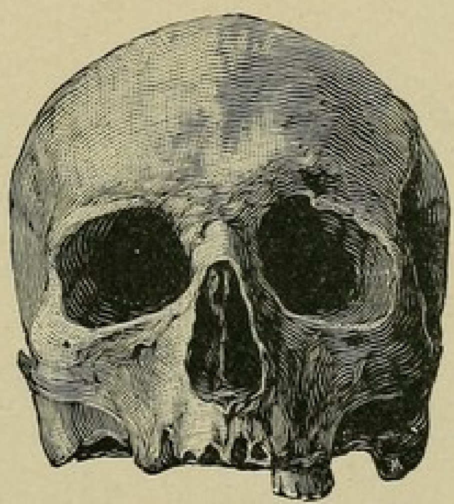


Fig. 46.

Horizontal index, - - - - - -	76.7	
Root of nose to occ. protuberance over vertex, -	39.5	c.
Circumference, - - - - - -	50.8	c.
Transverse diam., - - - - - -	145	mm.
Longitudinal diam., - - - - -	191	mm.
Occipito-frontal diam., - - - - -	59	mm.
Occipito-mental diam., - - - - -	28.5	mm.

The dome-like form of this cranium will be more evident on comparison of the two principal measurements with those of a skull of average development. A comparison was made with that of one of the white orderlies in the prison hospital, a man of fine physique and good cranial development. It was found that while the measurement over the vertex was the same as that of the negro, 39.5 c., the circumferential measurement was 58.5 c.

The next specimen (Fig. 46) is the skull of a noted Western criminal and desperado, who was lynched for train-wrecking in Wyoming a number of years ago. The conduct of this man during the progress of the lynching stamped him as a bravo of the most hardened type. An attempt was made to induce him to relate the particulars of a murder in which he had participated; the wife of the murdered man being present at the hanging and anxious to learn the details of her husband's death. To the persuasive efforts of the "regulators," and the tears and entreaties of the widow of his victim,

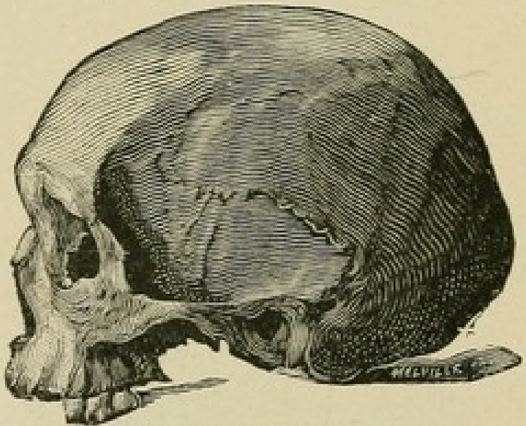


Fig. 47.

he replied: "D—n it, you'll hang me if I tell and you'll hang me if I don't. So here goes," saying which he deliberately kicked the barrel upon which he was standing out from under himself and thus saved his self-appointed executioners all further trouble.

This specimen is brachycephalic and chiefly characterized by its marked asymmetry.

The occipital region (Fig. 47) in this cranium is excessively developed, prominent and bulging, being especially prominent on the left of the median line; the occipital protuberance is situated about 8 mm. to the left; the parietal eminences are very asymmetrical, the right being very prominent and of irregular contour; the palatal vault is of medium height, the teeth regular and the maxilla well developed; the measurements are:

Horizontal index, - - - -	77.8
Circumference, - - - - -	50.3 c.
Posterior demi-circumference, - -	28.6 c.
Tranverse diam., - - - - -	140.5 mm.
Anterior demi-circumference, - -	21.9 c.
Longitudinal diam., - - - -	180 mm.
Bi-frontal diam., - - - -	105 mm.
Bi-mastoid diam., - - - -	126 mm.
Bi-zygomatic diam., - - - -	134 mm.
Root of nose to occipital protuberance, - -	312 mm.
Over vertex between auditory meati, -	327.5 mm.
Foramen magnum to sup. occipital angle, -	128 mm.

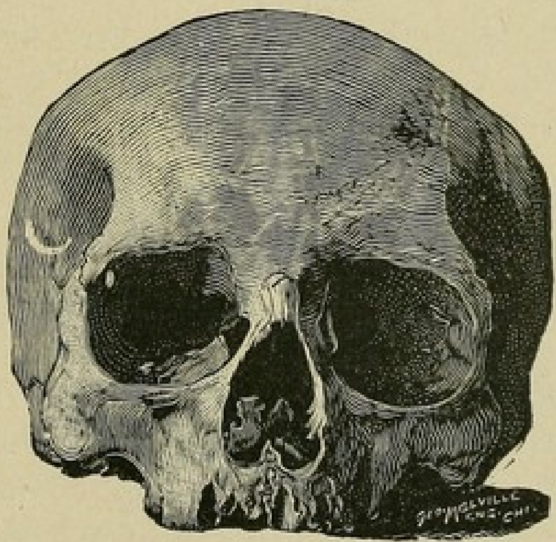


Fig. 48.

The next specimen (Fig. 48) is by far the most interesting of the series from the standard of degeneracy, and is certainly the most markedly asymmetrical. If it were possible to conceive of a special criminal type of cranium, this would in many respects be an ideal illustration. The subject was a noted Western desperado and train-wrecker, who was lynched at Carbon, Wyoming, back in the seventies, for an attempt to wreck a train at Medicine Bow. In this attempt he was assisted by the individual represented in Figs. 46 and 47.

The extremely disproportionate breadth of this cranium is well shown by the above illustration. The meagre development of the frontal region is very noticeable. On viewing this skull from above, the peculiar twisted appearance which may be observed in connection with the cranial type of the criminal in general will be observed. The orbits are relatively large and the face as a whole of a decidedly "squatty" appearance. The absence of the inferior maxilla is to be regretted, although considering the vicissitudes which the skull has experienced, its otherwise perfect state of preservation is rather remarkable. After the lynching of this gentleman the body was buried in a hastily improvised and shallow grave, from which it was very promptly resurrected by those scavengers of the prairie, the coyotes. The skull was finally found by a railroad employe and subsequently used as a paper-weight for some years.

Judging from the conformation of the cranial and facial bones, the lower maxilla, while probably well, or perhaps excessively developed, was without doubt asymmetrical. The relatively defective frontal development of this skull is its most striking feature when viewed in its anterior outline, and is best shown by comparison with Figs. 31, 32 and 34. In the former the extreme breadth is 122 mm. and the extreme length 196.5 mm., while the frontal breadth is 95 mm. In the skull under consideration, however, although the extreme breadth is 149 mm. and the extreme length but 171 mm., the frontal breadth is only 90 mm. The great disproportion in the measurements is at once obvious. In Fig. 34 the greatest breadth is 131 mm. and the greatest length 181.5 mm., yet the tranverse frontal diameter is 95 mm.

The disproportion is not compensated for in Fig. 48 by an increased longitudinal development of the frontal bone.

The twisted appearance of this skull is most evident on comparison of the parietal eminences. These are very prominent on both sides, the left being much the larger of the two; the occipital region is greatly deformed and exceptionally prominent, the bulging being most marked upon the left of the median line. The asymmetry of development is shown by a comparative measurement of the distance of each parietal eminence from the occipital protuberance; this measures on the right side 132 mm. and on the left only

119 mm. The squatty, animal-like type of this cranium is shown by a comparison of its vertical measurement with some of the others of the series; from the highest point at the vertex to the anterior border of the foramen magnum, the measurement is 118 mm.; that of Fig. 32, which is so distinctively anthropoid in its development and outline, the vertical measurement is 132 mm.; of Fig. 34, 128 mm.; of Fig. 38, 140 mm.; of Fig. 42, 148.5 mm., and of Fig. 47, 136.5 mm. A little study of these measurements will show the extreme animality of type in this cranium, even as compared with others of a pronounced degeneracy of type.

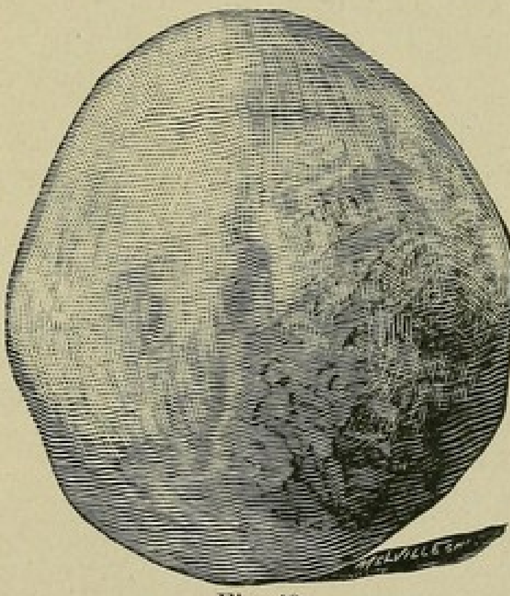


Fig. 49.

A view from above (Fig 49) shows the circumferential outline of this specimen. By comparing the quadrants of this illustration, the pronounced asymmetry of development is easily seen.

The superior maxilla in this skull is well developed, although the alveolar process shows an inferior development; the palatal arch is exceedingly low; the left superior maxilla is much smaller than the right; the palatal processes show great asymmetry, the right being 61 mm. and the left but 5 mm. in breadth; the measurements of this cranium are:

Horizontal index, - - - - -	87.13	
Circumference, - - - - -	49	c.
Anterior demi-circumference, - - -	20.35	c.
Posterior demi-circumference, - -	28.65	c.
Longitudinal diam., - - - -	171	mm.
Transverse diam., - - - -	149	mm.
Vertical diam., - - - - -	118	mm.
Bi-frontal diam., - - - -	90	mm.
Bi-mastoid diam., - - - -	108.5	mm.
Bi-zygomatic diam., - - -	132	mm.
Vertical circumference from ear to ear, -	279	mm.

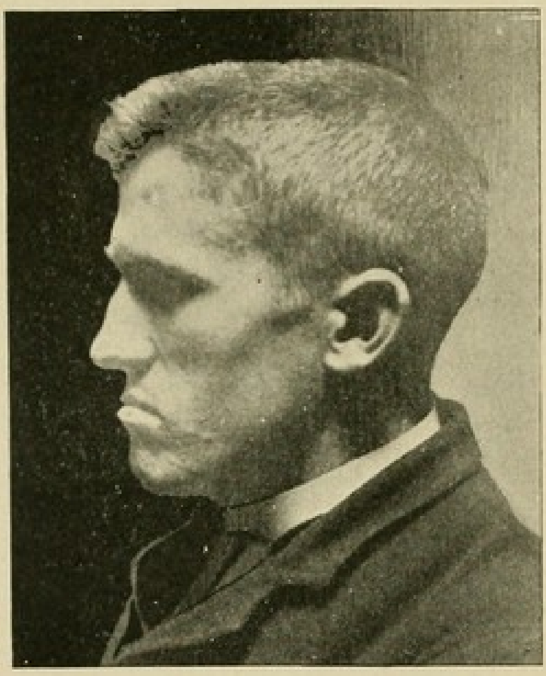


Fig. 50.

Center of left parietal prominence to occipital protuberance, - - - -	119	mm.
Center of right parietal prominence of occipital protuberance, - - - -	132	mm.
Anterior border foramen magnum to superior occipital angle, - - - -	128	mm.

Fig. 50 is the picture of Patrick Eugene Joseph Prendergast, twenty-five years of age, who shot and killed Mayor Carter Harrison of Chicago, October 28, 1893, at his residence, claiming that the mayor had not given him a certain office which had been promised him. Prendergast was born in Ireland, and came to this country at the age of five years. On the witness stand the author gave the following testimony: Height, 5 feet 7 inches. Weight, 132 pounds. Hair, red, coarse and stiff; very little upon face. Nose, fairly normal; thin at bridge, broad at alæ. Ears, large and projecting; lobes, short and broad; tragus, both well developed; helix, broad, with typical tubercles at the upper and outer border of the ear. Lips, upper small and thin, lower excessively developed; more prominent because of undeveloped upper jaw. Face, arrest of development of the bones of the face, especially at the alae of the nose. Zygomatic arches, normal, but appear prominent owing to the arrest of the bones of the face. Lower jaw, normal. Forehead, receding. Head, sunken at the bregma; occipital portion excessively developed; circumference, 22.2 inches (57 mm.); antero-posterior, 7.75 inches (20 mm.); lateral, 6.36 inches (16½ mm.); lateral index 82; therefore extreme brachycephalic. Feet large, hands normal, fingers long and skinny. Width, outside first permanent molar, 2.25 inches; width, outside second bicuspid, 2 inches; width of vault, 1.25; height of vault, .75; antero-posterior, 2.

This individual possesses all the stigmata of Lombroso's degenerate form of insanity, paranoia.

As was observed in the chapter upon "Developmental Neuroses," that "authors and specialists differ in regard to their definitions of neurotics and degeneracy, and also differ as to the cases that should come under the head of one and the other," the question would naturally arise (after reviewing the different cases under consideration), is there any difference? We find the same deformities in one that we do in the other.

DEFORMITIES OF THE JAW AS SEEN IN CRIMINALS.

"Although prepared to find a goodly proportion of atypical conformations of the jaws and teeth among criminals, our observations gave results which were a little surprising. There were 477 criminal subjects examined, of whom 468 were males and nine females. Of the whole number three were Chinese, eighteen were negroes and the remainder were whites, the latter representing many nationalities.

The following table shows the different deformities of the jaws and teeth that were found:

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V.Shaped Arch.	Partial V-Shaped Arch.	Semi-V.	Saddle Shaped Arch.	Small Jaw.	Partial Saddle.	Semi-Saddle.
468	M	163	66	17	5	70	13	79	19	59	30	92	24
9	F	9	9	..	..	..	..	..	..	..	..	..	..
Per cent..		36.06	15.72	3.56	1.04	14.67	2.70	16.56	3.98	12.36	6.29	19.28	5.03

In the majority of the cases the jaws of the negroes were well developed. One had a partial V-shaped arch, one a saddle, one a V, and in one the left body of the lower jaw was found to be much smaller than the right. The bones of the head and face were also well developed. The three Chinese were all sub-microcephalic, with very small jaws, and two of the three had saddle-shaped arches. It is worthy of note that the nine females examined had large and well developed jaws, with normal arches."

CHAPTER XI.

PROSTITUTION AND SEXUAL DEGENERACY.

Speaking of the class under consideration, the *Medical Record* points out that prostitutes represent a special, degenerate, criminal class. They are more decidedly a class by themselves than professional thieves. Over ten per cent are illegitimate; a considerable proportion have alcoholic, syphilitic, adulterous or criminal parentage. A large proportion have morbid sexual propensities, and crave sexual excesses. A very typical, instructive history of a prostitute is that of Alphonsine Plessis, idealized by Alexandre Dumas in "Camille." Her paternal grandmother, who was half prostitute, half beggar, gave birth to a son by a country priest. This son was a kind of country Don Juan, a peddler by trade. The maternal great-grandmother was a nymphomaniac, whose son married a woman of loose morals, by whom a daughter was born. This daughter married the peddler, and their child was Camille. She had, unquestionably, the powerful perverted sexual instincts of many of her class. She died childless early in life from consumption, nature thus extinguishing the race. People with the ancestry, the habits, the perverse instincts of the prostitute class cannot be cured or reformed by the enforcement of municipal ordinances. If taken from their surroundings and placed where they can earn an honest livelihood, they, as a rule, go back voluntarily to their old mode of life. And they do this despite the fact that this life is always a short one, and is sure to end in sickness, degradation and misery.

Mrs. Ballington Booth,* of the "salvation army," discussing the "social evil," points out that a by no means small proportion of the prostitute class are illustrations of the Biblical axiom, that the "fathers have eaten sour grapes and the children's teeth are set on edge."

* Quoted by Dr. Harriet C. B. Alexander in a paper read before the Chicago Academy of Medicine (*Medical Standard*, Vol. XIII).

Chaplain Merrick,* of the Millbank (England) prison, who has studied prostitution from a theological standpoint, arrives at practically the same conclusions. Betrayal under promise of marriage, usually assigned as the chief cause, he finds to be the lowest in the list. Nearly one-half of the thousands coming under his observation left their homes voluntarily to take up "a life of pleasure." The most extended work from the purely anthropometric standpoint is that of Dr. Pauline Tarnowsky,† who has studied 150 prostitutes in the Russian hospitals and prisons. She finds, practically, that prostitution is crime in women taking the line of least resistance. The prostitutes, like the other criminals, are divisible into criminals on occasion (vice, monetary reasons, etc.), accidental criminals, law-made criminals, weak-willed criminals, periodical criminals, born criminals, and insane criminals. The proportion of the law-made and accidental criminals in the *demi-monde* is much less than in the other classes, as Chaplain Merrick has shown. Seduction stands very low in the list of causes. The proportion of the criminal on occasion type is very large.

Dr. Tarnowsky concludes from her researches that the professional prostitute is a degenerate being, who is a subject of an arrest of development, tainted with a morbid heredity, and presenting stigmata of physical and mental degeneracy fully in consonance with her imperfect evolution. The degeneracy stigmata, due to an imperfect organization, are manifested in prostitutes principally by the frequency of skull deformities ($44\frac{1}{3}$ per cent), and deformities of the face ($42\frac{2}{3}$ per cent); by numerous anomalies of the ears (42 per cent), and of the teeth (54 per cent).

The mental stigmata are shown in a more or less marked intellectual feebleness, in a neuropathic constitution, in a notable absence of moral sense. It is also evident in the abuse of genesic functions and in the attractions this abject trade has for its subjects.

In order to determine if such conditions existed, I made,

* *Journal of Mental Science*, 1892.
† "Etudes Anthropometriques sur les Prostitutees et les Voleuses."

together with Dr. Harriet C. B. Alexander and Dr. J. G. Kiernan, some researches in the Chicago bridewell. The inmates here are the least intelligent of any of the class. The researches are necessarily far from complete, owing to the difficulties under which such researches must be obtained in case of persons with short-term sentences. They were, however, habitual cases, some being in the institution from time to time for twenty years, and most of them criminals.

The number examined was thirty. Our results are as follows:

Race:

Celtic-Irish,	13
Irish-American,	5
Scandinavian,	3
German,	1
German-American,	1
American,	2
English-American,	1
Latin-Swiss,	1
Negro,	2

These results tell very little, as the "fine" system of Chicago places only the "obtuse" class under imprisonment. One was seventeen years old, two eighteen years, one nineteen years, five between twenty and twenty-five years, three between twenty-five and thirty, six between thirty and thirty-five, five between thirty-five and forty-five, one was forty-six years old, two were fifty-five, three sixty, and one sixty-five. Neither the race nor age data are of any value. There were eighteen blondes, ten brunettes and two negroes. Four were demonstrably insane, and one was an epileptic.

In sixteen cases the zygomatic processes were unequal and very prominent. There were fourteen other asymmetries of the face. Three heads were Mongoloid, one Irish Celt, one Swiss, and one Scandinavian. There are Mongoloid race types in the regions where the first two come. Sixteen were epignathic and eleven prognathic. In one there was arrest of development of the lower jaw, and in four arrest of development of the bones of the face. The noses were abnormal in six.

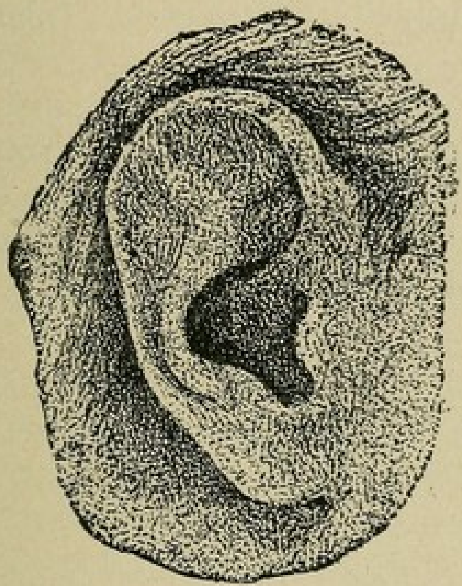
There were seventeen brachycephalic and thirteen mesaticephalic skulls. There were no dolichocephalic skulls. There were three oxycephalic skulls, of whom one was a Celt, one a German, and one a Scandinavian. There were eighteen dometype skulls, of whom seven were Irish Celts, five Celtic-Americans, one English Anglo-Saxon, one American Anglo-Saxon, and one German-American. There were four tectocephalic skulls, of whom one was an Irish Celt, one an Anglo-Saxon American, and one a Scandinavian. There were three platycephalic skulls, of whom two were Celts and one a Scandinavian. There was one plagiocephalic German and a stenocephalic Celt. One skull had a protuberance at the bregma. Twelve occiputs were flattened; in four of which there was no tubercle; eighteen had an enormously developed occipital protuberance.

The following table shows the measurements and the percentage of deformities of the jaws:

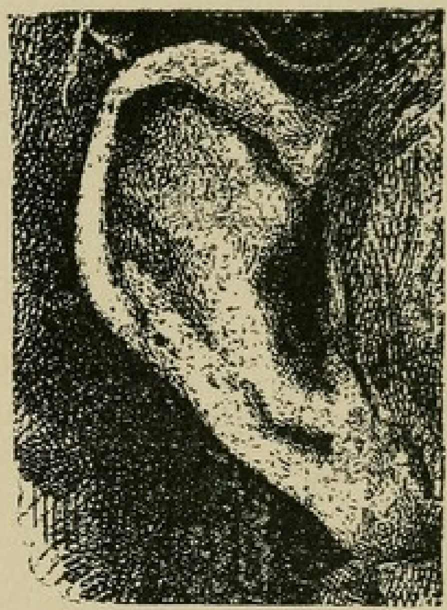
	Width outside 1st molar.	Width outside 2d biscupid.	Width between 2d bicuspid.	Height of Vault.	V-shape.	Partial V-shape.	Semi-V-shape.	Saddle.	Partial Saddle.	Semi-Saddle.
Average	2.00	1.69	1.06	49						
Per cent	....	....	....	....	10	17	7	27	10	10

Twenty-nine had defective ears; eleven were of the type shown in figure A, nine of the type shown in figure B, and nine of the type C. The normal ears were present in a member of a family which had furnished one mother and two sisters to the institution. Five Celtic-Irish had type A, and three Celtic-Americans, seven Celtic-Irish, and one Celtic-American had type B. One Irish Celt and one American Celt had type C. One Celt was normal. One German had type A. One German and one German-American had type

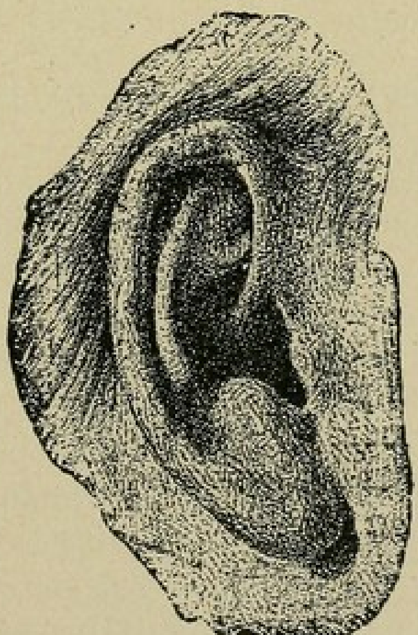
C. Two negroes had type C. One Anglo-Saxon-American had type C, and one English Anglo-Saxon had type A. The three Scandinavians (who were all more or less mentally



A



B



C

defective) presented all three types. Frigerio has said (corroborating a fact long ago pointed out by Morel) that the ear should be placed in the first rank among the organs affected by degeneracy.

Lombroso, in an examination of fifty prostitutes, found exaggerated lower jaws twenty-six times; plagiocephaly twenty-three times; asymmetrical noses eight times; prominent zygomæ forty. Grimaldi, in a study of twenty-six prostitutes, has similar results to those of Tarnowsky, from whom the following is quoted:

"Dr. C. Andronico, who, as sanitary physician at Messina, had to deal with a large number of prostitutes, is one of the first, at least to my knowledge, who has mentioned the signs of degeneracy in this class. He noticed among 230 girls, seen professionally, the following anomalies:

Flat nose, - - - -	20
Handle-shaped ears, - - -	35
Vicious implantation of teeth, -	10
Convergent strabismus, - - -	2
Facial asymmetry, - - -	4
Prognathism, - - - -	7
Receding foreheads, - - -	35

Let us pass now to the signs of bodily degeneracy we have observed in professional prostitutes.

That which first attracts our attention is the frequency of cranial deformities presented by prostitutes, and which we have observed in women of other classes in an incomparably less degree. These irregularities of the cranial conformation reveal themselves in prostitutes by oxycephaly, platycephaly, stenocephaly, and plagiocephaly.*

Many of these abnormal crania have also a notable development of the external occipital protuberance.

Before continuing, I compel myself to make a slight digression; to say that while our observations were made in a hospital especially designed for the treatment of venereal diseases, there is no ground for the conclusion that syphilis has had the least influence in the world on the conformation of the crania in question.

Out of 150 prostitutes taken at random from those

* Archivio di psichiatria, III, 1882, p. 143.

answering to the necessary conditions stated above (uniformity of race, ability to give their family history, and having been at least thirty-three years inmates of houses of tolerance), in these 150 prostitutes, we repeat, we have found signs of physical degeneracy in eighty-seven per cent.

The following were the abnormalities noted:

1. Deformities of the bony cranium, sugar loaf heads—oxycephaly; heads flattened at the vertex—platycephaly; narrow heads, compressed at the temples—stenocephaly; oblique crania—plagiocephaly; heads with marked depressions or cavities either in the region of the bregma or that of the lambda.

All these cranial malformations may depend upon different causes. Among the most probable ones we will cite these: (1) An arrest of development of the bone; (2) premature synostosis of the sutures; (3) pathological processes occurring during intrauterine life, or rather, during early infancy, such as syphilis, rickets, scrofulous affections, hydrocephalus, meningitis, etc.

Very recently Professor Recklingshausen, of Strassburg, has affirmed that, in infant crania, premature synostosis of the sutures may produce, according as one or all the sutures are involved, either dolichocephaly (sagittal suture), trocho and oxycephaly (generalized synostosis), or plagiocephaly (coronary suture of one side). Professor Recklingshausen also affirms that the girth of the cranium, and that of the brain, influence each other reciprocally, and that the form of the cranium, especially the pathological form, is ordinarily the result of many concurrent conditions. It may also depend as much upon disturbances of the development of the sutural synostoses, or of the bones, as upon primordial (anomalies) in the development of the brain.

The majority of the deformed heads of our prostitutes further show a marked development of the external occipital protuberance, a peculiarity observed in one-third of our cases. In an equal number of virtuous women we found it only five times.

Following are some illustrations of badly-formed heads:

Fig. 51. Head flattened at the vertex; forehead hydrocephalic; flat nose; lobe of ear much developed.

Fig. 52. Head elevated at vertex; flat nose.

Fig. 53. Development of parietal region chiefly on one side.

2. The anomalies of the face reveal themselves frequently by asymmetry, prognathism, and a sensible disproportion of different parts; by a deviation of the nose, a deep excavation of the root of the nose (nose strongly flattened). On account of the limited number of our observations, we have united in our tables of signs of physical degeneracy

Fig. 51.

Fig. 52.

Fig. 53.

these various anomalies under a single head, which we designate anomalies of the face.

3. The ogival palatine vault, although making a part of the facial anomalies, has been noticed by itself as a distinctive characteristic sign. We have been surprised to see it so often.

4. The complete division of the palate. Suture of the bones of the palate remaining open.

5. Defective teeth, irregular in growth, riding over each other, or, on the contrary, widely separated; teeth notched and grooved (Hutchinson's and Parrot's teeth); teeth encroaching outside the dental arch, of which they render the parabola irregular; and finally the atrophy or com-

plete absence of the superior lateral incisors. The wisdom teeth are very often lacking. In her excellent thesis of inauguration, Madam Alice Sollier noted the dental anomalies very common in the degenerates: "Idiocy, with or without epilepsy, predisposes to arrests of development to anomalies, and to lesions of the dental apparatus in a large proportion—eighty-one per cent."

6. Anomalies of the ear. In the first place, we notice the badly bordered ear, with excavated helix, described by M. Morel. Next, defective implantation of the ears, ears in the form of a handle; the ears with pointed tops, surmounted by the tubercle of Darwin; fleshy ears, with large lobules, also ears with sessile lobules.

7. Anomalies of the extremities. Congenital, lack of one phalanx, club foot, valgus and varus.

8. Local asphyxia of the extremities.

All the anomalies enumerated below are thus distributed among 150 prostitutes:

Malformations of the head (oxycephaly, plagiocephaly, etc.) noted in - - - - - -	62 women
Development of the occipital protuberance, -	62 women
Very receding foreheads, - - -	18 women
Hydrocephalic, - - - -	15 women
Various anomalies of the face (prognathism, asymmetry), - - - - -	64 women
Ogival palatine vault, - - -	38 women
Congenital division of palate, - - -	14 women
Vicious implantation of teeth, - -	62 women
Hutchinson's and Parrot's teeth, - -	19 women
Absence of lateral incisors, - - -	10 women
Badly margined ears (Morel), - - -	16 women
Defective ears (detached from head, deformed, etc.), - - - - -	47 women
Anomalies of the extremities, - - -	8 women
Local asphyxia, - - - -	2 women

It is evident that the possessor of one of these anomalies alone should not be considered as an abnormal being. It is only the coincidence of many of these deviations in the same person, connected often with moral abnormalities, that cause them to be regarded as signs of physical degeneracy and as connected with any hereditary defect.

In our prostitutes these physical anomalies have been found in the following numbers in the same individuals:

In 15 prostitutes,	a single anomaly, or one in	ten	per cent.
In 34 prostitutes,	2 anomalies at once, or	22.66	per cent.
In 35 prostitutes,	3 anomalies at once, or	23.33	per cent.
In 30 prostitutes,	4 anomalies at once, or	20	per cent.
In 14 prostitutes,	5 anomalies at once, or	9.33	per cent.
In 66 prostitutes,	6 anomalies at once, or	6	per cent.
In 4 prostitutes,	7 anomalies at once, or	2.66	per cent.
In 1 prostitute,	8 anomalies at once, or	0.66	per cent.

Eliminating the first 15 women presenting only one anomaly, and who cannot, therefore, be classed as badly organized individuals, and adding one prostitute who showed no physical deviation, we find that the other 134 prostitutes show, in 82.6 per cent of the whole, more than one anomaly at the same time. In comparison with these, respectable women, both illiterate peasants and cultured females, show an enormous difference. Thus, amongst educated women, we found only two per cent of anomalies, and amongst illiterate peasants, 14 per cent.

We take occasion here to recall the fact that our prostitutes were not especially selected as they were admitted to the hospital; all were taken who fulfilled the requirements as to race, ability to furnish the needed data, and who were not disfigured by syphilis.

So striking a difference between respectable females and prostitutes cannot be merely accidental. We believe that such a notable frequency of the stigmata of degeneracy in prostitutes is to be accounted for, at least in great part, by their family histories, which show, as we shall see in the next chapter, many of the causes predisposing to hereditary defect, as well as to arrests of development."

In concluding this chapter, I cannot but agree with the conclusions of Dr. Harriet C. B. Alexander, based on our Chicago researches, that the general propositions of Dr. Tarnowsky are borne out by these results, albeit degeneracy stigmata are more frequent among these Chicago specimens. More extended researches are needed, and it is to be hoped that physicians to allied institutions will not fail to cultivate this field. The results of Mrs. Ballington Booth and Chaplain Merrick show that these beings need treatment along physical lines laid down in institutions like the Elmira reformatory. Like the pauper and criminal, the prostitute is an atavistic survival of primitive states, out of accord with existing tendencies, but arising from degeneracy due to bad hygiene and its resultant moral and physical effects.

SEXUAL DEGENERACY.

An allied class, belonging to a still blacker phase of the night side of nature, are the sexual perverts; but one phase of sexual degeneracy can be dealt with here—the congenital form, which is associated with the stigmata of degeneracy as an expression of the defective line from which the victim has sprung. These differ in toto from the perversities or vice types fittingly relegated to the works on jurisprudence. The congenital type, as Dr. G. Frank Lydston has shown, are victims of inherited defect. It often links the degenerate lunatics, epileptics, etc., with the born criminal class.

CHAPTER XII.

MORAL INSANITY, PAUPERISM AND INEBRIETY.

There has formerly been much discussion of the subject of moral insanity, and it has been affirmed and denied with equal vehemence that there existed a form of mental disease to which the term "moral insanity" could properly be applied. It is seen, however, more recently that there are many insane persons in whom the principal difference from the normal consists in disease or defect of the moral faculties; while it is also true that in most such persons a closer inspection generally reveals other signs of mental disease, defect or degeneracy (using the word "mental" to designate the whole mind), besides simply immoral conduct, and that somatic signs are also present. In such cases, however, the seeming immorality is often the striking factor of the case, and the mind of the individual superficially appears clear and rational, which fact led early writers (Prichard, 1842,) to use the term in question. Later a controversy grew up in which one party protested against moral insanity being used as a cloak for depravity and the other insisted that many so-called immoral acts were the outgrowth of disease or inherent defect of the moral faculties. Such a controversy was often bitterly waged by the opposing sides in criminal prosecutions, and remarkable forensic contests of this nature have served to further obscure rather than clear up the subject. In some of these contests guilty and responsible criminals have escaped the consequences of their crime, while other persons innocent from imbecility, chiefly of the moral faculties, have been unjustly punished. Moral insanity is today an accepted form of disease of the mind, and presents features whereby it may be differentiated from depravity, or guilt of a responsible individual.

Krafft-Ebing, a German writer of authority, thus expresses himself with reference to this form of insanity: "If we seek to sketch the clinical signs of this peculiar defective state, we find as the most striking appearance, moral insensibility, a lack of moral judgment and ethical ideas, the place of which is usurped by sense of loss or profit only logically apprehended. Such persons may mechanically know and remember the laws of morality, but if such laws enter their conscience these persons are not affected by any real appreciation, still less by regard for them. These laws are cold and lifeless statements, and the morally defective know not how to draw from them any motive for omission or commission of an act."

To this "moral color-blindness" the whole moral and governmental order appears only as a hindrance to egotistical ambition and feeling, which necessarily leads to negation of the rights of others and to violation of the same. These defective individuals are without interest for aught that there is good, beautiful, and insensible to all influences of the heart. Such persons are repellant by their lack of love for children or relatives, and of all social inclinations, and by cold-hearted indifference to the weal or woe of those nearest to them. They are without care for questions of social life or sensibility to either the respect or the scorn of others, without control of conscience, and without sense of remorse for evil. Morality, they do not understand. Law is nothing more than police regulations, and the greatest crime only the transgression of some arbitrary order. If such persons come in conflict with individuals, then hatred, envy and revenge take the place of coldness and negation, and in their moral idiocy their brutality and indifference to others know no bounds.

These ethically defective persons, who are incapable of holding a place in society, are converted sooner or later into candidates for the workhouse, the bridewell or the insane asylums, one or the other of which places they reach after they have been as children the terror of parents and teachers through their untruthfulness, laziness and "general cussedness," and as youth the shame of the family and the torment of the community and the officers of the law by thefts, vagabondage, profligacy and excesses. Finally they are the "despair" of the asylum and the "incorrigibles" of the prison, and, Krafft-Ebing might have added, the mere burden of the poorhouse, since a large number of them pass into fatuity and imbecility as a terminal stage of their career. It may be said that if madness or crime do not claim them, pauperism is almost certainly their destiny.

Physical signs of defect and degeneracy are usually to be found with such individuals—asymmetries, paralysis, malformation, especially of cranial bones and teeth; the facial expression, the movements and the gait, are often suggestive of the abnormality of mind. In a large majority of such cases also, epilepsy, drunkenness or insanity will be found in the ancestry.

INEBRIETY.

Among ethical degeneracies is naturally included inebriety. Under this head may be properly classed those cases of periodic morbid impulse to drink, which are commonly classed as dipsomaniacs. This morbid state is best studied under two distinct heads—inherited and acquired. Both conditions may be associated with neuroses and degeneracy. Inebriety may be inherited direct from the parent, or the individual may have inherited a neurotic or degenerate nervous system from his parents, who are victims of other excesses or disease, such as syphilis, cancer or tubercular diathesis, etc. In such cases the individual, in almost every instance, displays somatic stigmata. Such persons, exposed to evil influences through society, soon become dipsomaniacs. Such is the history of a large percentage of those who visit the Keeley institution. There is properly no one condition that produces so many forms of the degenerate in the offspring as that of inebriety. In a later chapter are discussed the results of this disease.

CHAPTER XIII.

INTELLECTUAL DEGENERACY.

Intellectual degeneracy reveals itself chiefly under the forms of insanity, imbecility and idiocy, and is often accompanied with cranial, facial and dental irregularities. In addition to these, the unstable conditions of the nervous system, evident in the symptoms of idiopathic epilepsy or hysteria, should be placed in this same class. But, simple insanity, uncomplicated mania or melancholia, not connected with any organic lesion or recognized bodily disease, is not necessarily connected with any facial or cranial defects, nor is it to be considered as essentially indicating any intellectual degeneracy. Causes sufficiently powerful may produce these derangements in the brain of normal individuals, even above the average in mental and physical vigor. This is true also of the insanities connected with many bodily ailments, and, to some extent, of delusional insanity or paranoia, and many cases of periodical or remittent insanity. In many of these last, however, and in some cases of paranoia, there are blended stigmata of degeneracy. Of the developmental insanity of puberty (adolescent insanity or hebephrenia), often due to congenital structural deficiencies, the same is frequently true.

These cases fall under the head of vicious organization, of which insanity is the result. Under this class come, perhaps, first, the degenerative paranoiacs (the *originaere Verruecktheit* of the Germans), in which it is the rule to find misshapen crania and asymmetrical features, necessarily involving deformities of the bony parts, often extensive and characteristic. These patients are usually included among the paranoiacs, but there is a wide difference between them and the typical case of primary or secondary delusional insanity. The born criminals of Lombroso also fall into the degenerate class. They are the victims of heredity and organization, though none the less dangerous on this account. Many cases of hysteria also bear the stigmata of degeneracy. There are numerous exceptions, however. These are often impressible females, unequal to the stress of natural physiological requirements. Whatever stigmata of degeneracy they may display are to be found in directions other than those of gross deformities due to irregular skeletal development.

The great neurosis, epilepsy, is very often characterized by facial and cranial deformities. Epilepsy, in fact, is only a symptom of an organic cerebral defect that very often reveals itself in part by cranial and facial anomalies. The epileptic *facies* is readily recognized, even by laymen who have had much to do with these unfortunates. Dr. H. M. Bannister tells me he once tested this by a composite photograph of a number of epileptics, taken at random. Even with the imperfect methods used, the rather vague photograph was readily recognized by a number of asylum employes as that of an epileptic, and by some mistaken for the imperfect likeness of a certain typical epileptic not included in the number who contributed to the picture.

It is difficult to say of just what this epileptic *facies* consists, but it is due to facial irregularities in which the eyes and jaws largely participate, aside from the accidents to which they are liable from their disease, that frequently produce deformities. Congenital epileptics (especially insane epileptics) have very markedly misshapened, plagiocephalic crania, deformed or ill-proportioned jaws and facial bones; irregularities in the teeth appear to be very common among them. Some cases of so-called idiopathic epilepsy are probably due to traumatism received at birth, and many more to the results of natural causes acting in early infantile life, especially teething, often accompanied with nervous disturbances. Often these derangements are excessive, and the yet unformed nervous system receives a bias toward instability which affects the whole future life of the individual. Infantile convulsions of the teething period may give rise to epilepsy in the youth or adult. Where there is not direct passage from one to the other, there may be created a predisposition to the latter disorder that then requires much less than the ordinary cause to produce it. When this is the case, any later disturbance which would probably have little effect on a normal system, may produce the most serious results. The second dentition, which is not without its influence on the general nervous system, though it ordinarily causes little trouble, may in individuals thus prepared by prior instability, especially when complicated by anatomical or dental abnormalities, cause epilepsy or other neuroses, including insanity. Thus may result a direct connection between dental and mandibular deformities and mental and nervous diseases. The anomalies of the jaws and teeth, as regards their relation to mental and nervous diseases, may be divided into three classes, as follows:

First. Those in which the brain symptoms and the maxillary anomalies are both due to the same cause, and are stigmata of degeneracy (the deformities as in idiocy, imbecility, some forms of systematized and hereditary insanity).

Second. Those in which the maxillary deformities are due and secondary to the central disorders (as in the accidental deformities of epileptics and the atrophies observed in connection with certain brain lesions).

Third. Those in which the symptoms involving the nervous centers are secondary and consecutive to the deformity (neuroses from irregular dentition).

The practical importance of this last class will be readily appreciated. As dental or maxillary deformities are dangerous in neurotic individuals at special periods of life, their early correction becomes of the highest importance. The operator must therefore be able to recognize these conditions in order that he may guard against complications. I know a neurotic patient, thirteen years of age, who developed epilepsy as a result of having her teeth regulated. The necessary pressure exerted to remove the teeth developed the disease. I also know a patient, of a nervous temperament, confined to her bed two years as a result of improper care of the general health while the teeth were being regulated. The operator failed to recognize an unstable neurotic temperament. These conditions are very common at the period when the deformities of the jaws are usually corrected. The nervous system is in a critical period of development. This is particularly true of females.

In the great mass of the insane of the Northern United States, dental and maxillary anomalies appear to be excessively frequent. The following table shows the results of the examination of the jaws and teeth of 700 insane cases of patients taken at random (without regard to the nature of the disease) in the asylum at Dunning, Cook County, Illinois:

MAXILLARY DEFORMITIES AMONG THE INSANE.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle Shaped Arch.	Small Teeth.
430	M	347	10	4	2	18	12	29	3	5
270	F	139	8	6	4	26	14	18	9	2
700		486	18	10	6	44	26	47	12	7

In the next table we have the results of measurements of over 600 inmates of the Illinois Eastern Hospital for the Insane at Kankakee, classified according to the general type of their disorder:

	No.	Sex.	MEASUREMENT OF JAW OUTSIDE OF 1ST PERMANENT MOLAR. IN INCHES.			MEASUREMENT OF JAW OUTSIDE OF 2D BICUSPID. IN INCHES.			WIDTH OF VAULT BETWEEN 2D BI-CUSPID. IN INCHES.			HEIGHT OF VAULT. IN INCHES.			DEFORMITIES.						
			Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	V.	P.V.	S-V.	S.	P.S.	S-S.	%
Acute Mania.......	18	M	2.50	2.00	2.24	2.12	1.75	1.90	1.50	1.00	1.23	.62	.37	.55	1	2	2	3	2	1	61
	16	F	2.25	1.87	2.07	2.00	1.50	1.79	1.25	.87	1.07	.75	.12	.52	2	1	.	4	3	2	75
Melancholia........	67	M	2.62	1.12	2.23	2.50	1.00	1.90	1.62	.75	1.22	.75	.37	.55	9	15	5	7	10	1	65
	66	F	2.75	1.50	2.08	2.00	1.37	1.77	1.37	.87	1.06	.62	.25	.52	2	8	5	15	12	16	86
Paranoiacs.	63	M	2.50	1.87	2.17	2.12	1.50	1.94	1.50	1.00	1.25	.87	.18	.58	14	12	.	10	18	5	71
	24	F	2.50	1.87	2.13	2.00	1.50	1.77	1.75	.87	1.11	.75	.37	.50	1	3	2	10	7	4	87
Epileptics..........	40	M	2.50	2.00	2.24	2.12	1.37	1.87	1.87	1.12	1.26	.75	.37	.54	6	9	3	3	5	3	72
	15	F	2.25	1.87	2.07	2.00	1.75	1.79	1.12	.87	1.03	.75	.37	.54	1	3	.	5	3	.	80
General Paresis.....	19	M	2.50	2.00	2.22	2.12	1.50	1.91	1.87	1.00	1.26	.62	.37	.52	3	4	2	2	1	2	73
	1	F	...	...	...	...	...	...	...	...	...	...	...	...	1	.	.	.	.	.	..
Alcoholic Insanity..	9	M	2.50	2.12	2.30	2.00	1.75	1.94	1.37	1.00	1.26	.75	.25	.52	1	1	.	.	.	2	44
	..	F	...	...	...	...	...	...	...	...	...	...	...	..	.	.	.	.	.	.	..
Puerperal Insanity..	..	M	...	...	...	...	...	...	...	...	...	...	...	...	.	.	.	.	.	.	..
	5	F	2.37	1.87	2.09	2.50	1.50	1.87	1.37	.75	1.09	.75	.25	.52	.	2	.	.	1	.	60
Idiocy.............	2	M	2.25	2.00	2.12	2.12	2.00	2.06	1.75	1.75	1.75	.62	.62	.62	1	.	.	.	.	.	50
	4	F	2.25	1.75	2.00	2.00	1.25	1.62	1.12	.75	.99	.75	.37	.50	1	1	.	1	.	.	75
Degenerative Insanity —adolescent, hys-terical, chronic, etc.	9	M	2.50	2.00	2.28	2.12	1.75	1.93	1.50	1.00	1.08	.75	.37	.56	.	2	1	.	3	.	67
	6	F	2.25	2.00	2.10	1.75	1.75	1.75	1.75	1.75	1.75	.62	.50	.52	1	1	.	1	2	.	83
*Terminal Dementia.	147	M	2.50	1.75	2.09	2.25	1.12	1.87	1.75	.87	1.19	1.00	.25	.54	18	18	7	15	21	14	61
	102	F	2.87	1.12	2.12	2.12	1.37	1.79	1.75	.75	1.11	1.00	.37	.52	7	25	2	23	17	11	83
Total..............	613		2.46	.63	2.09	2.10	1.51	1.85	1.54	.99	1.21	.74	.33	.53							

*Under "Terminal Dementia" are included all those cases of secondary insanity of long duration usually called dements, and chronic maniacs. They include necessarily a very large proportion of degenerative and hereditary cases, but their history being lacking, just how much cannot be stated. It is probably not under 60 per cent, and may exceed 75 per cent.

The high vault is not conspicuous among these patients. Some of the irregularities were due to local causes, and the others were among cases of congenitally insane patients, or those who had become insane early in life. Most of the 700 were chronic cases, in whom confused derangement had followed an uncured simple insanity, mania or melancholia; the types, which as has already been stated, are not necessarily or probably connected with stigmata of degeneracy in facial or bony deformities. In such the outlines of the skeleton are, as a rule, well established long before any abnormal condition of the brain had made its appearance. Such patients, in fact, make up the greater part of the inmates of public institutions. It is not there that a very large percentage of deformities is to be expected. They are in this country, especially in its central and western portions, very largely of foreign birth—normal individuals of the lower orders of society, and of only moderate intellectual power and resistance—who, under the strain of the struggle for existence in new and often unfavorable conditions, have broken down mentally. They are not necessarily degenerates, but are mediocrities unable to undergo what are to them extraordinary conditions. An examination of these individuals under their different headings, however, may show a considerable percentage of deformities. While many of these persons do not show stigmata of degeneracy as regards their jaws, marked deformity of the face, ears and head were noticed in those persons who did possess deformities of the jaws and teeth, showing that the brain was defective at birth.

CHAPTER XIV.

NEUROTICS.

A definition has already been given of the term "neurotic," and mention made of the differences of opinion in regard to its signification. The term neurosis is applied to a large class of nervous disorders without a well-defined characteristic anatomico-pathological basis; and the word "neurotic," therefore, implies general indefinite tendencies to nervous disorders in the constitution of the individual. In its widest sense, and when used as a noun implying individuals, it may also include those who are suffering from minor chronic nervous ailments, as well as those who, from heredity or otherwise, are particularly liable to disorders of the nervous system. In this sense, a neurotic is not necessarily a degenerate, and while he may show some abnormalities in his physical organization, they are not to be considered as always and essentially the stigmata of degeneracy. Thus, deformities of the bones are apparently as common among neurotics as among degenerates, and the same nervous defects of nutrition that give rise to them in one may produce them in the the other; but the evidences of a neurotic constitution do not imply any such general defects as would involve the perpetuation of the species, as in the case with degeneracy. What is deficient in one direction seems often to be compensated for in another, and even when this is not obviously the case, there seems to be a resiliency above the average. Neurotics are often long-lived, peculiarly resistant to certain acute and fatal diseases, and are frequently noticeably retentive of their youthful appearance, which is, to a certain extent, an evidence of their resistance to the wear and tear of life and advancing old age.

The fact of the neurotic tendency often induces the individual to take better care of himself, and the youthful appearance may be due largely to arrest of facial development at an early age, thus retaining the miniature character throughout life. Considering, therefore, this class of neurotics, which does not include those afflicted with the more serious nervous disorders, such as epilepsy, they may be looked upon as the victims of evolutionary processes that are constantly going on in the race and under civilized conditions. Neurotics are not met with to any extent among barbarous races, but are numerous in civilized communities, where the weak are preserved from early death, and then subjected to the struggle for existence under the complicated and artificial conditions of modern civilization. Neurotics are naturally imperfect individuals in some directions, but they are often superior in others. Their disordered nervous functions and hyperæsthesias are not necessarily indicative of any inferiority of general organization. They may simply imply a more rapid advance in some one direction in the development of the nervous system than can be readily accommodated to by the remainder. These defects themselves may in some cases be the advance guards in the progress of the development of the race. As the nervous system controls nutrition in all departments of the organism, we would naturally look for anomalies with erratic nervous functions in these individuals. In these neurotics we often find a defective development involving the bony and other structures. They have fine and delicate features, small jaws, and defective teeth. These are the results of general systemic modifications connected with the neurotic state. But, besides these, special nervous disorders directly affect the nutrition of the jaws, the most notable instances of this being the diseases called acromegaly and facial hemiatrophy, the one causing maxillary hypertrophy and the other not infrequently unilateral atrophy of the jaw. In this connection, also, may be mentioned the arthritic diathesis, which is one of the underlying conditions of many neurotic manifestations, and which is responsible for many acquired bony deformities, not infrequently involving the jaws to some extent.

Overdevelopment of the brain and nervous system, but especially of the higher brain centers, which is the tendency of modern life, is not invariably followed *pari passu* by a corresponding growth of the other bodily organs and functions, and their unequal reaction to the demands of the higher organ is the source of a large crop of neuroses. There is, in this way, a somewhat more remote, but still probable, mechanical cause for cranial deformities and nervous disturbances, in the increasing size of the infant brain, with consequent enlarged head at birth, and the not correspondingly developed female pelvis, rendering birth more difficult, thus increasing the chances of injury to the skull and contents, and laying the foundation for future disturbances. Ill-assorted marriages, as regards mental and physical characteristics, intermixture of races, and, more perhaps than any other cause, the excessive strains of both mind and body in the struggle for existence in the existing conditions of life, the tendency to urban residence, with a resultant artificial and unnatural condition of life, immorality and disease, all have a tendency to increase the number of neurotics and degenerates, which is only partially compensated for by the reduced tendency to intermarriage due to the migration and congregation of large masses of the population. There is liable to be less concentrated hereditary taint in proportion to the population than in quiet, long-settled rural districts, but there is a vastly greater proportion of acquired defects in the city population. It is in connection with neurotics that specialists find a rich field for their investigation of deformities of the jaws and teeth and other special diseases of the eye, ear, nose, throat and lungs. This class of individuals are most common among the better classes, although the negroes of America are fast developing neurotic and degenerate tendencies. The reason for this lies in the fact that when weak, sickly children are born among the nobility of Europe, or of well-to-do people of Europe or America, the family physician is frequently called, and the best of care is taken of them. They are removed from one climate to another, thus avoiding the extreme heat and cold and other deleterious influences. By this means the life of the individual is prolonged. In this way, so far as the physical organization is concerned, we have an example of the survival of the unfittest. These people, by change of climate, pass the critical point in youth and middle life, and frequently become our best business men and women, although the taint of disease is still lurking in the system, and is handed down from one generation to another. Of these individuals, many possess defective osseous and nervous systems, which are either inherited direct, or the neurotic or degenerate condition may be inherited, as the result of which arrest or excessive development of any of the tissues of the body may take place in the offspring. Thus, father or mother may possess a large or small face or nose, weak lungs, or abnormal brain development, or any of the conditions noted under the heads of nutritive, degeneracy and local reversion tendencies; or on the other hand, the child, by inheriting the neurotic condition in otherwise healthy parents, may develop any of these conditions at some period in his or her life. A few illustrations will not be out of place at this time, and will serve to impress more fully upon the mind of the reader the points which the author wishes to convey.

The cases most interesting and important are those of the development of the child. Neurotic and degenerate symptoms from a mental standpoint are noticed long before deformities of the osseous system are developed. They show themselves in the form of mental weakness, varying from idiocy to imbecility and extreme stupidity on the one hand, and precocity on the other. Under the first class, the child is obstinate, quarrelsome, malignant and even immorally inclined, and is often spoken of as being wicked or vicious. Dr. Harriet C. B. Alexander* says the ruling instinct in the child of three or four is self-gratification, involved in which is a tendency to destroy what is disliked. Among the earliest manifestations of morbid mental activity in childhood are hallucinations which depend on already registered perceptions. In many instances even moral agencies produce sudden explosions of mental disorder. The inherited tendencies of childhood predisposes to these attacks. As Clouston has shown, neuroses and psychoses not requiring hospital treatment are by no means uncommon in the too sensi-

* The Medical Standard, April, 1893.

tive child with hereditary taint. Children of this class have crying fits and miserable periods on slight or no provocation. Clouston* also says precocity, over sensitiveness, unhealthy strictness in morals and religion for a child, a too vivid imagination, want of courage, thinness, and craving for animal food, are common characteristics. These children are over-sensitive, over-imaginative, are too fearful to be physiological, and tend, as a general thing, to be unhealthfully religious, precociously intellectual, and, at first, hyperæsthetically conscientious.

The other class of children, as a rule, are very handsome babies and children. Their brightness is noticed by the parents at a very early age, and they extol their many bright qualities and sayings. The tendency is for the parents to cultivate these precocious qualities, and believe it to be the proper thing to encourage them. While in early life they may possess the peculiarities of the other class, they also show those of degeneracy. These children are the best scholars in the schoolroom and learn their lessons with apparently little or no study. They are usually thin, frail children, and very nervous. Children of both classes are sure to show stigmata of degeneracy. This period of degeneracy commences at the sixth year, at or about the time the first period of brain development ceases. The bulk of the brain has obtained its growth. In some the cells begin to develop and the child commences to improve mentally very fast. In others mental development is slow. In still others it ceases altogether. From the time the second set of teeth begin to develop, until the twelfth year, neuroses of development and stigmata of degeneracy are stamped upon the head, face, nose, jaws and teeth, and later any of the conditions mentioned under the heads of nutritive degeneracy and local perversion tendencies may appear. In a class of sixty-four students, who graduated with the author, eleven were exceptionally brilliant; all were neurotics; most of them showed deformities of the head, face and jaws. The attention of the author was attracted to them because they always answered questions in the "quizzes"

* Mental Diseases.

promptly and fully, without hesitation or preparation. Only four of these men have made successful practitioners. The following cases are here mentioned to show the stigmata transmitted to the children.

NEUROTIC CASES.

CASE I.—Father, a retired coal merchant, shows marked stigmata of degeneracy, head hydrocephalic, left eye considerably higher than right, nose deflected to the left, face arrested at the alae of the nose, upper jaw small; is very close and mean in his dealings with others; is considered peculiar; he had attended personally to the building up of his fortune. Mother apparently normally developed. They have two daughters; both have inherited their father's head so far as size is concerned; the upper jaws are unlike. Both parents have hypertrophy of the alveolar process. The oldest daughter, sixteen years of age, is unusually bright in school, while the youngest girl, twelve years of age, is an imbecile.

CASE II.—Father, an exceptionally bright man, well-to-do, has no business except the care of his property; spends most of his time doing missionary work; is of a nervous temperament; at one time became partially insane upon the subject of religion. Mother very bright, but not healthy; has had three children; oldest, a daughter, died at the age of eighteen, of tuberculosis; of the other daughters, one sixteen, the other twelve years of age; the one aged sixteen has no ambition to do anything, while the youngest has inherited a nervous temperament, is very bright at school, and a fine pianist. All the children possessed deformities of the jaws, face and teeth; the two youngest are mouth-breathers.

CASE III.—Father, a very prominent lawyer, had made a great deal of money in his profession, and at one time was very wealthy, but being an indulgent man he allowed his family all the luxuries of life, consequently his three children became spendthrifts, and he died at the age of sixty-eight a poor man. The mother was a very fine woman, but with little education or force of character. The oldest, a son, an epileptic; the two youngest, daughters; both were married, but their husbands left them; they were prostitutes before marriage, and have been going down hill ever since; the youngest has become insane from the use of morphine and cocaine, and is now in the asylum. All inherited the upper jaw of the father, which was arrested in its development with a partial V-shaped arch.

Case IV.—Father, a minister, of Scotch descent. As a preacher is a success, has a full congregation at every service. As a business man has no ability, and does not seem to know right from wrong. In dealing with people, he does not seem to know the first principles of honesty; it is difficult for him to speak the truth; indeed, he forgets all about previous obligations, and if it is for his interest to state a falsehood, he does not hesitate to do so. The mother is an exceptionally bright woman; for five years used to write her husband's sermons. The minister has two sisters; one the author has never seen; the other is even more untruthful than the brother. There are five children, three boys and two girls; three of the children have myopia; two have arrest of development of the bones of the face; two, arrest of development of the superior maxillary bones, with partial V-shaped arches, one has inherited the family trait of being very untruthful. The jaws of father and mother are normal. The neurotic condition of the children in this case inherited the defective brain which presided over and developed a defective osseous system.

Two other similar cases—one a physician, the other a tradesman—have come to the notice of the author in which the children have not only inherited a neurotic constitution, resulting in stigmata of degeneracy, but have also inherited the art of lying. This inherited trait, or art of untruthfulness, is not unlike kleptomania.

Case V.—That children may inherit a neurotic temperament without apparent cause, is nicely illustrated in the following case: Father, forty-six years of age; mother forty-two years; both perfectly healthy, with the exception that the father has had sick headache more or less all his life; otherwise neither has been sick a day. Stigmata not noticed in either case. There are two children, one a daughter, sixteen years of age, and a son, nine years of age. The daughter has, and will retain a youthful face; has arrest of the upper jaw and a V-shaped arch; is unusually bright at school. The son has arrest of development of the bones of the face; the teeth are backward in their development, and therefore are not far enough advanced to indicate what the shape of the arch will be. Both of these children have had scarlet fever, and the boy has had a bad attack of pneumonia. It is quite possible, and I think probable, that the neurosis, with the stigmata, is the result of these constitutional diseases. Both children are apparently healthy and well.

CHAPTER XV.

GENIUS.

Every city the world over has its brilliant men and women journalists, editors, singers, artists. Critical examination by a physician would reveal in them a large majority of neurotics, and many of the most successful business men would undoubtedly be classed under the same head. Similar classification in skilled mechanics would produce like results. In all the face, jaws and teeth would bear the stigmata of degeneracy. To clearly comprehend the bearing of these observations, definition of the term genius, used as a subject for this chapter, becomes necessary.

Huxley says: "Genius is innate capacity of any kind above the average mental level"; or, a genius is one who is endowed with excessive mental development in some one direction. Much has been written on genius as a neurosis or evidence of degeneracy. If genius be capacity for work and power of concentrated attention, such as has characterized many of the world's greatest men, then it certainly cannot be considered a morbid phenomenon, as these are proper attributes of perfect mental and physical organization. The average normal individuals, and indeed, the great mass of mankind fall very short of perfection in these respects, and the few who approach it are from their achievements popularly classed among the geniuses of the age. The world occasionally sees an encyclopedic genius, with capacities developed in many directions. Admirable Crichtons, however, are so rare as to be merely the exceptions to the rule, which proves its validity, that great men are irregularly developed, and that the more brilliantly light is focused on one point the more apparent the contrast with the surrounding obscurity. The defects of these individuals are therefore the more prominent. It does not follow, however, that they are naturally imperfect or degenerate individuals; they simply illustrate the limitations of the human mind, its inability to concentrate activities except in a narrow sphere. Long continued devotion to one line of study may destroy or impair normal capacity in other lines. Charles Darwin complained that such was the case with himself; that in his later years he had become a mere machine for making generalizations upon data of natural science.

So much for what may be called normal geniuses, who comprise the vast majority, to say the least, of those who have done epoch-making work in the world's progress.

There is another class to whom the world attributes genius, and in many cases justly, who are irregularly developed from the beginning, and are hence unbalanced and imperfect individuals. These show precocious aptitude in certain directions, and astonish the world at once with their brilliance and their erratic performances. These have often a heredity of talent, but equally often a heredity of taint. The old adage that "great wit and madness are allied" seems to be verified often in their histories. Inborn talent in one direction makes an irregularly developed individual. If the mind in all other directions be up to the average, this talent tends to dwarf the other faculties by contrast, and often absolutely; the abnormally developed faculties apparently absorbing so much of nervous force that in the other directions the physical being is defective. A law of compensation seemingly exists in the make-up of many individuals—a talent in one direction is balanced by deficiency in another. In its extreme this is obvious in the "idiot savants," the "blind Toms," the precocious mathematicians, etc.

When the psychic hypertrophy takes a direction involving the emotional faculties, as in the case of musicians, artists and poets, some striking moral deficiency is often evident, one of the directions in which failure might naturally be expected to occur. This latter class of geniuses, possibly the most numerous to which the term is popularly applied, are, to a certain extent, examples of degeneracy, and if the term genius were limited to these it might be called a neurosis. This class of individuals is not limited to any one profession or trade, but is found in all the walks of life. Any man who is above the average in his line of business may be justifiably termed a genius.

Men of genius, as a rule, are deficient both as to mental capacity and physically. Nisbet* says that genius, insanity, idiocy, scrofula, rickets, gout, consumption, and other members of the neuropathic family of disorders, are but so many different expressions of a common evil—an instability or want of equilibrium in the nervous system. From a mental standpoint men of genius suffer from epileptic mentality, melancholy, alcoholism, hallucinations and apathy, absence of moral sense, impulsive tendencies, doubting tendencies, verbosity or excessive taciturnity, imbecile vanity, excessive egotism. Physically they present stigmata like pointed ears, excessive facial and head asymmetry, irregularities of the jaws and teeth, left-handedness and arrest of development of the whole body. A few illustrations would not be out of place at this time.

A lady of fifty-four comes from an old Massachussets family; has four sisters insane. She is an author of three books, and writes for magazines and journals; she is very bright. Some of her family have died insane and others were drunkards. She had taken up writing in order that she might have an active brain, thus preventing her going insane like her sisters, as she expressed it. She has arrest of development of the superior maxilla. Her three sons are all very bright; one has tuberculosis; the other two are small for their age. All possess arrest of development of the jaw, with facial and cranial deformities.

A forty-two-year-old journal editor, who is one of the most brilliant writers and talkers I have had the pleasure of meeting, quick-witted and very popular, one day he is in the best of spirits and the next has the blues so badly that his mood is felt by all with whom he associates. He has marked asymmetry of the face, arrest of development of the upper jaw and slight protrusion of the lower jaw.

Another editor, forty-eight years of age, is also very bright, very nervous, has strabismus, very large head, walks

* Insanity of genius.

unsteady and a little to the side; has a marked V-shaped jaw, with arrest of development.

The president of one of the largest railroads in the country is unusually smart as a business man; he has arrest of development of the upper jaw, with V-shaped arch and a saddle arch upon the lower jaw; marked asymmetry of the head and face.

An expert machinist was given the most difficult work to perform in the shop; his ability was such that in one instance, he could take in the most difficult situations and bring them out successfully; he was quite an inventor, and had improved many of the machines used in the shop; his greatest fault was that he was a periodical drunkard, and frequently, when needed the most would be away drinking. Later years, when he was given difficult pieces of work to perform and where brain work was required, it would seem to unbalance him; he would take liquor to brace him up, the result of which was that often before he was fairly under way with his work he would be lying drunk under his bench. He was irregularly built—the lower jaw was very small, the upper arrested, with V-shaped arch; asymmetry of the face, with very large, protruding forehead. A few years ago an expert mechanic could rarely be found in any department who could be depended upon. Most of them were very unsteady and periodical drunkards.

The causes which underlie the development of genius are as interesting as the study of the character itself. Indeed, I know of no more interesting study than that of tracing the history of great men from great-grandparents to great-grandchildren. In every instance disease, as suggested by Nisbet (quoted in the beginning of this chapter), is found associated. Neuroses and degeneracy crop out in some form in each generation, even more than in the average families that produce only mediocrities. The inheritance of genius seems to be perilous to the mental, moral and physical constitution, and these individuals who are most envied, are often only the most unfortunate.

In one hundred cases of editors, authors, newspaper men, professional men and expert mechanics, the following results were obtained:

Width outside first molar,	2.15
Width outside first bicuspid,	1.62
Width between second bicuspid,	1.05
Height of vault,	.51

DEFORMITIES OF THE JAW.

V-shape,	12
Partial V,	20
Semi-V,	6
Saddle,	21
Partial saddle,	12
Semi-saddle,	14
Marked deformities of the face,	32

CHAPTER XVI.

IDIOCY.

Dr. W. W. Ireland has defined idiocy as "mental deficiency or extreme stupidity depending upon malnutrition or disease of the nerve centers, occurring before birth or before the evolution of the mental faculties in childhood." A definition that seems more inclusive, and that more clearly describes the tissues of the body, is the one given by Dr. Shuttleworth: "A vice of the entire organism; an affection not only of the nervous system, but of the functions generally of organic life." Not a tissue of the body is exempt; the phenomena that check development of the brain-tissues will also interfere with proper development of the other tissues of the body.

No part of the body has received the impress of disease so markedly as the osseous system, and yet, pathologists have given this part of the idiotic system but little attention. This osseous system seems to have been constructed regardless of symmetry or uniformity. While in the normal individual the lateral halves are never uniform, in the feeble-minded the greatest symmetry prevails. This want of harmony is more apparent in the maxillary bones because of their peculiar formation and environment. The close proximity of the jaws, and their articulation, permit of irregularities being readily observed. At the beginning of my examinations I observed that other deformities than the V and saddle-shaped existed, all of which must be considered. I found both excessive and arrested development of the maxillary bones; arrest of the one, and excessive development of the other; protrusion of the upper or lower jaw; high or low vault; partial V and partial saddle-shapped arches; semi-V and semi-saddle-shaped arches; semi-V and semi-saddle-shaped on the same side, and small teeth.

Of late years some American investigators have made examinations among the inmates of our institutions for idiots, and reported that they found about the same proportion of irregularities as may be seen in ordinary practice.

I believe myself warranted in the assertion that a much larger percentage of deformities of the teeth and jaws exists among a given number of imbeciles, deaf and dumb and blind than in the same number of normal individuals, the various conditions being the result either of arrested development or excessive growth.

It is obvious that any condition of malnutrition, particularly if existing during the period of embryonal and infantile growth and development, which is sufficiently marked to cause perversion of growth in the complex nervous centers, must necessarily affect the tissues in general. Nerve-tissues have relatively greater vitality than the other tissues of the body, and every physician knows that the brain and spinal cord will often perform their functions after the other structures of the body have been seriously impaired by disease.

The varying opinions among scientific men, on either side of the Atlantic, led me to investigate the subject carefully. The examinations were made by myself and by able dentists in the following named institutions:

Asylum for Idiots of the State of New York, at Syracuse; Massachusetts School for Feeble-minded, at South Boston; Illinois Asylum for Feeble-minded Children, at Lincoln; Asylum for Idiots, Randall's Island, N. Y.; Minnesota Training-school for Idiots and Imbeciles, Faribault; Kansas State Asylum for Idiots and Imbeciles, South Winfield; Cook County Insane Asylum, Dunning, Ill.; Pennsylvania Institution for Feeble-minded Children, at Elwyn.

(Special reports may be found in the Transactions of the International Medical Congress, 1877, and in the Annual, 1888.)

The following tables show the total number of irregularities in each grade and sex:

TOTAL DEFORMITIES IN THE JAWS.*

No.	..	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
1977	..	1095	152	92	159	318	129	236	207	71
Per cent...		55.3	7.6	4.6	7.9	16.	6.5	11.9	10.4	3.5

Out of 129 congenital cases, or those who were known to have become idiotic before the sixth year, 87 per cent possessed marked deformities of the face and jaws.

The above table shows that almost one-half of the whole number examined had irregularities of the jaws and teeth. The children examined were over twelve years of age. Under that age irregularities might be considered as of local origin, while constitutional and developmental irregularities do not appear until the eruption of the incisors and first permanent molars. As would be expected, the largest percentage of irregularities is found in the low-grade class; and it is seen that the normal classes in the high and middle grades vary only about 12 per cent; the middle grade showing the largest percentage of normal jaws and teeth, the high grade the next, and the low grade the fewest number of normal cases.

The mental capacity of the idiot can indicate in a general way only the abnormal condition of the osseous as well as muscular, venous and arterial systems of the individual; thus, a high-grade idiot might possess an atrophied condition of any of the tissues of the body, while a low-grade idiot might develop any or all of the tissues to an excessive degree, this depending, of course, upon the inclination and condition of the blood-supply. Thus the arterial and nervous systems might be atrophied on one side, lessening the supply of blood to that side or limb, and producing atrophy of the muscular and osseous tissues on that side. The opposite effect might be produced on the other side; a large amount of blood would

* All tables show irregularities that are the result of small jaws.

be carried naturally to the extremities of the other side, causing hypertrophy of tissue.

If these tissues of the body are so prone to take on abnormal conditions, certainly the jaws must suffer more or less. I have observed three conditions that account for nearly all the irregularities of the jaws and teeth: excessive development, arrest of development, and inharmonious development of the maxillary bones. These abnormalities are developed with the osseous system, and may be properly termed constitutional, or developmental.

When excessive development occurs in one jaw, and the other is normal, or arrested development ensues, then the teeth in the abnormally large jaw protrude.

If the cranium is large, the superior maxilla is usually larger than normal. When the inferior maxilla is involved, the rami are as likely to be enlarged as the body of the bone. Sometimes the rami and the body develop uniformly. When there is excessive development of a part or all of the bone, protrusion of the lower jaw and teeth takes place. I have seen cases in which one-half of the superior and inferior maxillæ, as well as one-half of the cranium, was larger than the other. In these irregularities of the jaws, however, irregularities of each set of teeth are seldom seen. While it is proper to speak of these conditions as irregularities, yet they are so only as one jaw is related to the other.

I have already shown, in a paper read before the Dental Section of the American Medical Association in 1888, that irregularities of the teeth, which I have termed constitutional, prevail to a greater extent among the idiotic, deaf and dumb, and blind, than among an equal number of strong and well-developed persons; that not only is the brain-matter deficient in the feeble-minded, but that many cases are seen which show that the osseous system is generally defective; and that when the bone-tissue is arrested in development from malnutrition, the maxillary bones are affected.

It is frequently the case that when idiocy appears in a family, other members of the family are observed to be scrofulous, deaf, dumb, blind, or insane, showing that the conditions indicating neurotic tendencies have been transmitted through generations.

In his work on "Insanity in Norway," Ludwig Dahl gives many instances in which the result of this tendency is deafness, dumbness, or insanity, as often as idiocy. He says: "Acquired insanity and idiocy frequently appear side by side in the same family stock. Deaf-dumbness occurs frequently." He has traced the genealogies of a number of families, and has brought to light a number of interesting facts. In his genealogy of No. 3, the Ejvinds family have nine insane or idiotic, four deaf and dumb, and one epileptic. Other families showed a similar proportion of mentally and physically deformed persons.*

In his work on "Idiocy and Imbecility," p. 528, Dr. Ireland says: "Deafness frequently occurs in families where some of the other members are idiots." And again on page 16: "The children of epileptics are frequently insane or idiotic or hysterical, and the descendants of an insane person are often epileptic, idiotic, or insane. Deaf-dumbness, chorea, locomotor ataxia, hysteria, and other disorders of the nervous system now and then occur in the descendants, apparently as the result of an inherent neurotic tendency in the family."

In the report of the Commissioner on Idiocy appointed by the Legislature of Connecticut (see Report of Commissioners on Idiocy to the General Assembly of Connecticut, New Haven, 1856, p. 35), it was found that out of seventy cases of idiocy there were ten cases of idiotic parents, six insane persons, six insane relatives, eight epileptic parents or relatives, eight blind and two melancholic.

Dr. Howe shows ("On the Causes of Idiocy," Edinburgh, 1858, p. 35) that in seventeen families in Massachusetts the heads of which were blood-relations, there were born ninety-five children, of which forty-four were idiotic, twelve scrofulous and puny, one deaf, and one a dwarf. Morel and the school of investigation which he founded point out that the defective classes—*i. e.*, the congenital deaf mute, blind, luna-

* Lombroso has called attention to deformities of the jaws among the born criminals.

tic, idiotic, criminals, and paupers—are buds on the same tree of human degeneracy. In dealing with the evidences of degeneracy they cite defective teeth as one of the signs in most instances. These signs are atavism or reversion to lower types of structure and function. Many more cases could be given showing that a relation exists between the deaf, dumb, blind, and insane, but it is evident that the offspring of parents showing neurotic tendencies and symptoms are subject to these conditions. Medical men have commonly classified these lesions under the same head, and some specialists go so far as to classify the criminal and drunkard in this category. I have recently read an article from a French journal in which a left-handed person was also included.

While specialists have generally concluded that most of these conditions are derived from a common neurotic ancestry, the only common feature is a very low grade of cerebral development. In my investigations, concerning the osseous system in its relations to the irregularities of the jaws and teeth, I have observed a lesion common to all these conditions. With this object in view I have made examination of the mouths of all these classes including the criminal—which has been discussed in a previous chapter. I found great difficulty in enlisting sufficient interest on the part of superintendents of blind asylums to enable me to make proper examinations of the blind, their reason being that the sensitive nature of the patients would not permit of their exhibiting the mouth for examination. I have conducted a sufficient number of examinations, however, to make some estimate of the percentage of deformities of the jaws and teeth.

Dr. A. Wilmarth, of the Pennsylvania Institution for Feeble-minded Children, says: "In six brains, the island of Reil was exposed through the defective development of the third frontal convolution; in four cases on two sides, in two on one side only. In eighteen brains six were found where the cerebrum failed to cover the cerebellum by from one-eighth to five-eighths of an inch."

I could quote indefinitely from eminent authorities at home and abroad to show that not only are the different structures of the brain of the average idiot atrophied and often entirely wanting, but that diminution of weight is the rule. Enough cases have been cited to give a general idea of the defects in anatomical structure.

Having determined the constant relation of defective cerebral development to idiocy, it remains to be proven whether the defective condition is a special one affecting the brain only, or is an integral part of the generally defective or maldevelopment, or at least of a general tendency toward such perversions of growth. When we take into consideration the fact that the fœtus is developed in two lateral halves, which may or may not develop harmoniously, and may or may not fuse together properly, it becomes logical to presume that any influence which tends to produce inharmony and asymmetry of growth in one part of the body—*e.g.*, the brain—must necessarily tend to produce the same conditions in other portions of the fœtal halves, providing such influence is not a purely local one. The causes of idiocy not being local, but general, the inference is obvious. It is astonishing to me that the superintendents of institutions for the feeble-minded have made so little note of the asymmetrical relations of the two lateral halves of the body, in the cases under their care. Personally, I am of the opinion that harmony of members does not generally prevail in the anatomy of the idiot. In examining the inmates of various institutions, I was struck with the numerous examples of arrested development, hypertrophy and asymmetry of upper and lower extremities. These abnormal conditions accord with the types of cerebral maldevelopment already cited.

In a paper, by Dr. G. E. Shuttleworth, England, presented before the International Health Exhibition, London, August 2, 1844, upon "The Health and Physical Development of Idiots as Compared with Mentally Sound Children of the same Age," he says: "Many idiots are undoubtedly small at birth; not a few have been brought into the world prematurely, but in nearly all imperfections of functions interfere with due nutrition and development, as the following table will demonstrate:

TABLE SHOWING THE RELATIVE MEAN STATURE AND WEIGHT

Of the General Population, and of Twelve Hundred and Nine Idiots and Imbeciles in Earlswood, Royal Albert, and Larbert Asylums.

Age last Birthday.	HEIGHT.				WEIGHT.			
	GENERAL POPULATION.		IDIOTS AND IMBECILES.		GENERAL POPULATION.		IDIOTS AND IMBECILES.	
	M	F	M	F	M	F	M	F
	In.	In.	In.	In.	Lbs.	Lbs.	Lbs.	Lbs.
5	41.00	40.55	40.00	39.50	....	39.20	39.00	37.50
6	43.00	42.88	42.25	41.25	....	41.70	43.00	41.00
7	45.00	44.45	44.00	43.25	....	47.50	46.50	45.00
8	47.00	46.60	45.75	45.25	55.00	52.10	50.50	49.00
9	49.00	48.73	47.50	47.50	60.00	55.50	55.50	53.00
10	51.00	51.05	49.00	49.00	65.00	62.90	59.00	59.00
11	53.00	53.10	51.00	51.00	70.00	68.10	64.50	66.00
12	55.00	55.66	52.50	53.00	77.50	76.40	70.50	72.00
13	57.50	57.77	54.75	55.00	85.00	87.20	77.00	80.00
14	60.00	59.80	56.50	56.50	92.50	96.70	85.50	88.00
15	62.20	60.93	59.25	58.00	102.50	106.30	94.50	95.00
16	64.00	61.75	60.75	59.00	117.50	113.10	103.00	102.00
17	65.50	62.52	62.50	59.25	135.00	115.50	110.00	106.00
18	66.50	62.44	63.25	....	142.50	121.10	116.00	108.00
19	67.00	62.75	63.25	....	143.70	123.80	120.50	108.50
20	67.25	62.98	64.00	59.50	145.00	123.40	121.50	108.50
21	67.50	63.03	64.25	....	146.20	121.80	122.00	.....
22	....	62.87	64.50	....	147.50	123.40	122.50	.....
23	....	63.01	....	....	148.70	124.10	.....	.....
24	....	62.70	....	....	150.00	120.80	.....	.....
25–30	67.75	62.02	64.75	59.75	151.20	120.00	123.00	109.00
30–40	....	....	....	....	152.50	120.80	.....	.....
40–50	....	61.15	....	....	155.00	118.60	.....	.....
50–60	68.00	....	....	....	157.50	104.00	.....	....

"It will be observed that idiots are shorter than the general population: at five years, by one inch; at ten years, by two inches; at fifteen years, by three inches; at twenty years, by three inches. While, as regards weight, male idiots are lighter than the general population—at eight years, by four and one-half pounds; at ten years, by six pounds; at fifteen years, by eight pounds; at twenty years by twenty-three and one-half pounds; the disparity being greater in the male than in the female sex. It appears that the relative rate of growth of the two sexes of idiot children follows the same rule as that of normal children, and is subject to the same variations at the age of puberty, for two years preceding which the growth of girls is in excess of that of boys."

ABNORMALLY-SHAPED HEADS.

If the mental capacity could, in all instances, be measured by the size and form of the head, many among the idiotic would rank high. The shape and size of the skull are indicative of the mind only in a general way, the feeble-minded being about equally divided between abnormally large and small heads. The measurement of the ordinary well-balanced head ranges from twenty to twenty-six inches in circumference, and that of the idiotic head from twelve to thirty-six inches. Opinions vary in regard to the average size of the microcephalic idiots, some claiming that all heads of sixteen inches and under come under this class, and others that thirteen inches in circumference is the average microcephalic head; while on the other hand all heads which measure more than twenty-six inches in circumference would be considered either macrocephalic or hydrocephalic.

The extreme cases are comparatively few in the institutions. Out of six hundred inmates of the Pennsylvania Institution at Elwyn, which I examined with the assistance of the superintendent, Dr. I. N. Kerlin, and Dr. Wilmarth, I found but twenty-eight microcephalic, twenty-four macrocephalic and three hydrocephalic cases. We shall find these extreme cases exceedingly interesting in the study of the etiology of irregularities of the teeth, and shall give special attention to their relations later. There is a certain size of the head below which an individual must be an idiot. Voisin says that "the proper exercise of the intellectual qualities is impossible with a head of from eleven to thirteen inches in circumference, and a measurement of eight to nine inches from the root of the nose to the posterior border of the occipital bone." Irregularities in the external surface of the cranium predominate in every idiotic head, and in such variety that no two heads are found alike. These conditions show a want of development of the brain. The brain substance being the first to obtain its growth, the cranial bones are molded about it, and are, in a manner, supported by it until the sutures have united. If the brain be slow in developing and shaping, ossification of the sutures is retarded; should the brain, or parts of it, be retarded in growth, the cranium would be either microcephalic or asymmetrical in its development. Again, inharmonious closure of sutures may also produce unilateral contractions of the bones of the head. I do not wish to convey the idea, however, that asymmetry in the cranium is always the result of malformation of brain-tissue, as a certain number of cases may result from arrested development or interruption in the growth of bone tissue. *Per contra*, I am well aware that perfectly symmetrical heads are rare in even normal individuals. The diagrams in possession of our hatters tell a woful tale, not at all flattering to our racial self-conceit. This retarded growth may result from constitutional disturbances acting unfavorably upon general nutrition, or from inflammatory conditions of the osteophytic membrane, which may take place in utero, thus prematurely closing the sutures. There is no law governing the development of the brain and the closing of the cranial sutures. Those bones, the sutures of which close before the proper time, will be narrowed at the point of premature fusion. It is reasonable to expect that when bones prematurely ossify at one part of the cranium, dilatation will take place directly opposite, as the brain grows in the direction of the least resistance. This explains many peculiar deformities of the head. Again, if the majority of the sutures ossify prematurely, microcephalus may result. It appears reasonable, also, to infer that the shape of the basis cranii will be affected in a similar manner by too early or too late ossification. These changes are caused by improper nutrition of the bones and cartilage. A knowledge of this fact gives us a clear conception of the relation which various general conditions bear to idiocy and imperfect development in general. The influences of such perversions of nutrition as are produced by syphilis, tuberculosis, struma and intemperance over the ossification and growth of bone is a most patent one. The same influences which cause the shape of the base of the skull, and the contour of the face, do not depend very largely upon the ossification of the sutures. When ossification of the cartilages occurs early, a shortening of the basis cranii may result. Especially is this the case when premature ossification occurs in connection with the sphenoid bone. The age when the basilar portion ossifies in a normal subject is from fifteen to twenty years. Early ossification naturally produces a shortening in the antero-posterior direction, and also serious deformities in the shape of the face, and an abnormal curvature at the base of the brain. The superior maxillary bones are attached to the bones of the head and face by eight articulations, and as the ossification of the sutures occurs at about the same time as the ossification of the sutures of the basis cranii, the same influences which affect the cranium must also affect the superior maxilla. These conditions may account for family features not presenting themselves until middle age. This is a strong argument in favor of postponing the operation of regulating teeth until the contour of the face has been permanently established. When there is inflammation of the membrane *in utero* (which is of common occurrence), the sutures ossify before or soon after birth, and as a result the base of the cranium will assume and remain in an undeveloped condition, causing the face to present an abnormal shape and size, which will broaden the face, throw the cheek bones out prominently, make the nose broad, and flat, and sunken, and extend the space between the eyes, giving as a whole a face void of expression. When the sutures at the base of the skull ossify normally the antero-posterior diameter is longer, the base of the cranium is more angular, the features sharper, with the eyes closely set, and a face full of expression. The sphenoid bone does not attain its full size until from the twenty-fifth to the thirtieth year of age.

I am of the opinion that, when the bones at the basis cranii ossify before or shortly after birth, the superior maxilla and septum nasi assume a decidedly unnatural form.

Dr. Oakley Coles, in his work upon "Deformities of the Mouth," ascribes the different deformities of the jaw to premature ossification either of the sutures or the basis cranii.

Thus he says that "the deformity known as inter-maxillary prognathism is the result of a force operating on the inter-maxillary bone, such force originating in the body of the sphenoid, and being transmitted by the intervening nasal septum." He says also, page 93: "After carefully examining the works of various writers on the subject of microcephalic idiocy, there seems sufficient evidence to justify the belief that premature ossification of the sutures is the rule in a majority of cases of microcephalus, and we may therefore assume, if we cannot absolutely conclude, that this influence operates powerfully in the production of the dental deformity known as the lambdoid jaw" (or V-shaped arch).

While, as has already been observed, I believe that premature ossification of the sutures and basis cranii is followed by deformities of the jaw and septum nasi, I do not think that they bear to each other the relation of cause and effect. In this I beg leave to differ with Dr. Coles. It is unnecessary to expatiate upon this subject here, as it will be the principal topic for discussion in another chapter.

We have considered above the morbid influences of various disorders in producing a vicious condition of the entire system called idiocy. It would be erroneous, however, to conclude that this is the sole effect of these disorders, nor are excessive and arrested development limited to the crania of idiots, but they may be found in any portion of the osseous system, as appears from perusing the literature referred to below.

BIBLIOGRAPHY.

1. Hutchinson, J. "Arrested Development of the Radius. Fore-arm and Hand." Tr. Path. Soc. London, 1865–6, xvii. 223, 226.

2. Leroy. "Arrêt de Développement de l'Avant-bras Gauche." Revue Photog. des Hôp. de Paris, 1871, iii. 80–82.

3. Rodenstein. "Case of Arrested Development of both Upper Extremities." Am. J. Obst., N. Y., 1876, viii. 603–663.

4. Shattuck. "Case of Arrested Development and Growth of the Right Upper Limb of Man." Tr. Path. Soc. Lond., 1881, xxxii. 276–280.

5. Cayley, W. "Arrested Development of Fore-arm and Hand." Tr. Ibid., 1865–6, xvii. 430.

6. Chipperfield, W. N. "Curious Arrest of Development of the Hand." Madras Monthly J. M. Soc., 1873, vii. 409, pl.

7. Doran, A. "A Case of Arrested Development of the Bones of both Fore-arms; Extreme Senile Changes in the Osseous Tissues." Tr. Path. Soc. Lond., 1876, xxvii. 314, 316.

8. Dreyfous, F. "Arrêt de Développement du Membre Supérieur." Progrès Méd., 1878, vi. 483.

9. Foucher. "Excessive Development of Left Arm and Leg." Bull. Soc. Anat. de Paris, 1850, xxx. 98, 108.

10. Hill, A. "Case of Arrested Development in the Right Fore-arm of..." Brit.-Am. J. M. and Phys. Soc., Montreal, 1849, v. 119.

CHAPTER XVII.

NUTRITIVE, DEGENERATIVE, SPINAL AND LOCAL REVERSIONAL TENDENCIES.

While the conditions mentioned concern the present work but remotely, they should not be lost sight of, since they are the outcome of neuroses and degeneracy, and may be associated with stigmata of degeneracy involving the osseous system. Most of them are allied, and have been mentioned throughout this work; thus lymphoid degeneracy predisposing to phthisis and scrofula, tissue instability predisposing to excessive and arrested development of tissue have been frequently mentioned.

Allied conditions, that have come to the notice of the author, may be mentioned here. A young man with a deformed upper jaw and face, like Fig. 56, was married to a young lady with a deformed lower jaw, like Fig. 59. Both were neurotics and degenerates. At the end of two years twin girls were born. Another example: Father died at sixty-two years of cancer; mother still living at seventy-four years. Oldest child, peculiar; second, epileptic; third and fourth twins; in all, deformities of the head, face, jaws and teeth are present; all are boys.

A young man, successful in business, was under my care while in Chicago. After removal of the tartar from the teeth profuse hemorrhage of the gums occurred. After six days the hemorrhage was controlled with great difficulty. He was confined to the house all the time. In the meantime I learned from his family physician that he had had two profuse hemorrhages, presumably from the bladder. Two years after his experience with me his physician sent him to California; tuberculosis had set in and it was the only means of saving his life. He possessed a very marked V-shaped arch, with arrest of development of the bones of the face.

A sixteen-year-old girl, of marked neurotic temperament, delicate but handsome features, bright, and an excellent scholar, was taken ill, and is now being treated in a sanitarium. Her uterus is undeveloped; she has never menstruated, and is in a precarious condition; jaws small, with V-shaped arch.

Two very interesting cases of ameliac and polymeliac conditions have come to my notice. A gentleman, thirty-eight years of age, once in business in Chicago, possessed a face arrested in its development, having the appearance of a boy ten years of age; jaws small, with slight protrusion of the lower; he was minus arms; the hands were developed full size near the shoulders. The second case was that of a member of a family of the nobility of Spain. The stamp of degeneracy was noticeable throughout his entire body. He was short in stature, with an excessively developed brain; the upper part of his head was very long compared with the lower. He holds a very responsible government position. The jaws were undeveloped, with V-shaped arch; the left hand was located near the elbow.

A thirteen-year-old boy, of Irish descent, with high vault, V-shaped dental arch, arrest of superior maxillary bones; supernumerary little fingers upon left hand.

A young man, twenty-six years of age, of German parentage; was born with club-feet. Father died of consumption; mother still living. This young man is an organist; plays in church on Sundays and gives music lessons during the week. He is a marked degenerate. The skin is thick, coarse and dry, giving him a very old appearance on account of its shriveled condition. Ears undeveloped; eyes small and sunken; excessive development of the cheek-bones; hair coarse and stiff; face arrested, and he possesses a partial V-shaped arch. Width outside first molar, 2; outside second bicuspid, 1.75; width of vault, 1.60; height of vault, 58. One of the prominent features of degeneracy noticed in this case is the lack of hair upon the face. It has been the experience of the author that in nearly every case of club-feet, stigmata of degeneracy is stamped upon the head, face, jaws and teeth.

CHAPTER XVIII.

CONSANGUINITY OF PARENTS.

The effect of consanguinity of parents on the physical and mental development of their offspring is that of the concentration and reinforcement of hereditary tendencies. If the heredity is altogether good and no incompatible elements are introduced by either parent, occasional marriages of near relatives would not be productive of evil, and even good might result from the intensification of desirable qualities, as we see it, to occur in the close breeding of fine stock. Huth, the author of an elaborate work on "The Marriage of Near Kin," concludes that the mere fact of consanguinity of parents, irrespective of inheritance, in no way contra-indicates marriage. There are also some examples of isolated communities of a perfectly healthy stock; for example, the Pitcairn Islanders, referred to by Dr. Manning,* among whom idiocy, insanity and other similar degeneracies are absolutely wanting, notwithstanding constantly occurring intermarriage of nearly related individuals. These people live, it is true, under very simple and natural conditions, quite different from those of the densely populated countries or the centers of civilization. It is exceedingly doubtful, however, whether the vitality of a race is normally maintained under close breeding, in limited localities especially, even though physical signs of degeneracy are absent. Local intermarriages outside of all relationships, if followed up and practiced too continually, seem to have an unfavorable effect, as has been noticed in various communities. There seems to be a general law, or, at least, there is some reason to believe there is one, applying to nearly all forms of animal and vegetable life, that changes of soil and seed are beneficial.

There are localities in Europe where intermarriages pro-

* Australia Medical Gazette, 1885.

duce constantly individuals defective in constitution, mind, and limbs.*

The incestuous practice of marrying within the near propinquity had long existed in Spain, with its normal consequences,—dwarfing of the body, and mental degeneration.†

Writers on lunacy attribute lunacy, or innate idiocy, so frequent among Scotch families, to the old national practice of never marrying out of their clan.‡ The most degraded people in Portugal marry within themselves, and each generation is more degraded, which is also true in other countries of Europe.

In a county in South Carolina where the different families intermarried for many generations, the proportion of idiots and deformed is unprecedented.§ Mr. Tylor‖ has shown that among widely different races in the most distant quarters of the world marriages between relations—even between distant relations—have been strictly forbidden. He is inclined to attribute this to the evil effects of consanguineous marriages having been observed¶

Interbreeding among animals is much closer than with the human race. All breeders have testified to the deterioration which arises when too close breeding is carried out among animals.

Consanguinity in itself counts for nothing, but acts from related organisms having like constitutions, and being exposed in most cases to similar conditions. Many physiologists attribute the evil exclusively to the combination and consequent increase of morbid tendencies common to both parents; and that this is an active source of mischief there can be no doubt.

The short-horn cattle offer the most striking case of close interbreeding. A high authority ** asserts that many more calves are born cripples from short-horns than from other and

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* Smith.
† Sir W. Scott, "History of Napoleon Bonaparte."
‡ Percy Hunter.
§ Nott and Gliddon.
‖ "Early History of Man."
¶ Darwin.
** Mr. Wright, *Journal of Royal Agricult. Soc.*

less closely interbred races of cattle.* Even in an unenclosed country like Paraguay, where there cannot be such close interbreeding, there is an occasional introduction of animals from distant localities, to prevent degeneration in size and diminution of fertility.†

In regard to deer, as observed in the parks of England, Mr. Shirley concludes that in some parks, where there has been no introduction of fresh blood, the constant breeding in-and-in is sure to tell to the disadvantage of the whole herd.‡

The offspring of strong spaniels degenerate into weak and diminutive lap-dogs, when bred in-and-in. In the case of pigs, long-continued and close interbreeding does not affect the external form or merit of the young; but with many of them the general constitution and mental powers were seriously affected; in some cases idiots were produced.*

That consanguineous marriages have a very demoralizing effect upon posterity, is a well-known fact to all scientists and physicians. The results are very marked in the nobility of Europe. The mental wrecks as well as the physical condition of many of these royal heads are illustrations of intermarriage among near relatives. It is claimed by dentists that excessive or arrested development and irregularities of the teeth are more common among royalty than among the masses. It is very common to find children born of cousins and near relations in this country defective in body and limb. When the brain is involved, we have two factors which assist in producing excessive or arrested development of the jaws: First, direct inherited tendencies, such as a large or small jaw; and second, defective development due to neuroses. These deformities are very marked among the Hebrews, with whom intermarriages are very common. Thus, in the Hebrew Orphan Asylum, New York City, only seventy-four per cent of the inmates had normal jaws.§

Consanguineous marriages not infrequently result in men-

* Darwin.
† Azara, "Quadrupedes du Paraguay."
‡ Mr. Seebright.
§ Mr. Wright.

tal aberrations in the progeny. Dr. Howe states that in seventeen families, the heads of which were related by blood and intermarriage, the result was fearful. Most of the parents were intemperate or scrofulous, and some combined both evils; so that it must be admitted there were other causes besides consanguinity to increase the probability of infirm offspring. There were born in these families ninety-five children, of whom forty-four were idiots; twelve others were scrofulous and puny, one was deaf and one was a dwarf. In some of the families all the children were either idiotic or very scrofulous and puny. In one family of eight children five were idiotic. 'The commissioners of idiocy in Connecticut found in one hundred and sixty cases of idiocy, twenty which apparently resulted from consanguineous marriages. Of these, twelve were children of first cousins, three of second cousins, one of third, and four of distant relations. Dr. Langdon Down found that out of seven hundred and fifty-three male idiots thirty-three were the offspring of first cousins, three cases of second cousins, and four of third cousins,—in all forty cases out of seven hundred and fifty-three, or rather more than five per cent. Of the two hundred and ninety-five females, thirteen were the children of first cousins, three of second cousins, and four of third cousins,—in all twenty among two hundred and ninety-five, or a little less than seven per cent. His researches show that in England at least every fourteenth idiot is the child of cousins. The majority of cases of idiocy appear at birth, and many such may be traced to habits or tendencies of ancestors. Often it is difficult to determine in what generation the germs of the disease were planted. Ludwig Dahl, of Norway, in his work on "Insanity," shows, by means of a genealogical tree, how an apparently healthy couple may have children, grandchildren and great-grandchildren affected with idiocy and insanity. In reviewing the field of possible causes of idiocy, I am greatly impressed by the apparent influence of consanguineous marriages. Dr. S. M. Bemis, of New Orleans, has found, through his examination of statistics, supplied by a number of physicians, that among two thousand seven hundred and seventy-eight children, the fruits of intermarriage of first cousins, seven hundred and ninety-three were normal; one hundred and seventeen deaf and dumb; sixty-three blind; two hundred and thirty-one idiotic; twenty-four insane; forty-four epileptic; one hundred and eighty-nine scrofulous; fifty-three deformed; six hundred and thirty-seven died early.

With the larger percentage of neurotics and degenerates in our civilization, the chances of evil from consanguineous marriages are greatly increased, and, inasmuch as prudential considerations are largely neglected in such matters, the laws of some of the states of the Union prohibiting marriage between first cousins are not unjustifiable.

CHAPTER XIX.

INTEMPERANCE.

There is a wide variance of opinion among medical men regarding the probable influence of intemperance of parents in the production of idiocy and allied conditions in their offspring. Dr. Langdon Down is emphatic in his opinion that drunkenness at the time of conception is liable to produce serious results upon the brain of the child. Ludwig Dahl believes that the abuse of brandy in both father and mother is one cause of the large number of idiots in Norway. Demme reports that 64 per cent of the idiots received during seven years in the Bern asylum had drunken parents—fathers mainly. On the other hand, Dr. C. T. Wilbur, of the Illinois State Asylum for Idiots, states that in three hundred and sixty-five idiotic patients eight only claim drunken parents. Dr. Graham, superintendent at Earlswood, England, also states that he found among eight hundred inmates of that institution but six cases of idiocy which could be attributed to intemperance of parents. Whether or not drunkenness is responsible for idiocy we cannot decide, but we know positively that intemperate habits are transmitted from generation to generation, each series of progeny in the line of descent showing a lower grade of intellect. As further illustration I cannot do better than quote Dr. Shuttleworth:

"Considering the intimate and prolonged dependence of the child upon the mother during gestation and nursing, one would suppose *a priori* that maternal rather than paternal drunkenness would count most in the production of idiocy. In the cases which I have tabulated, drunken fathers preponderate in a majority of thirteen to four. Possibly the mental anxiety entailed upon the wife by a drunken husband during the impressionable period of pregnancy may in part explain the discrepancy. Whatever the direct effect of drink upon the fœtus *in utero*, there is little doubt that such nursing as a child is likely to obtain from a drunken mother will intensify any predisposition to mental defect. The baneful practice of giving infants alcoholic drinks seems to prevail to a great extent in Sweden and Norway. Such practice may in part account for the extensive prevalence of idiocy and juvenile insanity in Scandinavia, as described by Ludwig Dahl."

The smallness of the figures reported by Drs. Wilbur and Graham may, perhaps, be reasonably accounted for by the presumption that the facts were not fully reported. It is usual in public institutions to take only assigned causes in making out statistics, and it is very commonly the case that discreditable causes are not given as such in commitment papers, etc. Family pride, and on the part of the children, the dislike to state facts discreditable to parents, are often the causes of the suppression of important data. The reason of the preponderance of drunken fathers over drunken mothers is easily accounted for, when we take into consideration the greater tendency to intemperance in the male sex. It is doubtful whether there could be found in this country as large a proportion of maternal drunkeness as Dr. Shuttleworth reports in Great Britain.

Idiocy is only one, and that, probably, not the most frequent evil result in the offspring from parental intemperance. Insanity, criminality of the moral insanity type, vagabond tendencies, and, perhaps, more than any other one thing, epilepsy, may be traced back to this source. Dr. Hypolite Martin, in investigating the subject of epilepsy in children in the Salpitrière, in 1877, found parental intemperance in 46 per cent and I am informed by one who has had fair opportunities of observation, that a very large proportion of the idiopathic cases, of the epileptic inmates of the insane asylums have this antecedent. The obtainable figures are, moreover, rather under the truth, in all probability, owing to the difficulty already mentioned of obtaining correct reports as to discreditable facts. The gentleman gives, as instance, that he has known parental intemperance denied absolutely in the history, while a drunken parent brought his child to the institution. It is probable, therefore, that full and correct data would give a very high proportion of intemperate antecedents of parents in idiocy, insanity, epilepsy, and generally in other neurotic and degenerative conditions. If we take into account also the poverty, anxiety, disease, and all the unfavorable conditions due to intemperance, the percentage will be stili further increased. The habit of giving alcoholic drinks to infants, alluded to by Dr. Shuttleworth, is not at all uncommon amongst the classes who use these stimulants freely, and with this should be mentioned also the practice of giving neurotic stimulants, such as strong tea and coffee, to very young children, which is very common in the poorer classes of our large cities. Tobacco, also, is frequently given to children, and has its share in the production of degeneracy. The habit of cigarette smoking by young boys, so much deprecated of late, seems to bear abundant evil fruit in the production of insanity and other nervous derangements, and prepares the way for future degeneration in the offspring of its habitués. It is a singular fact that nearly all of the inebriates in the sanitariums and asylums are habitual tobacco users in some form or other. This would indicate that the persons so using it had acquired a very nervous condition, and that the stimulant was unconsciously used to tone up a nervous system. An offspring of such a parent could not expect to inherit a strong, healthy constitution.

Deformities of the jaws among this class were found to stand second to those of the prostitute in the list of large percentages. This could hardly be otherwise when we consider the fact that this class, like the prostitute, is a marked neurotic and degenerate one, with all the vices combined.

TABLE OF DEFORMITIES OF THE JAWS OF THE INEBRIATES.*

No.	Normal.	Large Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch	Semi-V-Shaped Arch.	Saddle Arch.	Partial Saddle Arch.	Semi-Saddle Arch.
514	25.4	6.4	59.5	1.5	24.4	0.3	9.3	13.2	7.7

* The examination of inebriates was made in The Keeley Institute, Dwight, Ill.; The Inebriates' Home, Ft. Hamilton, N. S.; Washington Home, Chicago, Washington Home, Boston, and Dr. Crother's Institute, Hartford, Conn.

If all the deformities of the head and face had been included there would have been fully 95 to 98 per cent of deformities among this class of individuals. Many of these unfortunates were geniuses or unusually bright people, including doctors, judges, lawyers, ministers, railroad officials and business men.

CHAPTER XX.

MATERNAL IMPRESSIONS.

The popular beliefs in regard to the effect of maternal impressions on the offspring are not shared to any very great extent by the medical profession—that is, in their extreme acceptation. There is, of course, no question as to the possible influences of the maternal conditions during pregnancy, but the direct action of maternal impressions is exceedingly dubious. If the popular notion in the regard were based on fact, it would be extremely unfortunate, since no pregnant woman can be assured against mental and emotional shocks such as those to which the production of various monstrosities is attributed. There is, however, a very great possibility that cannot be disregarded by physicians, that in many cases serious damage may be done to the unborn child by the occurrence of such accidents, which may reveal itself in its post-natal development under some one or more of infinitely variable forms of physical and psychical degeneracy. When we consider that the mothers in these cases are very likely themselves to have some nervous or mental instability, this is still more a matter for consideration. The physical and mental conditions of either parent at the time of conception may have their influence, though this is not often readily determined. Something has already been said that bears on this point when speaking of the effects of intemperance of parents—especially paternal intemperance—on the offspring.

It is unquestionably a fact that a fright to a mother during pregnancy is occasionally a cause of idiocy in children. Women instinctively shrink from anything which would produce a shock or special mental impression during the period of gestation, fearing for both the mental and physical welfare of the child. Strange to say, the same maternal instinct prevails with the brute creation.

Dr. G. H. Fisher has written a very complete history of the "Literature, Classification, and Description of Human and Brute Monstrosities," including the so-called parasitic monster known as "Fetus in *Fœtu*," and the various super numerary formations of parts and organs which are familiar to medical men. Many interesting cases are given by this author, including deformities of the upper and lower extremities and internal organs. He shows that the lower animals may become insane, and that heredity and pre-natal shocks have much to do in producing these conditions.

Innumerable cases of pre-natal shocks producing idiocy, where the parents were both apparently healthy, are on record. In one case the news of the loss of the husband at sea had the effect of impairing the intellect of the unborn child. Again, the same result occurred in another case as a result of fright occasioned by a team of horses running away with the mother when well along in utero-gestation. Baron Percy, a French military surgeon, observed that out of ninety-two children whose mothers had been exposed to the terrors of a tremendous cannonade at the siege of Landau, in 1793, sixteen died at the instant of birth; thirty-three languished from eight to ten months, and then died before the age of five years; and two were born with numerous fractures of the bones of the limbs.*

Just how impressions of the mother affect the fœtus is difficult to describe, but that they do produce marked effect is illustrated in the following cases: A man and wife, living upon a farm, had twelve children. The country was high, rolling ground, air perfectly pure, and one of the healthiest districts in the state. The death rate at that time was only about three per 1,000. The children, six boys and six girls, were born just about two years apart. The surroundings and conditions of life, as far as I am able to ascertain, were the same in the entire twenty-four years; no taint of any kind in the family as far as I could learn. All the children grew up to be men and women. The fifth, a boy, died at the age of twenty-two years. He possessed a very small, undeveloped chest, arrest of development of the bones of the face and nose, long slender nose, total collapse of the outer

* Trans. N. Y. State Med. Soc., 1865–68.

walls, and chronic nasal catarrh, which he possessed from birth; death was the result of consumption due to catarrh. The seventh, a girl of eighteen, died of consumption, contracted by contagion while nursing a sick cousin who died of the disease. The youngest, a man now twenty-four years of age, has head and face excessively developed forward, as illustrated in Fig. 88; a decidedly V-shaped upper jaw and arrest of dental arch of the lower jaw; chest contracted; only one testicle passed into the scrotum, a condition inherited from his father. Has taken up a profession, and indoor life is not conducive to health; he is therefore delicate. The man is as bright if not brighter than any of his brothers or sisters. Why should two children, the fifth and last, be constructed so differently when all the conditions are the same? There is only one answer—either worry, starvation, or physical debility. The author could select many cases illustrating this peculiar uterine development and education, but this one is sufficient to show its peculiarity.

CHAPTER XXI.

CITY VERSUS COUNTRY LIFE.

It is a well-known and recognized fact that the people of the city are of lower stature, lighter limb and are more susceptible to the ravages of disease. That mortality is greater and longevity less in the city, as compared with the country, is too well understood to need much discussion. * The mortality is two and one-half times greater in the city than in the country. †

It has been said that a family living continuously in London, and intermarrying with families who have resided in London constantly, would die out in three generations. Again, a family living in London for two hundred years and marrying among people not less old, would become extinct within the two hundred years. ‡

If all the people of the world lived in cities the human race would become extinct in two and one-half centuries; § in all probability the mortality would be greater the larger the cities. It has been shown that women attain greater longevity in the city than in the country. In the country the life of women is monotonous; the brain is used very little and very little recreation is taken; the hours of work are very long, from early morning until late at night; thus insufficient sleep does not give the body time to recuperate. Longevity of men is lessened by residence in the city, no doubt due to closer confinement and more hazardous occupations. We also find that dissipation and intemperance are increased.

The greater mortality of cities is due to foul air, unsanitary conditions and intemperance. ‖ Among these may be included irregular hours, want of exercise, unhealthful and more hazardous occupations, undue excitement of the nervous

* Mr. Stockton-Hough, "Relative Influence of City and Country Life."

† Professor Donaldson; Sussmilch; Drs. Jarvis, Farr, Berg, Herz, and many others.

‡ Mr. James Cantile. J. Milner Fothergill.

§ "Relative Influence of City and Country Life."

‖ Dr. Morgan.

system, less pure water, unwholesome food, unhealthful dress and an overcrowded condition of the people, especially in tenement-houses and flats. We must not forget the fact that country people are continually thronging to the city, and by intermarriage with city people infusing new blood and new life into them. This fact no doubt adds much to lessen the mortality of the city.

That the quantity of oxygen is sensibly diminished in the air of large cities, even in the open street, cannot be denied.* The large number of people congregated in a small area, together with the artificial means, if we may so call it, of using up oxygen by means of increased fires and light, would naturally reduce the oxygen in the air and increase the carbon dioxide; add to this the fact that vegetation is utterly wanting, which is the chief factor in using up the superfluous carbon dioxide and supplying us with free oxygen. The amount of sunlight is also diminished. Now, when these two conditions exist, we would naturally expect to find lessened physical development. "Light is the very life-blood of nature, without which everything in nature would perish utterly." † When blood passing from the lungs, where it does not obtain a supply of oxygen, carries to the brain and other tissues and organs carbon dioxide, the consequence of an arrest in the changes necessary to life and growth would result. ‡ The effects of carbon dioxide poisoning are far-reaching. Through the brain it affects all tissues of the body. Lack of pure air and of bracing air creates a distaste for exercise; active exercise, but exercise not carried to excess, keeps up the equilibrium between waste and repair. § Another cause of the lack of exercise is the facility with which different parts of the city may be easily reached by means of street-cars, cabs, omnibuses, etc. Then, also, we find that people in the city are more hampered by dress than those in the country, which is a cause for deficiency of exercise. We also find in the city a lack of suitable places for exercise. Now,

* Professor Wilson.
† Sir David Brewster.
‡ Dr. Bell, "Perils of School-room."
§ Dr. Darbishire, "Recreation."

since deficiency of exercise exists among city people, we would naturally expect to find deficiency of physical development, which is the case. The city-born criminal is found to be inferior, physically, to the country-bred.* Biologically, man is a fresh-air animal; † exercise in fresh air increases the activity of all organs of the body. Muscular activity demands activity of the circulation to keep up the equilibrium of waste and repair. Muscular activity creates increased activity of all the eliminating organs, to rid the body of the products of the disintegration of molecular activity of muscles. The circulation being increased, the respiratory system is increased to meet the greater demands for oxygen. This brings about a vigorous action of all the organs of the body, and, being a physiological process, if kept within physiological bounds no harm but good can result. This course of living was carried out in the patriarchal age. There was moderate activity of all the organs of the body; there was repose to the nervous system; the appetite was normal, digestion was healthy, and there was exemption from local causes of disease. No other causes of death occurred, save those arising from accidents and old age.‡

The converse of muscular activity producing well-developed physical condition must be true; *i. e.*, lack of exercise will cause lessened physical development.§ Animals which for generations back have taken little exercise have their lungs of smaller size, which moderates the form of the bony fabric of the chest, and the latter affects the form of the body as a whole. With our anciently-domesticated birds, where wings have been little used, their size is somewhat diminished, and we find the sternum, coracoids and scapulæ modified in form.‖ The decrease in the amount of exercise must cause a decrease in the appetite or create an abnormal appetite. The country-bred person therefore eats pastries, meat-pies and hearty food, and has no difficulty in digesting them.

* Dr. Beddoe.

† Dr. Darbishire, "Recreation."

‡ Dr. Smith, "Limitations and Modifying Conditions of Human Longevity."

§ Herbert Spencer, "Physical Education."

‖ Mr. Darwin.

He has plenty of fresh milk, butter and vegetables; the milk, from the presence of the phosphate salts, heightens stature.* The city person cannot eat meat-pies and pastries at all, therefore he rejects them.† He finds that he can eat meat; as a consequence he partakes largely of a flesh diet, but his exercise is hardly sufficient to digest this. If he is not strong enough it passes through the alimentary canal undigested, partly decomposed, causing in some cases only abdominal tenderness; in other cases other evils.‡ If the digestion is strong enough to digest this food, additional work is thrown upon the liver and kidney. Uric acid is one of the products of the oxidation of flesh food.§ It is excreted by the kidneys, and sets up interstitial nephritis. Uric acid is also a cause of gout and lithæmia.

Again, the city-bred person rejects all fats, which are necessary to healthy tissue; he rejects them because the greater part of his life is spent in an overheated room. People who live among the Esquimaux soon acquire a relish for whale-blubber and all the fats and oil they can obtain.‖ This lessened use of fats, and diminished oxygen and sunlight, are the great causes of pulmonary consumption, which claims twenty-five per cent greater mortality in the city than in the country.** Deficiency of breast-milk in mothers is a cause of stunted growth,* and want of good cow's milk is also a cause. Early and copious use of alcohol, and intemperance; want of opportunity and stimulus for the development of their physical powers by young persons in town, the earlier occurrence of puberty,‡‡ and greater frequency of youthful profligacy* are among the etiological factors of stunted growth. The crowding of people in tenements, where breathing of effluvia over and over occurs, also the crowding together of pauper population in cellars and underground rooms, must act as fruitful causes of deformities and disease.

* Beddoe.
† J. Milner Fothergill.
‡ Dr. C. Chambers. "Dietetics."
§ Fothergill; Dr. Chambers.
‖ Darwin.
** Professor Donaldson.
‡‡ Quetelet. "On Man."

These houses are often erected on land made of sweepings of streets, where the streets are narrow and filthy. The sewerage is often inadequate to the demands, and the contents of cesspools surcharge the porous earth.* Wherever such conditions are met with, sickness must prevail, and thus all physiological processes, growth, and development will become perverted.

In the city the constant excitement hastens the development of the nervous system, which is the center of the nerve-force supplying all the organs of the body. Unrhythmical, harsh, and jarring sounds cause molecular disturbance of the system. Specialization must have a baneful effect upon the body. The exclusive concentration of mind and muscle to one mode of action is both negatively and positively pernicious, and more so when accompanied by bad air in overheated and ill-ventilated apartments.† Close confinement in school-rooms, together with competition, which must necessarily follow from our public school system, must work ravages upon the system, especially the nervous system, of the children, united as it is with the pernicious conditions existing.‡ In addition to the school duties, the city child has usually to pursue the study of music, painting, and the like, from all of which the country child is free. All these must necessarily produce an artificial condition of life, under which condition a degenerated physique is found, and more deaths must occur.§ The child is ill-equipped to meet the demands of physical life, and therefore it cannot meet the demands made upon the brain and nervous system.

Population tends to concentrate more and more in dense masses. In some of our older states from fifty to seventy-five per cent of the whole population live in cities numbering eight thousand or more. Registration reports of Massachusetts, which have now been published for forty-seven years, show that in thirty years—from 1850 to 1880—the

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*Dr. Clendenin, "General Causes of Disease"; Dr. Jas. Johnson; Carl Pfeiffer.

†Dr. Beard, "American Nervousness."

‡Sir John Sinclair.

§Dr. Price.

average age of all persons who died in Suffolk, in which Boston is included, was twenty-three and one-third years. The corresponding age in Barnstable county, also on the seaboard, was thirty-seven. In Franklin county, an inland rural county, it was thirty-eight and one-half years, while in the island county of Nantucket it was forty-six and fifteen one-hundredth years, nearly double that in Suffolk county, thus showing that the uniform higher death-rate is greater in densely-populated counties.*

In the town of Sharon, Norfolk county, Mass., which is the highest point of land in the eastern part of Massachusetts, and has a population of about thirteen hundred, the average longevity is sixty-four years.

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* President C. W. Eliot, "Family Stocks in Democracy."

CHAPTER XXII.

CONSTITUTIONAL LESIONS.

The results of constitutional diseases are more marked in the osseous system than any other part of the human body. Debilitating acute diseases (fevers, the exanthemata, etc.) in children are sometimes followed by sudden overgrowth of bone, which is quite noticeable. This process affecting the osseous system may account for certain proportions of those cases of measles, pneumonia and other diseases which are followed by dental irregularities and maxillary deformities. In some cases, however, the process is a low grade of inflammation, which is followed by atrophy of the jaw instead of hypertrophy or hyperplasia. The special predilection of these processes for the superior maxilla is, on account of its liberal blood and lymphatic supply, and the contiguity of such cavities as the antrum and nasal *fossæ*, which, in many cases, contribute their quota of irritation.

The question of diathesis enters largely into the etiology of maxillary and dental deformities. The physical characteristics of strumous children demonstrate this fact quite forcibly. The description of this diathesis given by Fothergill is decidedly apt in this connection: "The diathesis has an imperfectly developed osseous system as one of its characteristics. The bones are small, the shafts slender, the epiphyses enlarged; the hands are often unshapely from this osseous defect; the thorax is small; the forehead is high and prominent; the jaw is small, and the teeth crowded and carious."

Persons of a nervous diathesis have small jaws. Constitutional diseases, such as the exanthemata, syphilis and phthisis may affect the jaws in common with the other bony structures, and as the teeth do not vary much in size in different subjects, a relatively small jaw results in such cases. Dr. Florence Hunt informs me that the majority of the Swedish and Norwegian patients of the Cook County Insane Asylum are affected with scrofula and other constitutional diseases, and that post-mortems reveal soft and undeveloped epiphyses not unlike cartilages. Writers on surgery have assigned as some of the causes of non-union of fractures of bones, the so-called scrofulous condition, the existence of any of the exanthemata, or the debility arising from them, and syphilis.* The arrest of development of the entire organism following cerebro-spinal meningitis is well known to everyone.

Pathologists have maintained that the regenerative process in all tissues is below par in constitutional diseases; that is, that wounds do not heal so readily in a person the subject of constitutional disease. The development of tissue from an embryonal type to mature tissue is identical with the regenerative process† in the healing of wounds, or, as Senn‡ calls it, the vegetative process. Therefore, the same causes that retard the one process must retard the other. Following out the theory of Metschnikoff and his followers, we must conclude that the energy of the organism is expended in repelling the advances and barring the further progress of the micro-organisms that are the causes of these constitutional diseases. In consequence of this continuous warfare between the cells and microbes the tissue cells, that are regenerated, do not increase the size of the organ as in normal development. That these constitutional diseases do cause an arrest of development in children is well known to every observant parent. Sometimes this arrest of development will be permanent at the time of the disease, but more often the growth of the child is stopped for one or more years, and frequently development will not go on until the child is taken to another climate. The effect upon the jaws and teeth is very marked, especially is this the case in the upper jaw. When arrest of development of the teeth takes place pits and furrows are found upon the enamel. Every specialist of experience is able to determine, by these pits and furrows, the exact year when arrest of development took place. The well-known Hutchinson's teeth, familiar to every physician and dentist, are well-marked illustrations of this fact.

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* Erichsen, "Science and Art of Surgery." Wyeth, "Surgery."
† Hamilton, "Pathology."
‡ Senn, "Principles of Surgery."

The eruptive fevers in children have a tendency to leave the system in a neurotic and degenerative condition. We frequently find children, who, before their illness were apparently healthy and well, after having these diseases are sickly and ailing for years, and occasionally they never wholly recover. Such conditions affect the eyes and ears, and not infrequently the organs of speech. The eyes remain weak, and occasionally the patient becomes nearly or quite blind. The hearing is frequently permanently impaired; occasionally also the nerve centers, which preside over the development of the osseous system, and there is a general arrest of development of the whole body. Such persons not infrequently remain sickly through life, while occasionally they recover their health, though the body ceases to develop its normal size. A few illustrations will not be out of place here.

A young girl, now fifteen years of age, born of apparently healthy parents, had a very severe attack of scarlet fever at the age of seven years. Arrest of development of the upper jaw, and a V-shaped arch developed; she has been near-sighted ever since and now has very weak eyes; she stopped growing for three years; she was taken to California and Europe, as the result of which she is now getting her full growth.

A boy had pneumonia at the age of four. He is now nine; arrest of development of the bones of the face is very marked; he is not old enough yet to decide what effect it will have upon the jaws and teeth; he has stopped growing, and is now very small for his age.

A young lady, now twenty-two years of age, had scarlet fever at the age of seven, as a result of which she became deaf and dumb; the bones of the face and jaws are undeveloped, and possesses a marked V-shaped arch; pits and grooves upon her teeth denote the age when she had the disease; she has developed into a very handsome, full-grown woman.

A lady, forty years of age, had scarlet fever at three years. Her eyes became inflamed, and she lost their sight for twenty-four years, when they gradually grew better, owing to change of climate; she can now see fairly well. However, when her health became poor her eyes still troubled her; she is fully developed in size; the bones of the face are arrested in their development; the jaws and dental arch are normal.

Arrest of development of the tissues of the body can take place at any period as a result of the constitutional diseases, up to the time when the person gets his full growth. Arrest of development of the jaws, however, the result of constitutional diseases, to produce dental deformities, must occur prior to the sixth year. This, however, does not include excessive development of the jaw-bones proper. It is in the cases like those just mentioned where arrest of development is apparently not inherited in the parent, but is the result of a constitutional disease which afterward becomes a fixed type and is handed down from generation to generation. In this way, I believe, we are rendering permanent a deformity of the osseous system which was originally an acquired one.

CHAPTER XXIII.

NEUROSES OF DEVELOPMENT OF THE BONES OF THE HEAD AND FACE.

Neuroses of development of the bones of the head have been fully considered in the chapter on crime.

To the great anatomist, Camper, belongs the credit of studying the human face from a scientific standpoint. This great anatomist gave his name to the famous facial angle which, even up to the present day, serves as a standard by which to judge the rank of the human face in comparison with the lower forms of animals. In one of his works he gives, "physical observation on the difference of the feature of the face considered in profile, as the heads of apes, orang-outangs, of negroes and other peoples, tracing up to the antique heads." "You will be astonished," he says, "to find among my first plates two heads of apes, then one of a negro, and then one of a camel." Since Camper's time scientists, alienists and neurologists have been able, by close study and observation of certain peculiar forms and shapes of the face, to group typical deformities with certain forms of degeneracy. Thus, as early as 1820, Groham, who had given much attention to facial expression and cranial characteristics, anticipated the conclusion of modern criminal anthropolgists. He wrote: "I have often been impressed in criminals, and especially in those of defective development, by the prominent ears, the shape of the cranium, the projecting cheek-bones, the larger lower jaw, the deeply placed eyes, the shifty, animal-like gaze." Charles Kingsley made the remark many years ago: "I have generally seen, with strong animal passion, a tendency to high cheek-bones, and who also possess dark complexion. These generally are confined to women." Mosso found prominent zygomæ or cheek-bones in thirty per cent of sexual offenders against twenty-two per cent normal persons. Lombroso says born criminals have projecting ears, thick hair, thin beard, projecting frontal eminences, enormous jaws, a square and projecting chin, large cheek-bones and frequent gesticulation. It is, in short, a type resembling the Mongolian or sometimes the Negroid. Like Lombroso's Negroid or Mongolian types, among criminals, so Langdon Down has found the same among idiots, with the exception of protruding chin; Langdon Down has in almost every case found retreating chins. Tarnowsky, in her work, says: "The anomalies of the face are frequently shown in asymmetry, prognathism and evident disproportion of various parts of the face. There is a profound excavation at the root of the nose."

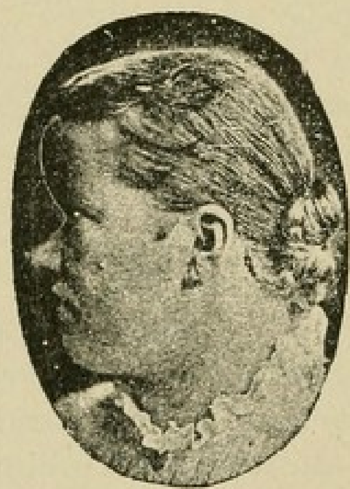

Fig. 54.

While I agree with these authors that prominent cheek-bones and protruding and receding chins are apparent among the degenerate classes, yet my own experience teaches me that other conditions exist which these authors have overlooked, which, however, have a great bearing upon the degenerate classes. As in the classification of the deformities of the jaws and teeth, I have not been able to find any two just alike; but it will not do to say that certain forms denote idiocy, others criminality, still others prostitution and epilepsy. We shall not only find these abnormalities among all of the degenerate classes, but among our professions, business men, in school-rooms and even our homes. (Most of the cases here enumerated are my private patients, and while I am not at liberty to describe each case as I would like, yet enough can be said of each case to give a clear description. It was with considerable difficulty I obtained their consent to allow me their pictures for this work. In each case the consent was only obtained by a promise that names should not be mentioned and that the object was purely for science.) First, what causes the seeming protrusion of the zygomæ or cheek-bones, and the lower jaw? Let us examine the faces of the following persons, and we shall not only find protrusion, but also arrest of development of these bones. Again, a prominence of one side and an arrest of the other.

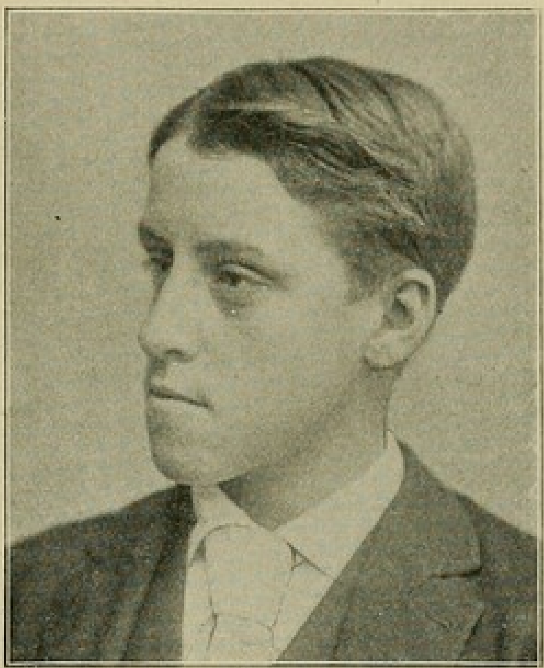

Fig. 55.

The following deformities of the face are due to arrest of development. These cases are classified according to their deformity, making it easy for the reader to understand them. In the following case I could not obtain the consent of the patient to use her picture, but the one here shown is taken from Tarnowsky, and is a correct outline of the face of my patient, from whom I obtained the following history:

Case I, Fig. 54.—Is a school-teacher, thirty-two years of age, of a very nervous temperament, bright and well educated. Father and mother living; father a periodical drunkard; grandmother died of consumption. One of her cousins committed suicide, and another became insane. A sister of cousin hanged herself. Grandmother, on mother's side, became insane, and a grand-aunt committed suicide. She was born in the East, but came west on account of a tendency to consumption. The forehead is very prominent, with a marked depression at the bridge of the nose. The nose is undeveloped, and has the appearance of falling into the face. Hypertrophy of the mucous membrane and bones of the nose require her to breathe through the mouth. The

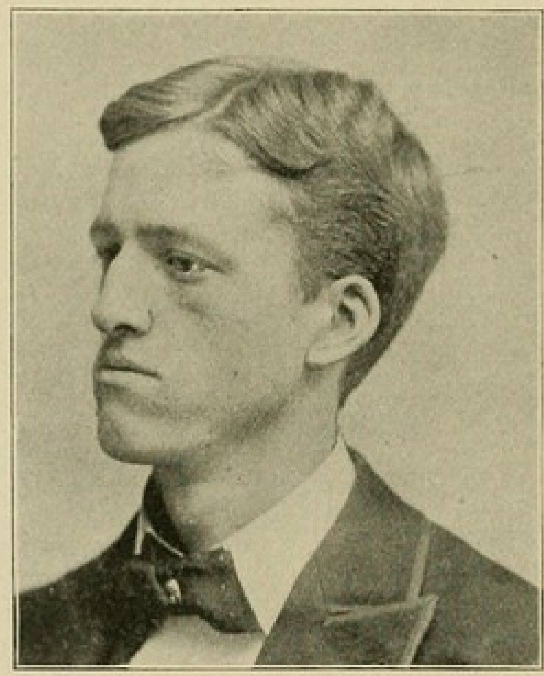

Fig. 56.

chest is undeveloped, and she is quite round-shouldered. The jaws and chin are fairly well developed. The alveolar process, although small for the body, has normal dental arches. Width outside first permanent molar, 2; outside second bicuspid, 1.90; width of vault, 1.60; height of vault .62. Third molar not present, and teeth small, hence the reason for no deformity.

Case II, Fig. 55.—Is that of a young man eighteen years of age. His mother died of epilepsy when he was two years old. Father died of locomotor ataxia about six years ago.

He, therefore, has inherited a marked neurotic tendency. The lower jaw seems to be quite prognathous, while the face, from the upper border of the lower teeth to the superciliary ridge, is markedly concave. The superior maxillary bones, as well as the zygomæ, are arrested in their development. The eyes have a sleepy look and are quite deeply set in the head; forehead narrow and quite prominent. This seems to be a case of atavism. There is a total collapse of the walls of the nose, difficulty in breathing, hypertrophy of the tur-

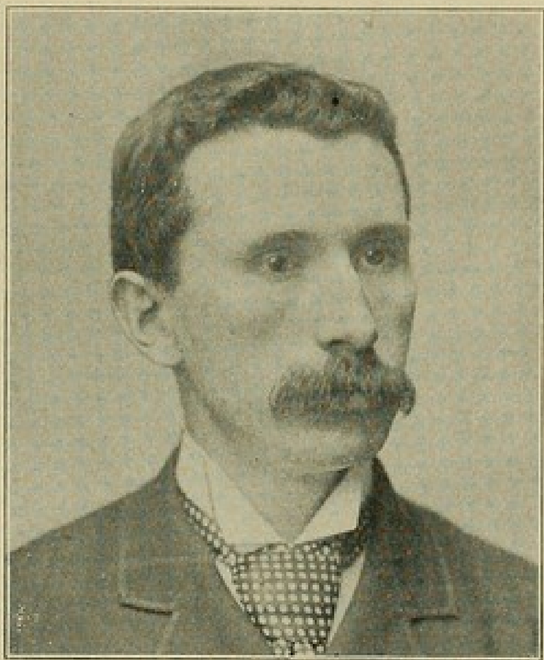

Fig. 57.

binated bones and mucous membrane, adenoid growth, and mouth-breathing. In this case, we cannot say that the lower jaw is excessively developed, because the teeth, which are not large, just fill the space, while the incisors do not protrude, and the third molars are in place. The upper jaw, however, is greatly arrested in its development. The third molars are not present. They could not erupt if they were there for want of space. (My experience has been that the third molar is nearly always missing in neurotics and degenerates.) The left first bicuspid has been extracted, thus allowing spaces to occur between the incisors. In order that the teeth may all come into position, the anterior alveolar process has been pushed forward .60 of an inch. If the bones of the face had developed, the lower jaw would have appeared to a better advantage. This case shows an arrest of development of the superior maxillæ, zygomæ and nasal bones, with a normal lower jaw. A marked ridge extends the entire length of the vault at the suture. The distance outside of first molar is 2; outside second bicuspid, 1.75; width of vault between second bicuspid, 1; height of vault, .62.

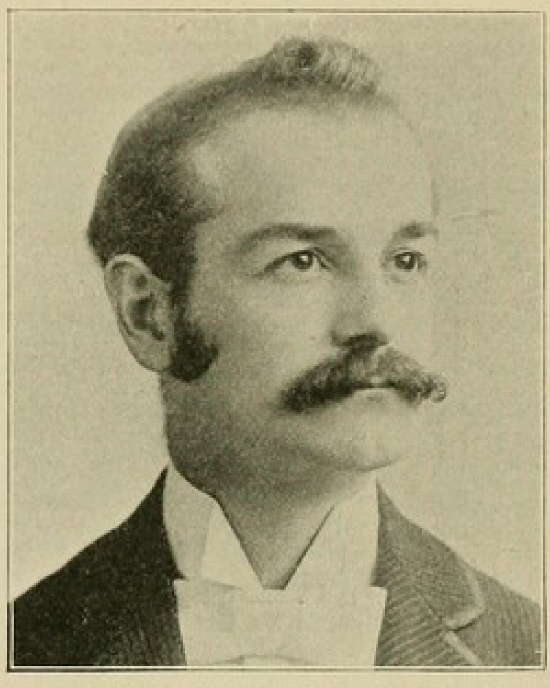

Fig. 58.

The chest walls are very contracted, the shoulders considerably stooped, and chest expansion very slight. Owing to the death of his parents it is impossible to state whether this is a direct inheritance or an arrest of development in the individual.

Case III, Fig 56.—A young man, twenty years of age, a marked neurotic; bookkeeper; is above the average in intellect; has a bright, piercing eye. The appearance of the face and jaws are about the same as Fig. 55, with this exception, that the zygomæ are a little more developed. Width outside first permanent molars, 2; outside second bicuspid, 1.72;

between second bicuspid, 1.02; height of vault, .59. There is a total collapse of the nasal openings, causing him to breathe through the mouth since he was four years of age; the two sides of the left nostril approximate, while the turbinated bones upon the right side, owing to hypertrophy, fill the space. A thickening of the mucous membrane throughout the anterior and posterior nares is also observed. This picture was taken two years after the contour of the teeth had been restored; therefore, the upper lip is more pronounced than in

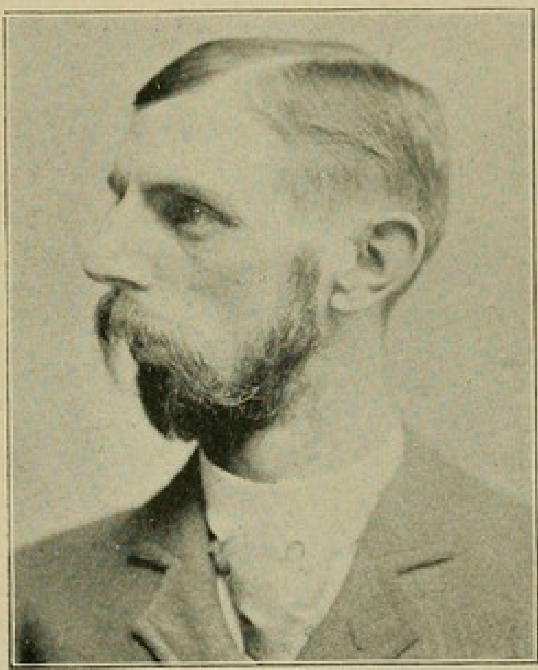

Fig. 59.

Fig. 55. There is, however, a marked concavity of the face between the zygomæ and the upper jaw; the upper lip was depressed, as in Fig. 55, before the operation. The chest is very contracted, with very little or no expansion on inhalation. He has an anæmic look, due to close confinement. The father has well-formed jaws, while his mother possesses a marked arrest of development of the upper jaw, showing that he has inherited this condition from the mother. His father is an honored business man.

Case IV, Fig. 57.—Stenographer; married; of excellent habits and good principles; steady and a hard worker. When a small child his relatives claim that he was a chubby, fat boy. His father and uncle possess this arrest of development. This gentleman. has two sisters and a brother; one of the sisters has the deformity, and a brother slightly. Upon examination I find cheek-bones prominent, arrest of development of the superior maxillary bones, a well-formed and regular alveolar process and dental arch, fine teeth, and full normal lower jaw. Width outside first permanent molar, 2.25; outside second bicuspid, 1.90; width of vault, 1.26; height of vault, .52. With such a history no one could dispute that this deformity was a clear case of direct heredity. The chest

Fig. 60.

is a little broader than the other two, but there is the same weakness of voice that is observed in the other two.

CASE V, Fig. 58.—This man is a graduate of medicine and dentistry; above the average in intellect. Father, mother, brother and sisters all living; no family history. He was born a marked neurotic; a fair dentist, but liked medicine better, and would have made a good practitioner; was a good musician; could play several instruments, but preferred the cornet. Arrest of development of the upper jaw occurred at or about the sixth year. As the teeth were crowded, with considerable protrusion of the anterior teeth and alveolar process, there was a pronounced semi-saddle-shaped jaw. Was strictly temperate. Died at the age of twenty-six years of general paralysis. Width outside first molar, 2.03; outside second bicuspid, 1.90; inside, 1.60; height of vault, .75.

Case VI, Fig. 59.—Aged thirty-six years; married. Born in England of English parents. Father sailor. Father died of inflammation of bowels; mother, rheumatism of the heart. No history; came to America fifteen years ago. Is in the harness business; a man of excellent habits. He is a neurotic. The bones of the face are arrested in their development. The line drawn from the bridge of the nose to a point

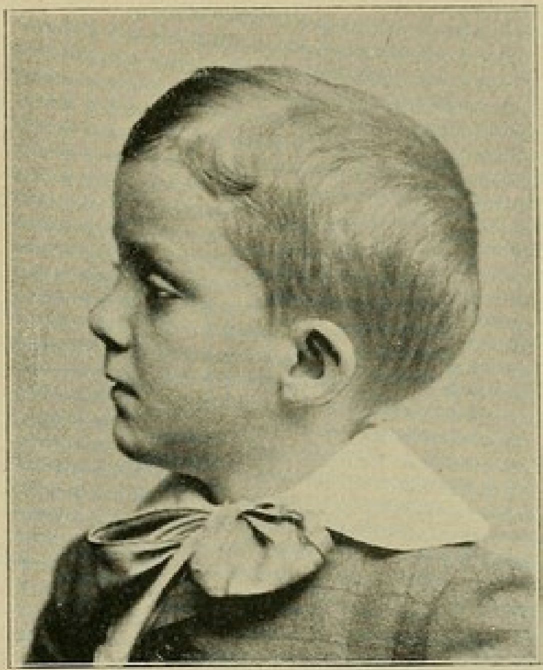

Fig. 61.

opposite second molar produces a marked depression. There is a marked arrest of the lower jaw. The anterior surface of the lower centrals occlude at the first bicuspid; this gives the appearance of no chin. All the teeth are present in the upper jaw, the width of which is 1.75 outside first permanent molar; it is also a saddle-shaped arch. In order that the jaws may accommodate all the teeth, they have pushed the alveolar process and jaw-bones forward. This man has been a mouth-breather all his life; the mouth, therefore, has always been open; the result is that the teeth and alveolar process have grown downward. Although the lips are long enough, he cannot close them, owing to the excessive development of the teeth and alveolar process. The alveolar process and teeth of the lower jaw are normal in development. The height of vault is .82 (this is an unusual high vault). The alveolar process is large and thin. This nicely illustrates how high vaults are produced. The cheek-bones are also arrested, but not to the extent of some. The eyes are deeply set; the supercilliary ridges very prominent. The nose is very long and thin; the sides of the nose approximate, and there

Fig. 62.

is a marked thickening of the mucous membrane; nose-breathing is impossible; the chest is contracted, and the mouth is continually open. The head is microcephalic; the forehead low; the posterior part of the head is very prominent; ears large.

CASE VII, Fig. 60.—Twenty-four years of age. Her father is now suffering from paralysis. No history; a neurotic; very fine musician and artist; brilliant conversationalist. Jaw-bones proper are well developed. The rami are excessively developed, but the teeth and alveolar process are undeveloped. There is very little enamel upon the teeth, and what remains can be scraped off like horn. The crowns of the teeth are worn away one-half their length. Width of jaw outside first molar, 2.25; outside second bicuspid, 2; width of vault, 1.50; height of vault, .50. She is unable to bring the teeth together, and therefore cannot masticate her food. To compensate for this she does her chewing with her tongue and the roof of her mouth, on account of which her tongue has become hypertrophied to such an extent that the jaw has been widened by the lateral pressure upon the teeth. With an effort she can bring her jaws together, which makes her

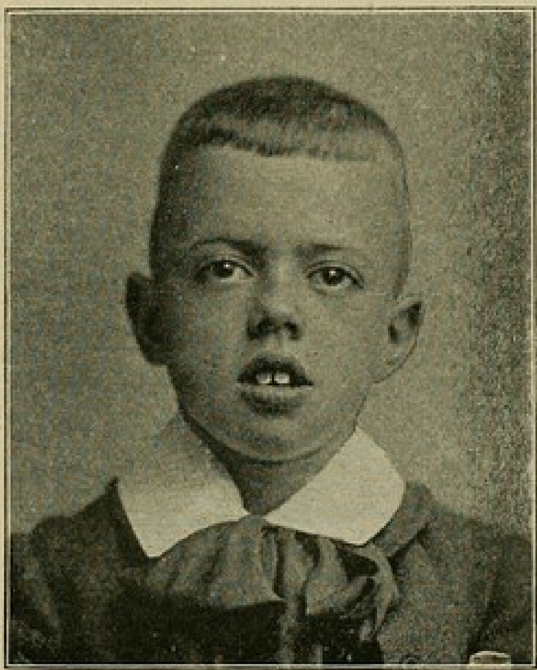

Fig. 63.

pout and the chin protrude, making her resemble an old woman. In order to meet this deficiency crowns were placed upon all her teeth, which has the effect of bringing her jaws at rest in the proper position.

CASE VIII, Fig. 61.—This little fellow is eight years of age. His father and mother are Scotch and are cousins. He has, what is generally understood to be, an arrested hydrocephalic head; it is, however, a macrocephalic head. He is about the average in regard to intellect. The first permanent molars have erupted, and the central incisors are just coming through. It is early yet to decide just what deformity will be produced, because the permanent teeth are not far enough advanced. A saddle or V-shaped arch is sure to follow, because there is not room for the cuspids and bicuspids to erupt. Arrest of development of the lower jaw is quite noticeable at this early age. There is considerable hypertrophy of the superior alveolar process now. Width outside first molar, 2; height of vault, .50. This boy will either become á genius or a degenerate. It is my experience where

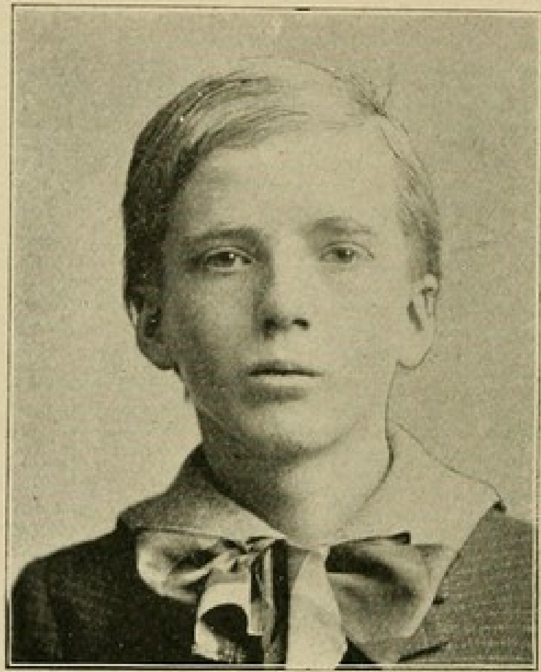

Fig. 64.

he anterior lobes of the brain are so prominent and over-developed, that arrest of the upper jaw results.

Case IX, Fig. 62.—This girl is fourteen years of age. Father and mother living. She is a marked neurotic. The upper jaw and face were very much undeveloped. The dental arch was V-shaped, and the teeth very irregular. This picture was taken after the teeth were regulated. The upper dental arch was spread .62. The face, therefore, is fuller in every direction, and appears at a better advantage than it would otherwise. There is excessive development of the anterior lobes of the brain, with corresponding fullness of the anterior part of the head; she is very bright and a fine reader. The jaw became arrested at the sixth year. Width outside first permanent molar, 1.75; outside second bicuspid, 1.50; width of vault, .84; height of vault, 50. Before treatment the face was very thin and contracted at the alæ of the nose, not unlike Figs. 55, 56, 57. Is a mouth-breather; marked thickening of the mucous membrane, and hypertrophy of the turbinated bones. While the chest is very much contracted, it is now filling out; she has a husky voice and a very old

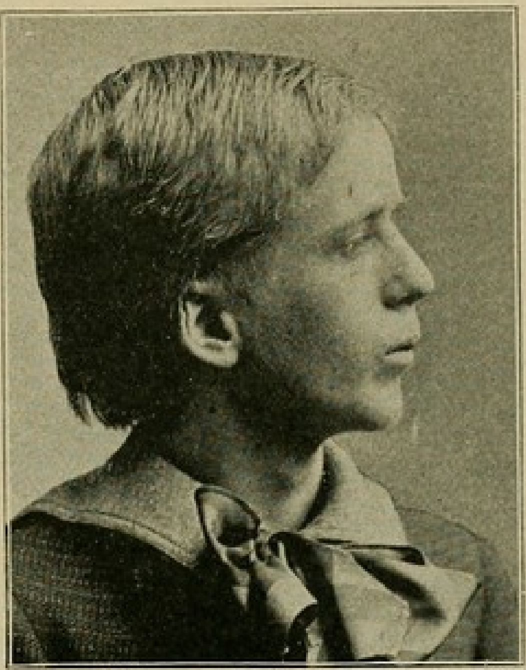

Fig. 65.

face. This case shows how much a face can be improved by treatment.

Case X, Fig. 63.—Seven years of age. Father and mother living. No history; both have well-developed jaws. The anterior lobes of the brain are excessively developed, and the anterior part of the head is quite high and prominent. This boy has always been a mouth-breather, and has been sick most of his life; he had so little vitality that it was with difficulty that he has been raised to this period of life; he is now very delicate. Deflection of the septum, hypertrophy of the mucous membrane, and turbinated bones. The mouth has been kept open to such an extent that occlusion has not taken place. The rami are short; the result of this is, nature has caused an excessive development of the anterior alveolar process. Width outside first molar, 2; outside second temporary molar, 1.75; width of vault, 1; height of vault, .36. I expect that the face will remain undeveloped from this period.

CASE XI, Figs. 64 and 65.—Aged thirteen years. Father and mother living; father a paranoiac; has an excessively developed forehead and well-developed jaw. The boy is a

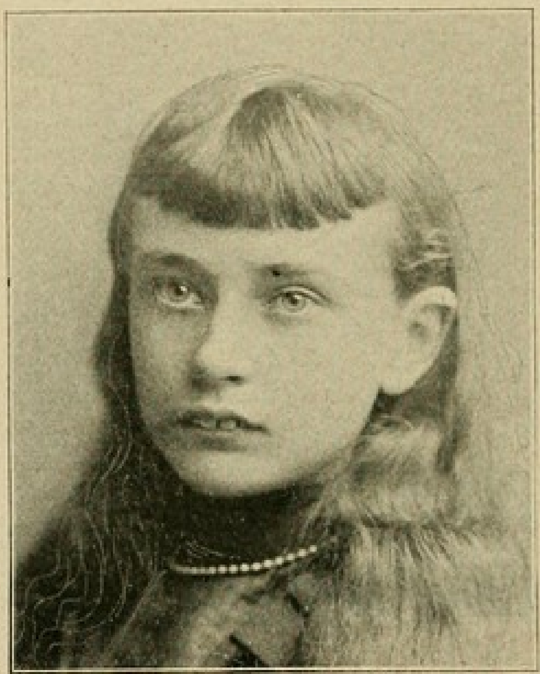

Fig. 66.

marked degenerate, almost bordering on imbecility. The anterior cerebral lobes are well developed, and the forehead, like the father's, is also well developed. The face looks like that of a man thirty-five or forty years of age. The whole body is arrested in its development. His legs are short and he walks like a man of seventy. The joints are large, while the bones are very small, showing impoverished blood. There is a marked arrest of development between the super-cilliary ridges and the zygomæ, and also the lower jaw; this gives an apparent protrusion to the nose and upper jaw.

The eyes and their sockets are also arrested, and he is obliged to wear glasses on account of astigmatism. The bones of the nose are well developed and there is plenty of breathing space. He has a growth of fine, white hair all over his face. The ears are undeveloped, consequently the hearing is affected. Width outside first permanent molar, 1.84; outside second bicuspid, 1.75; width of vault between second bicuspids, .84; height of vault, .50. While the boy was under treatment, I prescribed beef, wine and iron, which he needed, owing to the impoverished condition of the blood.

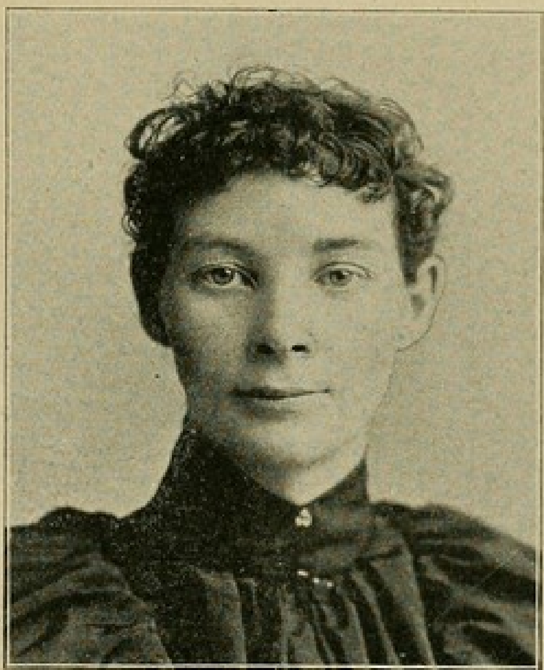

Fig. 67.

His father would not let him take it because it contained wine. I then put him on gentian. When the treatment was about half finished, I sent in a bill. The father wrote in reply that he was out of money, and that I must trust in the Lord. I have been doing so for the past three years.

Case XII, Fig. 66.—This young lady, sixteen years of age, came to me to have a deformity of the mouth corrected, four years ago. Her mother is a neurotic; her father, although a large, fleshy man, has small jaws. Marked arrest of development of the bones of the face has taken place. She possesses a very thin nose, deflection to the left of the septum; enlarged right inferior turbinated bones, and hypertrophied mucous membrane. She is a mouth-breather like Fig. 63—the mouth being kept open. The anterior alveolar process has developed downward, causing the teeth to protrude. Width outside of first molar, 1.95; outside second bicuspid, 1.65; width of vault, 1; height of vault. 47.

CASE XIII, Fig. 67.—Excessive development of the bones of the face. This lady, thirty-two years of age, married, has one child. Father and mother living and in perfect health.

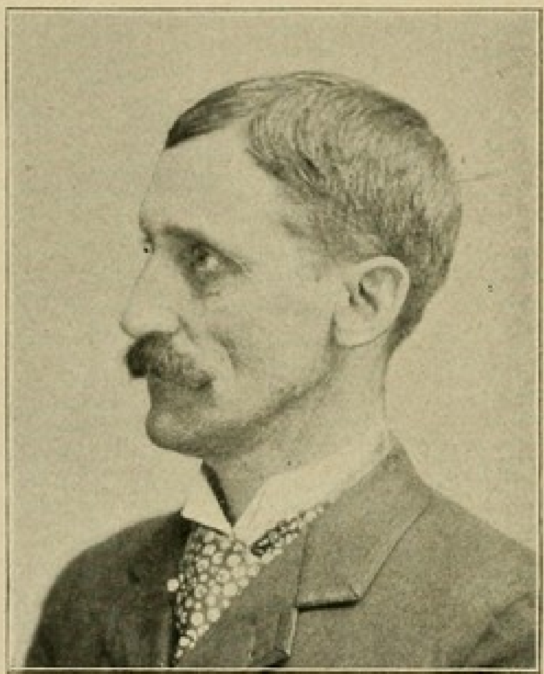

Fig. 68.

She is healthy in every respect and above the average in intellect. Bones of the face normal, except zygomæ, which are excessively developed.

CASE XIV, Fig. 68.—This young man was born and raised in Boston. He possesses a weak physical make-up; has very contracted chest and stoops. Marked arrest of bones of the face. Long, slender nose, the outer walls coming in contact with the inner, and is therefore a mouth-breather. There is a slightly excessive development of the lower jaw. He was supposed to be in consumption, and was ordered west. The change of climate and out-door exercise have completely restored him to health.

CASE XV, Fig. 69.—This gentleman, a medical student, possesses about the same history as Case XIV. He, however, has a more marked deformity. There is a great arrest of development of the bones of the face, and a more marked protrusion of the chin; this, however, does not show, owing to the beard.

In comparison of these cases there is very little difference

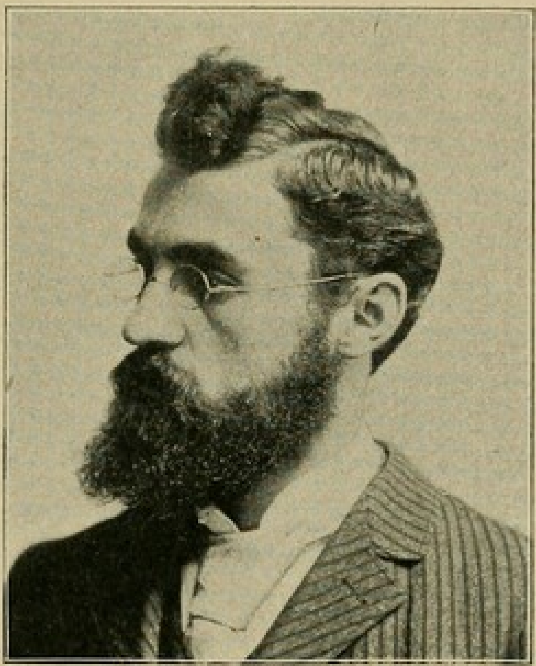

Fig. 69.

in width of the upper jaw in the first five cases. Three are 2, one 2.03 and one 2.25. Fig. 54 shows arrest of development at the bridge of the nose. Fig. 55 shows arrest of development of the bones of the face extending from the supra-orbital ridge, including the eyes, zygomæ and superior maxillæ, presenting a concavity of the face as far down as the superior border of the inferior teeth. Fig. 56 is precisely like Fig. 55, with the exception that the zygomæ are still more developed. Fig. 57 is exactly like the last two, with the exception that the zygomæ are still further developed. In Fig. 58 the features are still more normal, but arrest of development is noticed at the alæ of the nose. Fig. 59 not only shows arrest of development of the bones of the face, but also marked arrest of the inferior maxilla. The apparent prognathism is the same in all except Fig. 59. This is not excessive development of the lower jaw, but a normal development. The lower jaw develops independently of the bones of the head, and, owing to its mobility, usually develops normally. The apparent prognathism is due to arrest of the upper jaw.

In a large proportion of cases, however, the face is normal, and the undeveloped lower jaw is present. Again, the bones of the face are normally developed upon one side and arrested upon the other. In these cases all the conditions presented in the chapter on the development of the bones of the face are readily seen. They indicate the period at which the part of the brain which presides over the function of development of the osseous system ceases to operate, leaving the bones in an undeveloped state.

Comparing these faces, and their deformities, with those of the degenerate classes the deformities of one do not differ from the other. The make-up of the contour of the head, face, jaws and ears of Prendergast, and other degenerates, differ from others only under dental observation. The question naturally arises, at this point, as to how frequently stigmata occur with people in the common walks of life. Repeated examinations in street and steam cars, medical and dental colleges, halls and practice in and about Chicago have given the following results: In practice 68 per cent, in halls, cars, etc., from 45 to 65 per cent; in a billiard hall, out of 128 persons either playing or looking on, 72 or 87 per cent of deformities of the face and jaws. In medical and dental colleges, where students come from the country and different parts of the United States, the percentage will fall as low as 45 per cent, while in the congregation of city people the per cent of deformities will range from 55 to 65. It would not be fair to take the percentage of my patients into consideration, because my practice is made up largely of the treatment of irregularities of the teeth. In analyzing the large percentage, found in dental examinations, the fact should be remembered that irregularities of the jaws and teeth come under observation in large numbers for special treatment. It would, however, be safe to say that from 55 to 60 per cent possessed these deformities. Taking the defective classes as a whole, as found in our asylums, the percentage of deformities between them and society at large is not striking. If, however, congenital cases, habitual criminals, drunkards, prostitutes, paupers, etc., be considered, the percentage is from 85 to 95 per cent. Stigmata, as has been shown in the chapter on development of the face and jaws, appear before or at the sixth year. This illustrates conclusively that the brain centers which preside over the osseous development are affected at or soon after birth.

In the present state of our knowledge of brain development, the question arises, why is it that two persons possessing the same deformities of the head, face, jaws and teeth, one is a criminal, idiot, inebriate, pauper, the other a business man or genius? The answer naturally suggests itself, that while the nerve centers of the brain which preside over the development of the osseous system are the same in both cases, producing the same results, other nerve centers of the brain which preside over the intellect continue to develop in the second period of brain growth, between the sixth year and puberty. Character matures *pari passu* with other development; the whole period of youth is a formative one, and it cannot or ought not be unduly handicapped by an osseous system practically fixed in the first decade of existence. These cells may develop in one line producing genius, or they may develop uniformly, producing a well-balanced brain. In the other case, the nerve centers in the second period remain undeveloped, and the idiot, criminal, inebriate, pauper and prostitute results. Thus we find stigmata in persons possessing a normal brain, and it is possible to find neurotics and degenerates with a normal osseous development.

It will now be seen why modern medical jurisprudence, in passing an opinion on a case of alleged idiocy, insanity, inebriety, prostitution, pauperism, criminality, etc., should take particular care to examine the face and jaw external and internal, thereby fixing the date of abnormal development due to inherited or congenital defect.

Regarding the comparative degeneracy of foreigners and Americans, it seems probable that stigmata are not as marked in American-born criminals as in foreign. This seems due to the fact that in the old world, consanguinity, long lines of drunkards and prostitution, and marriage of criminals, have had great influence upon these aberrations. Scientists and specialists in this country are of the opinion that the more marked degenerate types are imported individuals. As this country develops in age with the large immigration of foreigners, together with our own criminals, paupers, etc., these excessively marked degenerates, as illustrated by Lombroso, Ferri, Manouvrier and others, will become more numerous. In an examination, by the aid of a magnifying glass, of the photographs of epileptics and insane criminals in Lombroso's atlas—L'Homme Criminel—although these are very small and indistinct, the following deformities of the face and jaws are found:

Arrest of the bones of the face and superior maxillæ, - - - - - -	98
Arrest of the lower jaw, - - - -	32
Excessive development of the upper jaw, -	11

In an examination of photos of criminals in the Bertillon collection, in the French Building at the World's Fair, the following results were obtained of 145 examined :

Arrest of bones of the face, - - -	54
Arrest from orbit to lower jaw, - -	24
Arrest from zygomæ to lower jaw, -	30
Arrest of lower jaw, - - - - -	65

All have large, prominent noses; many sunken eyes, and not a few are cross-eyed. This attempt to classify these deformities (not for the purpose of obtaining percentages, which is out of the question with pictures) is simply intended to show that they exist among degenerates in other countries.

CHAPTER XXIV.

NEUROSES AND COMPENSATORY DEVELOPMENT OF THE BONES OF THE NOSE.

It would be difficult to understand why the bones and soft tissues of the nose are not just as liable to show stigmata of degeneracy as the facial and maxillary bones. Indeed, such is the case. Deformities of the nasal septum, deflection, hypertrophy and atrophy of the turbinated bones, and deformities of the maxillary sinuses, are almost always associated with arrest and excessive development of the facial and maxillary bones. This is naturally to be expected; and, in the history of cases already mentioned, and hundreds of cases examined by me in the past few years, there is hardly a single instance in which some deformity of the nose is not noticed. They are naturally associated together. While it is possible to occasionally find deformities of the maxillary bones without deformities of the nose, so it is possible to find deformities of the nose without maxillary deformities. My experience has been that there are very few normal septa.

Theile examined 117 skulls and found the septum normally placed in 29. Semeleder examined 49 and found the deflection to the left in 20, to the right in 15, and a sigmoid deformity in 4. Harrison Allen, in 58 skulls, found narrowing to the left side in 19, to the right in 21; in six of the latter the septum and superior and middle turbinated bones met.

Zuckerkandl believed that the dry skulls did not give an accurate illustration of the true condition, and then made his researches upon the cadaver. Out of 370 cases he found 123 symmetrical, and 140 asymmetrical; in the deformed specimens, the septum was inclined to the right in 57 cases, to the left in 51, and was sigmoid in 32. Mackenzie examined 2,152 skulls in the Museum of the Royal College of Surgeons and found 1,657 cases where the septum was more or less deformed. In 834 the deviation was to the left, and in 609 to the right. In 205 the deflection was sigmoid, while in 5 the irregularity was zigzag, showing 70 per cent of deformities in the dry skulls, and only 40 in the cadaver. Heyman's examination showed 99 per cent of deformities in living subjects. With the status already shown, there seems to be quite a difference in the percentage of deformity as regards races. Thus Zuckerkandl found in 103 cases of barbarous and semi-barbarous people 24 were asymmetrical. Mackenzie found in 430 skulls of superior races 22.6 per cent of deformities, and also confirms the observation of Zuckerkandl.

Harrison Allen found, in 93 skulls of negroes, deformity of the septum in 21.5 per cent. The author has examined over 11,000 skulls in this country and Europe, including the large collection in the Museum of the Royal College of Surgeons, and 347 living individuals, with the following results: Owing to the fragility of the septum the whole or anterior part was lost in many of the skulls, the result of which only 7,600 had sufficient bone remaining to give any idea of its shape. My examination of skulls in the Royal College of Surgeons, London, practically tallies with Mackenzie. In the 7,600 skulls, 5,762 showed marked deformities. Out of 687 ancient Peruvian skulls, 147 possessed deflection of the septum. In 69 stone-grave Indians, 35 were normal and 34 deformed. In 18 mound-builders, 8 were normal, 10 deformed; 6 California Indians, 4 were normal.

Dr. J. M. Whitney, of Honolulu, brought 28 skulls of ancient Hawaiians to the Columbian Dental Congress which met in Chicago, August 14th, 1893. These were taken from lava caves. There is no question of their antiquity, many of them possessing the appearance of the Neanderthal skull. The jaws were unusually well developed, as well as the bones of the face. The external bones of the nose were also well formed. While there was a lack of that marked asymmetry due to excessive arrest of development of the turbinated bones, as noticed in the Peruvian skulls, yet the bones were far from being uniformly located in the cavities of the nose. There were, however, two in which the inferior turbinated bones were undeveloped, only rudimentary ridges being present. Deflection of the septum was noticed in 23 cases—some in the anterior part of the bone, others in the middle, and still others in the posterior part. In the two cases where the inferior turbinated bone was undeveloped the septum deflected to that side. Nature not seeming to be satisfied with the amount of material at hand built out projections which seemed to take the place of the missing turbinated bones. One very singular case was observed where the deflection commenced midway, from before backwards, the greatest deformity being three-fourths its distance into the left cavity, midway between the turbinated bones. Upon that side of the vomer there was a large ridge, its greatest projection being about .25 of an inch in length. Upon the opposite side there was another smaller ridge, evidently for the purpose of supporting the deflected point, and also for the purpose of affording greater surface for mucous membrane and blood-supply. Of the 347 living persons, 107 showed deflection of the septum.

I have shown, like deformities of the other bones of the cranium, face and jaw, that it makes no difference whether the individual was of the ancient or modern, barbarian or civilized, all possess these deformities of the septum. No two are alike, nor can we find any one growth resembling another in number. Loewenberg, Mackenzie and Ingalls have classified these deformities, but the author will not attempt to do so for two reasons; *first*, he did not study the deformities with that object in view; and, *second*, from years of observation he is of the opinion that each case is a peculiarity in itself.

I have given these figures in detail because it will be seen that in the original examination of the skulls of the cadaver and living individuals, there is no uniformity in the figures. The author does not believe that it makes any difference in the deformity of the septum whether the subject is alive, on the dissecting table, or the skull has been grinning from the shelf of a museum for twenty years. The two points of attachment are fixed (if the patient has reached puberty), and the septum, green or dry, cannot very well change its position, except that there may not be quite so marked a deflection in the dry subject.

If the deformity were of a sigmoid nature upon one side, or the shape of the letter S, the part of the bone or cartilage being dry would prevent its changing to the opposite side in the one case, or a reversal of the S-shape in the other. It is easy to see why it is more difficult to diagnose deflection of the septum in the living subject or cadaver than in the dry skull, on account of the soft tissues located in the anterior part of the nose. This, no doubt, will account for the small percentage of deformities reported by Zuckerkandl and the author. I found great difficulty in making my examinations upon living individuals; indeed, I am well aware of the fact that it is almost impossible to discover the contour of the vomer in its middle and posterior parts, where they are as frequently observed as in the anterior part. This deformity was of all manner of shapes, sometimes like the letter S, again the letter C, and often like the small italic letter *f*. Sometimes it would be carried over so far as to approximate the right or left outer wall of the nose. From the fact that it is attached throughout at its upper and lower border to a solid, bony frame-work, its middle portion is liable to bend in any direction like a loose sail in the wind. Deflection of the vomer, due to fracture of the cartilage, or the deflection of anterior part of the nose, is easily differentiated from a fractured vomer.

Several theories have been advanced as to the cause of these deformities. Quelmalz and Schultz believe that they are due to the action of astringents drying up the membrane, causing it to contract, thus drawing the bone and cartilage down upon itself. Morgagni believed that it was due to excessive development of the vomer. The view held by many is that advanced by Trendelenburg, that it is due to a crowding up of a high-arched palate, as he had observed the two conditions so frequently connected. Jarvis has reported four cases, all in the same family, which would suggest that it is due to an hereditary taint. It would be very difficult to establish this theory because of its frequency. If the doctor had said that the neurotic or degenerate conditions which underlie the building up of the system were inherited, it would seem to me to be more plausible. Schaus' and Welcker's investigations tend to show that there is a faulty development of the facial skeleton, but in just what manner it is impossible to say. The author agrees with this theory. Bosworth* and others believe that septal deformities are due to traumatism. Bosworth says, page 288: "The clinical history of many of these cases affords direct evidence of this, and even in those cases in which the direct injury is not testified to, I think it safe to say that an injury has occurred, which may have been of so slight a character as not to have excited especial attention at the time of the occurrence. An injury to the nose need not necessarily give rise to the immediate development of a notable deformity, as in fracture, but it may set up a low grade of morbid action, which, going on through a number of years, will finally develop a condition by which the normal function of the nose is seriously hampered." He also says, on page 291: "The point on which I would lay special emphasis is that the deformity is primarily the result of traumatism, and secondarily of a slow inflammatory process which results therefrom." That a *very few* cases of deformity and fracture of the septum are due to traumatism, I believe to be true. The author is well aware of the fact in one case in particular, when a boy of sixteen, he asserted his rights, when he received a blow upon the nose from his opponent which fractured the cartilage and made a lasting impression upon him. That from 50 to 80 per cent, or even 5 per cent of deformities of the septum, are due to such injuries, I believe to be out of the question. In the large number examined by the author, 2,684 possessed what appeared to be fracture. The vomer in many of these specimens commenced to deflect at its outer surface and gradually deepened until, at about its middle or posterior two-thirds, it reached its deepest part and then gradually decreased in depth until the posterior attachment was reached. Its appearance was not unlike the sail of

* "Diseases of the Nose and Throat."

a ship. On the convex surface, in many cases, nature had thrown out provisional bone to support this curvature, which might be considered a break, but in most cases simply a bend. That a blow, whether slight or as powerful as could be given by a Corbett, could produce a fracture of the vomer, the greatest deformity of which is located from .75 to two inches inside the nose from the point of the nasal spine, would hardly look reasonable. Anterior and posterior to this deflection, the vomer appeared in most cases to be nearly or quite normal. In nearly every case the fracture would involve only one-half of the vomer, the other simply bending; so that such a condition could be brought about by a blow is absurd. It seemed that the point of the greatest deformity was the thinnest part of the bone.

It would appear to be a very easy matter in the skull to decide whether a fracture had taken place before or after complete ossification by the character of the wound, thus approximating the date of the injury. That it was caused by a low form of inflammation, set up as a result of a slight injury *in utero* or after birth, does not seem to be a rational theory, because the inflammatory condition must necessarily extend upon both sides of and through the septum, extending its entire length. If due to an inflammatory condition the bend or break would be found at any part of the septum, and the position and shape would be different in every case. As the location upon the septum, from above downward, is nearly always the same, and as the shape is always from before backward, inflammation could not produce it. In order, therefore, to produce a fracture, we must first have an excess of septum. Therefore, unless the fracture is the result of a direct blow, it would require years to produce sufficient growth and curvature to produce a condition in which fractures, or even an abrupt bending, could take place.

The theory, then, that the deformity is "primarily" the result of traumatism due to injury *in utero*, or at the time of delivery, or even subsequently, except by direct force, and secondarily to a slow inflammatory process, to my thinking, will not account for these deformities. Indeed, fracture of soft tissue, such as the vomer before ossification, is not possible. The theory advanced by Trendelenburg, and supported by many specialists today, is so absurd that it would seem almost unnecessary to say anything about it at this time, but as this theory is still taught in our medical colleges, I deem it necessary to call the attention of specialists to some of its absurdities. I will say, however, at the start, that wherever we find a high, contracted vault, we also observe a deflected septum. Often, however, a deflected septum is found without a high, contracted vault. While the high vault and deflected septum go hand in hand, the one does not produce the other. It has been shown, in the chapter upon the devel-

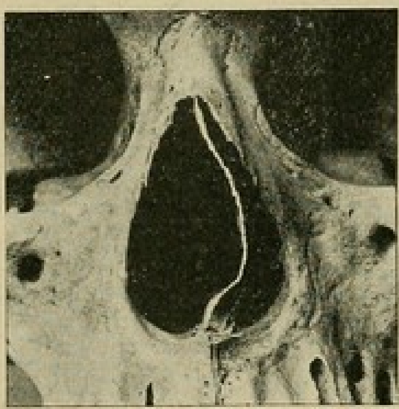

Fig. 70.

opment of the vault, that it is developed downward and not up. The development of the suture, which unites at the median line, is precisely like laying the keel of a ship, only upside down; it is laid first and is the foundation upon which the superstructure rests. The narrow, contracted vault is never seen before the sixth year, except in cases of monstrosities. Many septa are deformed before that date. There is nothing, then, to cause the upward movement of the vault. The ridge is not the result of a pushing down of the suture by the vomer. The vomer would have to become taut to accomplish this, but we always find it bent in such cases. Again, if the ridge was produced by the action of the vomer it would be nearly or quite uniform in thickness its entire length, but this is never the case. If it were possible to crowd down the middle and posterior palate, it would be impossible to crowd down the anterior part of the palate, which is covered by the anterior alveolar process. I have frequently observed a ridge extending along and including the alveolar process as far as the incisor teeth. I have examined 1,367 skulls containing vaults so depressed, but have never been able to find a corresponding depression in the floor of the nose.

Again, it would be as impossible to force down the vault at the median line as it would be to force a keystone through a brick or stone wall by the weight resting upon it. The author, and others, have shown that deformed septa are

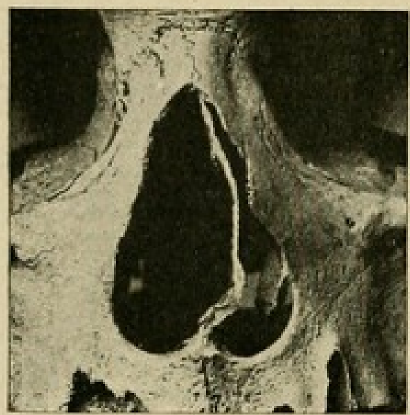

Fig. 71.

common among early and pure races, who do not possess contracted arches; so that it will be seen that one is not dependent upon the other. As regards the length of the septum, I agree with Morgagni, that it has developed beyond its normal size, and in order that it may accommodate itself to its surroundings, it must deflect either to the right or left. Statistics show, in some cases, that the right side has the preference; others show that the left side is more favored, and again, that it is about evenly divided as regards deformities.

Let us now examine some of these cases and see if we can throw any light upon this subject. The first seven cases are Peruvian skulls from Harvard college. Figs. 70 to 73, inclusive, are well developed, while Figs. 74, 75 and 76 are arrested in their development. These photos were taken by a regular photographer, and were arranged so as to get as much light into the cavities as possible. Some, however, are quite unsatisfactory, for, while they show the septum, the turbinated bones and surrounding parts are not well illustrated. Fig. 70 shows the septum deflected to the left—resting upon the inferior turbinated bone of that side. The right turbinated bones (which are poorly shown) are excessively developed, to such an extent that while they do not quite touch, they take the contour of the nasal septum. Fig. 71 shows a similar condition, while the nasal septum is not deflected quite as far. The right superior turbinated bone is excessively developed, but not to the extent of the inferior

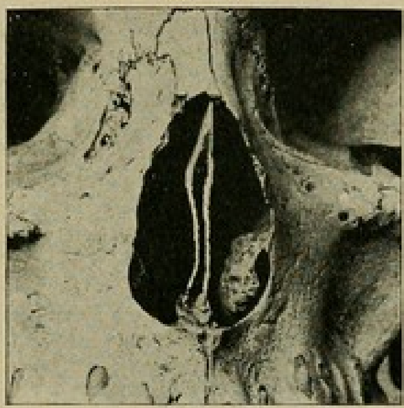

Fig. 72.

one. Fig. 72 shows a septum almost straight. The left inferior turbinated bone is nicely shown. The other turbinated bones are also excessively developed, but do not extend so far forward. Also notice that the septum is divided into two parts. It will be observed that in the other two, unlike this one, the turbinated bones are arrested in their development upon one side, and excessively developed upon the other. Both cavities are entirely, but uniformly, filled with complete masses of soft, spongy portions of the turbinated bones. Stigmata of degeneracy are marked all over the skulls, while the cavities of the nose are smaller, or arrested in their development. The two sides of the face are quite unlike, and the orbits are very much undeveloped. There is a marked arrest of development of the left maxillary bone, which contains an antrum only about one-half the size of the right side. The arrest of development has caused the teeth to be forced out on a large circle, in order that they may come in contact with the lower teeth. This action has caused the roots of the teeth, in many cases, to protrude through the outer plate of alveolar process. The mastoid processes are also excessively developed. A profile view was taken of this skull (Fig. 73) in order to obtain as good a view as possible of the large right inferior turbinated bone. This bone is so large that it extends nearly to the floor of the cavity. The most remarkable point in regard to this deformity, outside of the excessively developed turbinated bones, is, that

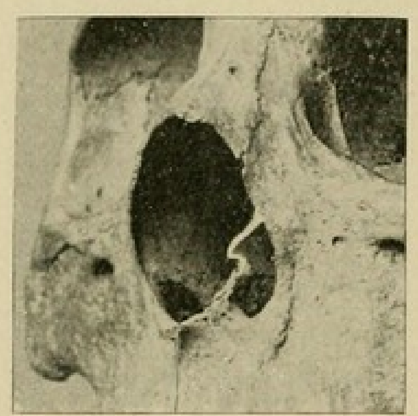

Fig. 73.

not only is the septum deflected to the left until it rests upon the wall of the cavity, but that the nasal spine is also deflected. Fig. 74 shows nasal cavities arrested in their development. The septum is but slightly curved to the left. The nasal cavities are filled with excessively developed turbinated bones, and the spaces between the turbinated bones and the vomer are about evenly divided. Fig. 75 shows a very small nose, the vomer is deflected to the left below, and at about one-third of the way up it takes a decided turn to the right. In the examination of the turbinated bones the right inferior bone is very large, the left very small, while the reverse is the case in the two upper bones. Fig. 76 also shows stigmata of degeneracy in the nasal cavities. Here the vomer is about straight, while the turbinated bones upon both sides are so large that they fill the cavities; the spaces between, however, are uniform upon both sides. We have now seen that deflection of the septum and excessive development of the turbinated bones are associated with large, well-formed nasal cavities, as well as with small, contracted cavities in ancient as well as modern people. The same relation exists between the vomer and turbinated bones in all the skulls as well as in living persons. The extent and location of the deformity depends upon the extent of development and location of the turbinated bones. They may not necessarily be excessively developed or arrested in their development, but if the outer walls are small, reducing the size of the nasal passages, and

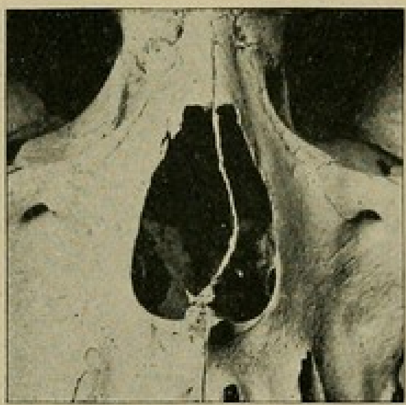

Fig. 74.

the turbinated bone unevenly situated or nearly filling the cavity, the septum will deflect to the right or left and conform to their shape, leaving uniform spaces throughout the entire length of the bone. Inhalation and exhalation cause the vomer before or during ossification to deflect to the right or left, according to the size and location of the turbinated bones. The air striking the septum, just as the wind strikes the sail of a boat, produces uniform spaces between the septum and turbinated bones. The bend or breakage is almost invariably at a point of the concavity just midway between the two turbinated bones on that side, and at the thinnest part of the vomer. When the turbinated bones are undeveloped upon one side and excessively developed upon the other, the force of air causes the vomer to bend toward the smaller turbinated bone, thus lengthening it, so that the air will enter and leave uniformly upon both sides, as illustrated in Figs. 70 and 71. If the turbinated bone is large upon one side, the force of air will cause the unossified vomer to develop, and if the cavity of the nose is large, the whole volume of air will eventually strike the vomer upon one side, causing it to bend right or left until the air is uniformly distributed or it comes in contact with the turbinated bones upon the opposite side. In Figs. 74 and 76, the turbinated bones, developing nearly uniformly upon both sides and filling the nasal cavity, give no opportunity for the septum to deflect to the right or left. The spaces, therefore, are uniform upon

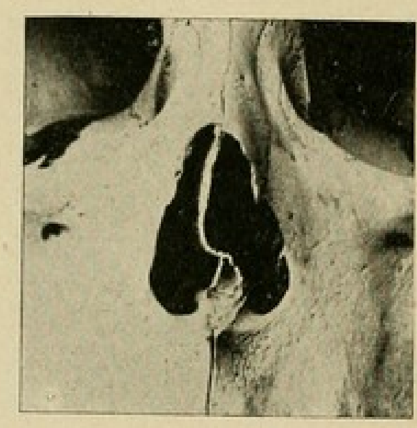

Fig. 75.

both sides. It is also safe to say that when these bones are covered with mucous membrane that the nose was completely filled, and that these persons were mouth-breathers.

Associated with unstable development of the superior maxilla and bones of the nose, we must necessarily have unstable development of the mucous membrane, resulting in a thickening of the membrane and adenoid growths. These conditions are almost always to be found in connection with stigmata of degeneracy. We can now see why, in idiocy, imbecility, etc., patients possessing (apparently) high vaults, are mouth-breathers. There is an arrest of development of the bones of the face, jaw and nose. The patient cannot breathe through the nose; the mouth being open the teeth and alveolar process develop down for want of antagonism;

and the contracted vault, which looks high because of the arrest of development, results.

It is quite common to find entire arrest of the inferior turbinated bones upon one side or upon both sides. Again, one or both inferior turbinated bones will be partially developed.

The following skulls, in the Army Medical Museum at Washington, possess such deformities:

Alaska Indians—

- Skull No. 1,090, case 177; lower right turbinated bone undeveloped.
- Skull No. 1,092, left inferior turbinated bone undeveloped, vomer gone.
- Skull No. 1,094, both inferior turbinated bones undeveloped.
- Skull No. 2,431, no inferior turbinated bone.
- Skull No. 2,453, no inferior turbinated bone.
- Skull No. 2,798, no inferior turbinated bone.
- Skull No. 2,451, no left inferior turbinated bone.
- Skull No. 1,216, case 180; both inferior turbinated bones undeveloped.

Many Peruvian skulls show undeveloped inferior turbinated bones. Thus:

- Skull No. 630, case 166; no right inferior.
- Skull No. 631, case 166; no right or left inferior.
- Skull No. 115, case 167; no left inferior turbinated bone. Individual over twenty-two years of age at time of death.

Excessive development of the turbinated bones is also very common. Thus, No. 2,131, case 175, Vancouver Island Indians: The right middle turbinated bone is excessively developed, so that it fills the anterior middle of the nasal cavity with a large cavity in the center. The left middle and right and left inferior bones were well developed, filling both nasal cavities. In this case the vomer, which stands uniformly between the turbinated bones takes, the shape of the letter S. No. 2,129, Vancouver Island Indians, shows left superior turbinated bones; excessively developed to a level with middle turbinated bone. The vomer is deflected to the right, then to the left, in order that it may stand in a central position. Skull 1,309, case 173, illustrates the theory of the author very nicely. The right middle turbinated bone undeveloped, inferior right excessively developed; the vomer at its middle takes a V-shape, in order that it may stand in the middle between the turbinated bones.

That inhalation and exhalation govern the development and shape of the bones of the nose is nicely illustrated in many ways. When the nasal cavities are small and the bones become enlarged upon one side, the outer wall will become

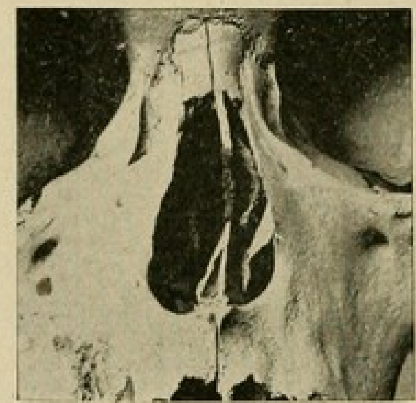

Fig. 76.

concave, encroaching upon the antrum. Again, when the nasal cavities are small, the turbinated bones will develop and curl upon themselves so that uniform space is obtained for the passage of air. In a long, narrow nasal passage the bones will develop long and narrow; the superior turbinated bone will develop down, sometimes below the lower edge of the superior turbinated bone. In other cases the nasal cavities will be short and broad. In these cases the bones will become large and short. I have seen them develop straight out from the outer wall, and then turn upon themselves back to the point of origin. Sometimes they are very thin and dense, like the vomer. Again, they are thick and cancellated, like the spongy alveolar process. Occasionally one nasal cavity will be lower than the other. In such cases a corresponding deformity is almost sure to result in the vault. When the nasal cavities are not uniform in development—that is, narrower in front than behind—the turbinated bones will develop posteriorly, and either become undeveloped anteriorly or will curve more, so that air may be evenly distributed throughout the cavity. When the turbinated bone develops larger or smaller behind than in front, the bone will bend upon itself to conform to this deformity.

Skull No. 736, case 179, has also a very marked deformity of the vomer; it is bent in both directions. The anterior half is midway between the turbinated bones, while the posterior half is bent to the right, the greatest point being between

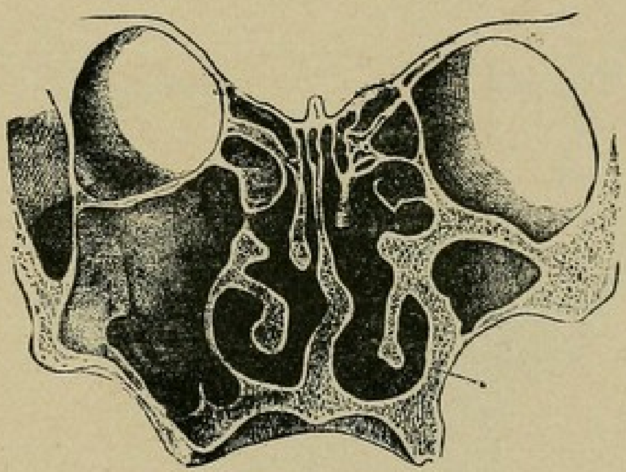

Fig. 77.

the right upper and lower turbinated bones. Both concavities have projections—one to the right, the other to the left. The anterior curvature of the vomer is the largest, and for this reason the left turbinated bone is undeveloped. This, however, does not allow sufficient room for the air to become evenly distributed through the nostril upon one side. The most remarkable thing is that to procure room the air had forced the vault of the mouth on that side downward, making a very marked and noticeable deformity. The dental arch is well developed.

Occasionally the turbinated bones are so situated that the air will deflect the vomer to one side or the other in such a manner that there will be a deformity at right angles, just below the inferior turbinated bone. This, however, cannot be located very near its place of attachment, for the reason that the vomer commences to enlarge or thickens as it reaches the nasal spine, thus preventing the bend.

The drawings of Zuckerkandl are here given because they illustrate the very points which I have made, and because they are true to life.

Fig. 77 shows the bone very unevenly developed. This is partly due to an excessively developed antrum upon the left side and a correspondingly small one upon the right side. It will be noticed that the turbinated bones and vomer are so distributed that there is a uniformity of space throughout the cavity. The vomer even has deflected to the right in order

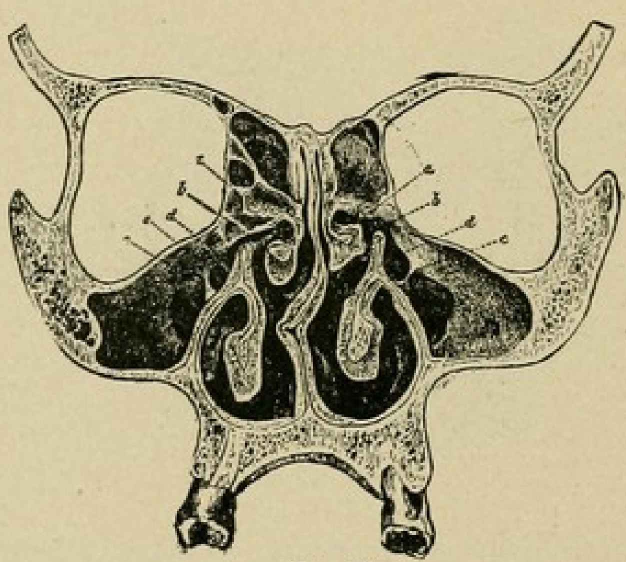

Fig. 78.

to produce this harmony. It will be observed, however, that the bone is not broken, but simply bent, and that this bend is about opposite the enlarged left inferior turbinated bone. Although the face is very asymmetrical, the bones, which are intended for the purpose of warming the air, are nicely arranged. The right cavity is considerably lower than the left; the inferior turbinated has lengthened to correspond. Aspiration has separated the lateral halves of the vomer, and the space has filled in with bone.

Fig. 78 is quite another case. Here we see the facial bone uniformly developed; the antra are comparatively uniform; the turbinated bones, however, are very unevenly developed.

The bend and break in the vomer are about at a point between the two turbinated bones, and exactly opposite the excessively developed right inferior turbinated bone. It will be observed that the bend is no greater in the one than in Fig. 77, and yet in Fig. 78 the left plate is fractured, while the right one is slightly bent. This is usually the case. There is not a complete fracture, but a semi-fracture.

Fig. 79 shows still a different condition. The left antrum is nearly closed; to compensate for this a number of sinuses are formed. In order that the air may be warmed uniformly the septum has developed to the left. The lower part has enlarged, and the middle has deflected to the right, thus

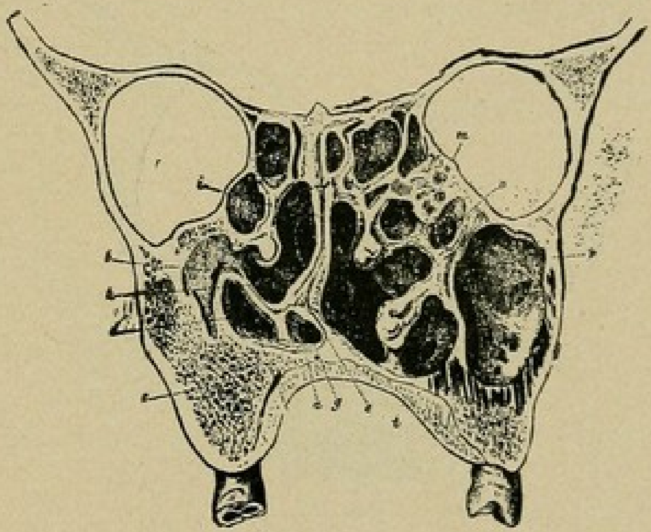

Fig. 79.

giving a more uniformity of spaces. The right inferior turbinated bone has also enlarged for the same purpose.

Fig. 80 is a splendid illustration of arrest of development of the bones of the face, nose and jaws. The bones are very unevenly developed, with excessive development of the left superior turbinated bone, which has a cavity in it no doubt for the purpose of producing more surface for the blood-supply. An individual with such a development must necessarily possess a degenerate condition, with weak lungs, small chest, and low vitality. In order that the air may be uniformly warmed the septum has deflected towards the right. The vomer has deflected towards the right in order that the turbinated bone may have room, and also to furnish uniform space. The septum in this case is bent and not broken.

Fig. 81 is another form of deformity which I have occasionally observed. In this drawing we observe that the nasal cavities extend laterally nearly outside of the alveolar process. If we were to undertake to open the antrum through the cavities of the teeth we should drill into the floor of the nose. I have observed such cases. Having such a large space the turbinated bones have adjusted themselves to the best advantage. The septum also has adapted itself as best it can by deflecting toward the left side, having bent itself at its weakest part and opposite the enlarged turbinated bone. There is,

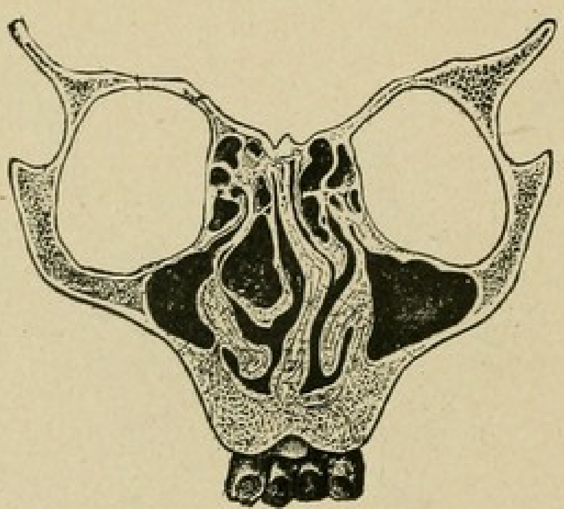

Fig. 80.

however, a large space upon the right side between the two turbinated bones. The thickness of the bone prevents its being bent by the pressure of air, and excessive development of the vomer has taken place upon that side as a substitute.

Fig. 82 shows the turbinated bones upon both sides excessively and uniformly developed, the result of which is that the vomer is straight upon the left side, while the right half has been torn away, and by aspiration the air has drawn it slightly into the space between the two bones.

Figs. 83 and 84 are drawings taken from frozen specimens in the Army Medical Museum at Washington, showing that the parts of fracture and deflection are situated between the turbinated bones.

Another illustration, to show how nature will adapt herself to abnormal conditions, is nicely shown in a skull in my possession of a girl fourteen years of age, who died of consumption. There is hardly a bone which goes to make up the skull, including the lower jaw, that does not show stigmata of degeneracy. The left inferior turbinated bone did not develop. A simple ridge is present where the bone should be attached to the outer wall. The right inferior turbinated bone is excessively developed. The vomer has curved to the side where there is space and from the enlarged right turbinated bone. Although there is quite a bend, owing to the fact that the girl died at the age of fourteen, it did not develop and bend to the extent that it would had she lived.

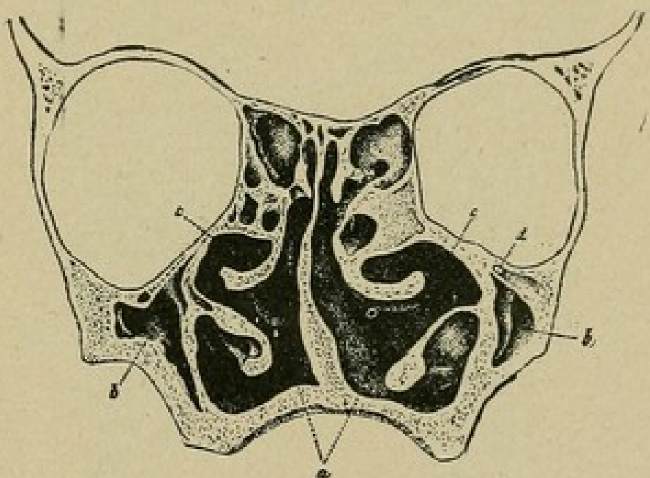

Fig. 81.

Another case is that of a bone projecting .36 of an inch, (situated upon the right side of the vomer just midway between the superior and inferior turbinated bones) .75 of an inch in length, 1.50 inch in from the nasal spine, and .50 of an inch from the posterior border, which is comparatively straight. The anterior part is slightly curved, but perfectly straight .50 of an inch anterior to the commencement of the deformity. There is a slight groove upon the opposite side of the vomer to correspond to the line of projection. It stands just midway between the two turbinated bones. This is not a fracture, nor can we in any sense claim that the projection is for the purpose of repairing a fracture. The length of this projection would also preclude such an idea. These projections vary from a mere ridge up to a projection .36 of an inch in width. It would seem that nature, being unable to develop the bone sufficiently to carry it far enough, built out a projection in order to complete its design.

These projections were first mentioned by Langenbeck, who gave to them the name of exostoses. They were afterwards described by Theile, Harrison Allen and John Mackenzie. "These projections," says Bosworth, "are always found along the sutural lines of the septum, and consists in a more or less well-developed angular prominence or ridge, which, projecting into the nasal passage, acts to obstruct normal respiration."

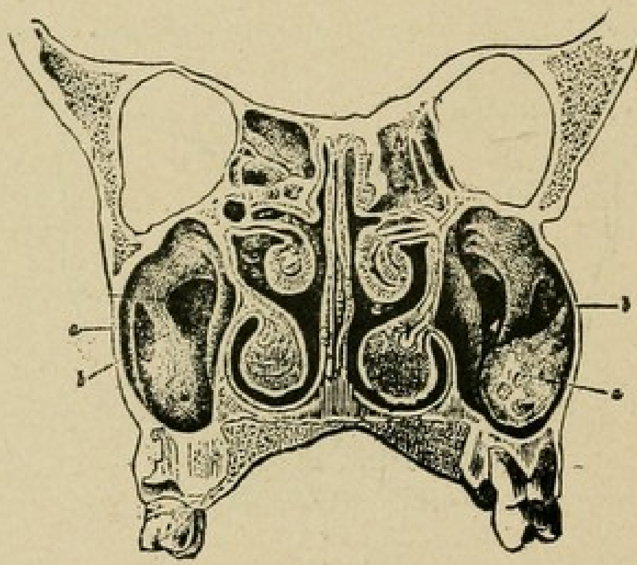

Fig. 82.

This has not been my experience, as I have always found them situated upon the convex surface, and the greatest projection being at the weakest point of the septum. As the greatest deformity may be located at any point between the anterior and posterior edges of the bone, we are liable to find the greatest point of projection on any part ot the septum, but they are always situated midway between the turbinated bones. This projection I believe to be due to irritation, the result of inhalation and exhalation.

From the observation made it would seem that the deflection of the vomer was due to a wise provision of nature. In its deviation to the right or left, with a decided depression always at a point where there is the greatest space; sometimes in the anterior part of the bone, and often in its posterior part; sometimes high up, and again low down, depending upon the location of the turbinated bone, with a rib of bone developed upon its convex surface, which I believe is nature's way of supporting the deformed parts. My reason is that it does not extend the entire length of the septum. It seems to be also intended for a supernumerary turbinated bone. The deflection and the supernumerary turbinated bone are to compensate for the space on either side of the nose. Just as the intelligence of the individual depends upon the amount of gray matter in the brain, and the gray matter depends upon

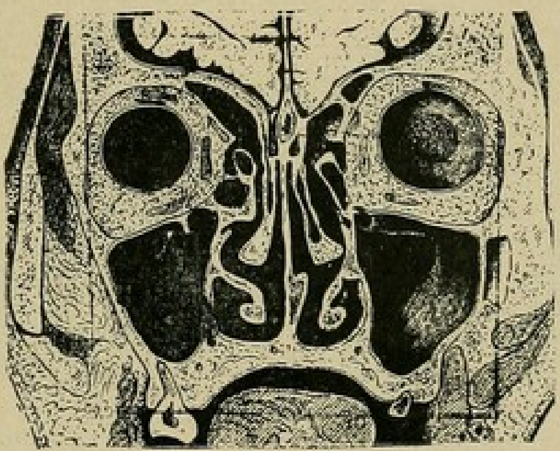

Fig. 83.

the number of lobes or convolutions, so the warmth of air which is taken into the lungs depends upon the amount of blood, the blood upon the amount of mucous membrane, and the mucous membrane upon the contortion of the bones of the nose to produce surface. If they are arrested upon one side, those upon the other enlarge or elongate, and thus make up for the deformity. I have also shown that when the inferior turbinated bone is entirely arrested the bend in the septum and projection seem to compensate for the loss. In neurotics and degenerates, in many cases, the lungs and the chest walls are undeveloped and very delicate. Nature requires that the air shall be of a uniform temperature before it is taken into the lungs.

The deformities take place before puberty, and in a majority of cases before the sixth year. We know this to be the case, because the stamp of degeneracy is placed upon the face at this time. The arrest of development of the jaw takes place at the time the second teeth erupt, and the arrest of the nose and face shows that the individual possesses a face of that age.

The width of the external nasal cavity varies considerably. In 2,000 cases, the greatest width was 1.25 of an inch; the smallest width was .75. The length from the nasal spine to the edge of the nasal bones was (greatest length) 1.54 and the smallest 1.20 of an inch. These skulls, however, are made up of Peruvians, stone-grave Indians, mound-builders,

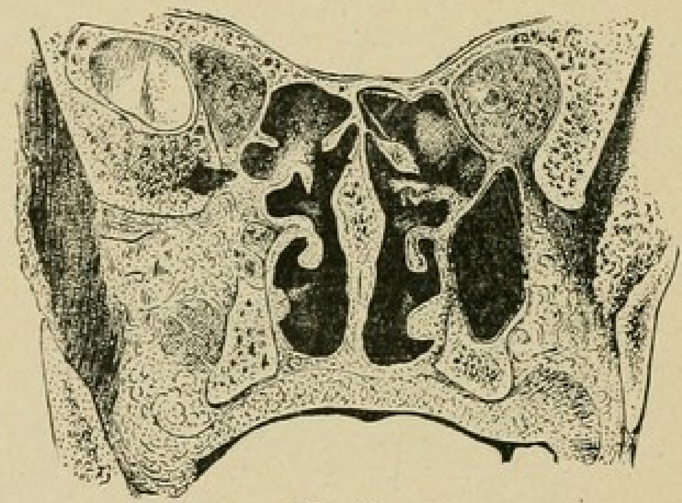

Fig. 84.

cliff-dwellers, Hawaiians, etc., etc. In neurotics and degenerates, when arrest of development of the face and nose had taken place, I found that the width measured .50 to .60 of an inch, and the length .80 to .90 of an inch. In these cases, if the turbinated bone developed uniformly, the vomer will be straight. If asymmetry exists, the vomer will be deflected to one side or the other, in which case the bone, when covered with mucous membrane, will fill the cavity of the nose and mouth-breathing will result.

Taking a general view of the nose, in many cases there is a want of harmony in its general outline. The nasal bones become arrested in their development, and the tip of the nose is turned up, owing to a normal or excessively developed cartilage. Another and very marked deformity is one in which the nasal bone and cartilage are excessively developed. The bone takes one angle and the cartilage another, producing a double nose. This condition is very common among Hebrews. There are, however, Americans frequently seen upon our streets who have developed nasal organs to such an extent that there is material enough for two fair-sized noses. In a majority of these cases there is a total collapse of the walls of the nose, and frequently mouth-breathing results.

Fig. 88 illustrates such a case, although the nose is not nearly as large as these two I have just alluded to. This illustration, however, gives a fair idea of such cases. In over 2,000 measurements of the nasal bones, the shortest was found to be .40, the longest 1.65 of an inch in length. It will be seen that even the bones without the cartilage would make a fair-sized nose. These bones take different angles. It would seem that those which are the largest take the greatest angle. A form of deformity, which is more common than is generally supposed, is that in which the nose is deflected to the right or left. This deformity, however, is often so great that it produces a marked asymmetry of the face, and often so slight as to be unnoticed by the average observer. There is no doubt that it is carried to the right or left by the cartilaginous septum, when only the soft tissues are involved; but when the bones of the nose are deformed, quite another condition exists. Marked deflection, as well as other deformities of the nose, are not observed in early life, but as the face develops the deformity becomes more prominent, and at the age of puberty is well defined, although it does not reach its full development until twenty-five or thirty years. In most every instance the two lateral halves of the face are asymmetrical, as well as the nasal bones. The bones of the nose develop upon one side and deflect the lower border to the opposite side, where the bones are undeveloped. This has a tendency to deflect the cartilaginous septum in the same direction, which, in turn, exaggerates the deformity. The author has observed noses in neurotics and degenerates deflected nearly 45° from a normal position. It has been stated that these marked deflections are due to injury *in utero* or at birth. As the bones of the nose are undeveloped at birth, and as marked deflection is not observed until later in life, it would seem out of place to bring forth such a theory.

At birth the nasal cavities are not evenly developed. Nature tries to correct this defect. If one side is larger than the other, more air will pass through one side than the other. If the two sides are nearly even, the amount of air will be about uniformly distributed.

Ziem has shown that if one nostril of a rabbit be permanently closed and the animal killed after it has attained its full growth, the nasal cavity of the affected side will be found to be undeveloped, and asymmetry of the face will have taken place. This is also the case when one side is undeveloped; the air passes through the opposite side and the passage becomes enlarged. A greater quantity of air passing through, a greater surface of mucous membrane is required to warm it. The turbinated bones become physiologically enlarged, owing to the stimulation of the air, and the vomer is carried to the weak side. The undeveloped condition of the nose and asymmetry of the face of animals, as demonstrated by Ziem, can be accounted for in no other way than a want of stimulation of air inhaled and exhaled.

The septum ossifies much slower than the surrounding bone, and therefore it is more easily moved out of its normal position. At, or about the sixth year, the deformity is well established. The air stimulates a physiological development of the septum, and it bends toward the undeveloped side. It grows faster than the points of attachment, and as a result the septum, according to the law of mechanics, bends toward the smaller part. When inhalation takes place, the air passing through the undeveloped passage, produces suction, thus drawing the bone toward that side; while upon the other hand, the large volume of air passing through the large nostril, forces it in the same direction. Thus, by aspiration and pressure, the thinner part of the bone is bent to the weaker side, which gives a uniform space for the pressure of air throughout the nose. The location of the deformity depends upon the asymmetry of the two sides and the thinness of the vomer. We will frequently notice, by close examination of section of the vomer (as illustrated in Figs. 82, 83 and 84, and also in plates 1 A, 1 B and 1 C, of "Atlas of Head Sections," by Wm. Macewin, M. D., just published), projection upon one side or the other, and sometimes upon both sides, due to fracture or excessive development of bones that they are always located between—the turbinated bones. They are not always just in the center, but they are not far from it. I believe these are also the result of stimulation by exhalation or aspiration of air, producing a healthy physiological action at that point.

When a slight irritation of the mucous membrane takes place, as a result of cold, it thickens. The child experiences difficulty in breathing. In the spasmodic effort to draw air into the lungs through the nose a vacuum is formed and the septum is developed and drawn to the point of least resistance, which would naturally be at a point between the turbinated bones. In this manner the septum takes the outline midway between the bones. The fracture very rarely extends through the two halves of bone; only one side breaking, while the other is simply bent. The fractured half being always upon the convex side leads the author to believe that it is due to (1) the thickening of the mucous membrane, (2) accumulation of moisture or purulent mucus, and (3) an excessive effort on the part of the patient to draw air through the nose. This being impossible the vomer is drawn into the space after partial ossification has taken place, and, as a result, fracture of that half and simple bending of the other half. The edges of the broken half are torn apart from the other half, producing a space between, which is eventually filled up with bone cells. This condition is not unlike the fracture of a green stick. Sometimes it will be drawn to the right side in one place and to the left in another. Again, in the same manner, the two lateral halves are separated their entire length, as illustrated in Fig. 72. Please note that there is a projection of the right half at a point midway between the right turbinated bones. This seems to the author to be the only natural thing, since, in many cases, the deflection and fracture only extends a short distance in the anterior middle, or posterior part of the vomer, while the bone will be perfectly straight anterior and posterior to the deformity. The shape of the deflection and fracture, it seems to me, can be accounted for in no other way. In order that fracture may take place, the vomer must have ossified partially or completely, which occurs at middle life; therefore injuries *in utero* or subsequently, before ossification, are out of the question. If the turbinated bones are uniformly developed the vomer will, in most cases, remain quite or nearly straight. The force produced by drawing air will frequently separate the two halves and, occasionally, produce one fracture upon one side, the other upon the other side. Not only are the cartilages of the nose brought in close relation to each other, but, occasionally, the force is so great that there is a total collapse of the outer bony walls and they are drawn toward the septum, making a groove upon either side, the nasal bones remaining perfectly flat at the upper edge.

In this way, by taking a general view of the cavities and the nasal bones, we find a uniform distribution throughout the nasal cavity.

Under such conditions the specialist should be exceedingly careful in regard to operations for the removal of excessive growths in the nose.

The conclusions here reached may be stated as follows: The deviation of the nasal septum to one side or the other is the result of an unequal development of adjacent bony parts, more especially and directly of that of the turbinated bones. It depends largely, if not exclusively, upon the development and position of these latter. They, in turn, are dependent in great measure upon the development of the facial bones, which are modified as the facial angle increases and prognathism is lost. The turbinated bones being, as it were, exostosed, not molded in many directions by adjacent parts, encroaching more irregularly upon the nasal cavity, as their origins are disturbed or dislocated. The freedom of these nasal passages for the the transit of respired air is essential, and the tendency of normal respiration is for both nostrils to share equally in this function. The natural consequence of this is that the vomer, the ossification of which is incomplete until puberty, is deflected and occupies as nearly as possible, as a rule, a midway position between the bony prominences on either side. The deflection of the septum is therefore a compensatory arrangement for the evolutionary imperfections of the facial development—it is an incident of evolution. We find

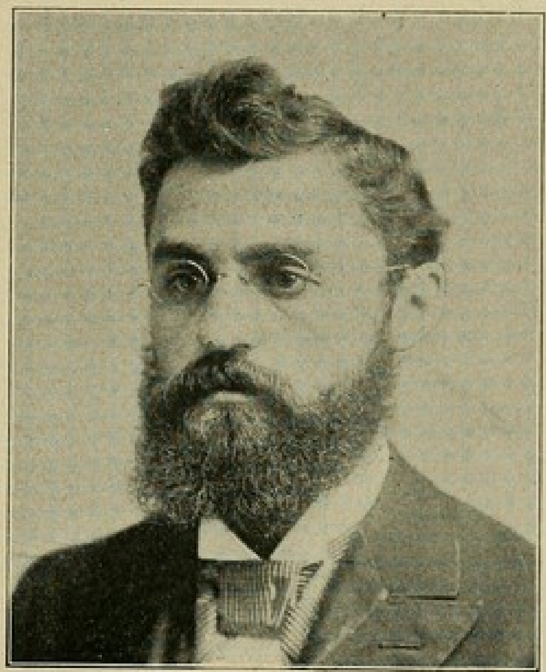

Fig. 85.

it therefore most frequent in the higher races, while in the ancient Indians of this country and the negroes and others, as observed by Allen, others and myself, the percentage of its occurrence is markedly decreased.

Instability of tissue-building is to be expected in neurotics and degenerates. It is easy to see how with such an unstable bone tissue to build upon the mucous membrane of the nose can take on atrophy, hypertrophy and adenoid growths, resulting in mouth-breathing.

It seems to be the accepted opinion of physicians at the present time that consumption is not an inherited disease, but that the patient inherits or acquires a weak constitution, and at certain periods, when the system is in proper condition, the bacilli find a habitat in the lungs and disease results.

The human mouth is known to contain bacteria of almost every variety, and the author has taught students for the past ten years that it was his opinion that the mouth becomes the nidus for the accumulation of germs, and that when the system becomes in the proper condition, these germs bring on not only tuberculosis, but pneumonia and affections of the throat, including lesions ranging all the way from simple sore throat to the most malignant form of diphtheria, and it seems to the author that these conditions may be avoided, to a certain extent, by keeping the mouth in a healthy condition. Persons who are susceptible to these diseases, but more particularly consumption, are those who have inherited weak constitutions, such as neurotics and degenerates. Somatic signs are quite noticeable in most of these cases, and by early recognition, proper treatment with change of climate will, in

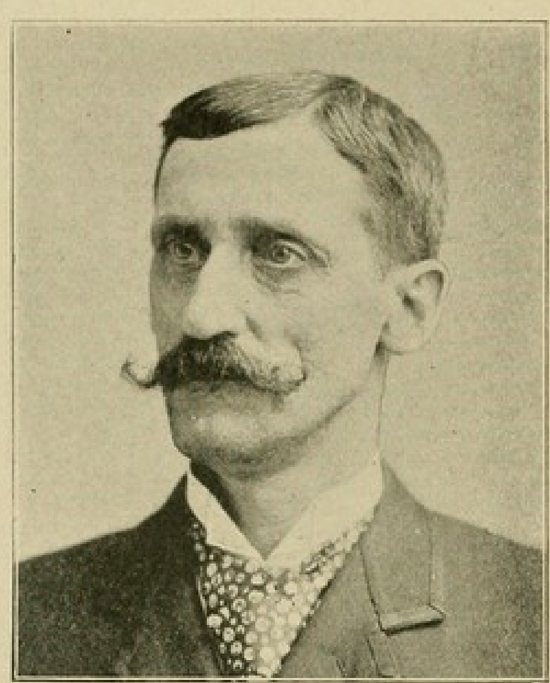

Fig. 86.

most cases, prolong life for many years. These signs have already been spoken of indirectly, but as they have a direct bearing upon deformity of the nose, it will not be out of place to call the attention of the reader to some of the deformities, and one that plays an important part in the welfare of the patient: Total collapse of the outer walls of the nose is frequently observed among neurotics and degenerates. This is associated with arrest of development of the bones of the face, jaws, deformities of the dental arch, weak, contracted chest,

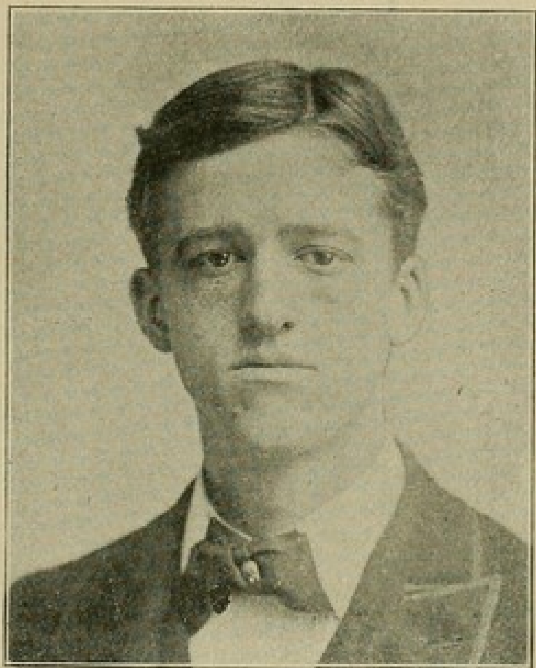

Fig. 87.

round shoulders, husky voice, etc. In most cases of this description the nose is very long and thin. The nasal bones are excessively developed or arrested, with marked deflection of the septum. Frequently some one of the different forms of nasal catarrh are present. When the patient attempts to inhale air the outer walls are brought together and nose-breathing is impossible. The result is mouth-breathing, not only taking cold air into the lungs, but also diseased germs. The preceding illustrations (Figs. 85, 86, 87 and 88) are those of persons who possess all of the signs herein enumerated.

These pictures are front views of those used in the chapter upon deformities of the face, and are intended to illustrate the long, slender nose. By comparing these with those representing the side view, a very good idea of the thinness may be obtained. Three of these persons are now infected with tuberculous deposits, and the fourth will require the best of care to prevent infection. It is possible for persons to contract tuberculosis who do not present stigmata, but it is the experience of the writer that parents who have children possessing the somatic conditions noted in this chapter should

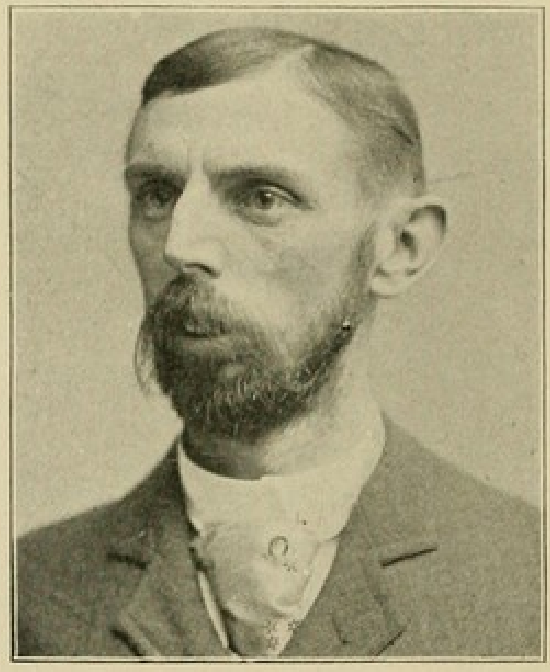

Fig. 88.

pay particular attention to their early hygienic welfare in this regard.

CHAPTER XXV.

NEUROSES OF DEVELOPMENT OF THE ANTRUM.

To describe the antrum is one of the most difficult tasks which the author has ever undertaken. He has examined many skulls with this idea in view; but he has found that a description of one would not answer for another. Indeed, no two could be found to correspond, and their location, as will be observed, is not a certainty. The length, height, width and location of the antrum is governed entirely by the shape of the face and by the bones of the nose and of the superior maxillæ, thus different nationalities would possess antra of different sizes and shapes. They seem to assume the greatest variation even in normal individuals, while stigmata of degeneracy are not only marked upon the external but also upon the internal surface, in neurotics and degenerates. We cannot say, however, that a large maxilla will contain a large antrum or a small maxilla a small antrum; many things will have to be taken into consideration. Indeed, it would be impossible by looking at a person to outline the position of the cavity. Gray says: "The antrum is a large, triangular-shaped cavity; its apex, directed outward, is formed by the malar process; its base by the outer wall of the nose. The author has examined skulls where the base of the triangle and apex were just the opposite. Indeed, from the author's experience, he would very much doubt the propriety of calling the shape of the antrum a triangle. He has observed antra almost square, with rounded corners; others that would be very difficult to describe owing to the many deformities which they assume. Septa and bulging here and there with corresponding depressions would preclude any such description. We occasionally find the outer wall of the nose bending into the antrum, filling 25 to 33 per cent of its space. Occasionally, the outer walls of the antrum will be very thin; in such cases the antrum will be large and well formed, but when thick, we usually find the antrum small and badly deformed. If the orbits are not evenly located (which is very common) the vault of the antrum will be higher upon one side than upon the other. Sometimes the contour of the orbit will be changed so that in one antrum the outer wall will be the highest, and again the inner wall in another. This, however, will depend to a great extent upon the general construction of the osseous structure.

Occasionally we will find the nasal cavities so large that they will extend nearly or quite to the outer alveolar borders. Again, the antrum will not be larger than the end of the little finger and will be located in the malar process.

In cases of stigmata of degeneracy, as illustrated in "Arrest of Development of the Bones of the Face and Jaw," we would expect to find different shapes and positions of the antrum. Thus, in one case, the cavity was very small and resembled a crescent, with its concavity toward the nasal wall, its convexity toward the malar process. It was not large enough to admit the end of the little finger. In this case it did not extend as far laterally as the inferior orbital opening. The opposite side was similar in shape and extended just beyond this opening. Sometimes the antrum upon one side will be very long, while that of the other is very small; usually the nasal cavity will be carried over nearly one-half of its size to the side of the smallest antrum. We sometimes find soft, cancellated bone extending the alveolar process into and filling the antrum, leaving a number of small openings or sinuses which resemble the ethnoidal cells. In these cases the contour of the face is also very much disfigured; a drill passed through the alveoli of the first and second bicuspids would not reach an opening.

Bosworth says, on page 75, in reference to the development of the antrum (Fig. 89): "Or again, deficient absorption of the alveolar process in fœtal life may produce marked encroachment upon the lower portion of the cavity. On the other hand, the cavity may be abnormally enlarged from excessive absorption of osseous tissue in fœtal life downward into the alveolar process or forward, as the result of which the antrum may extend between the floor of the nose and the hard palate, as seen in Fig. 90, or it may extend up into the malar bone or into the frontal, as the result of a similar process of absorption in this direction."

As the alveolar process is never developed in fœtal life, nor to the extent as represented here, until all the permanent teeth are in place, which would be at about the tenth to the twelfth year, absorption could not take the place of something that did not exist. Again, there is not room for the development of the first and second set of teeth.

This drawing (Fig. 89) illustrates a jaw and nasal bone of a person, certainly in later life, after all the teeth had been removed and absorption of the external surface of the alve-

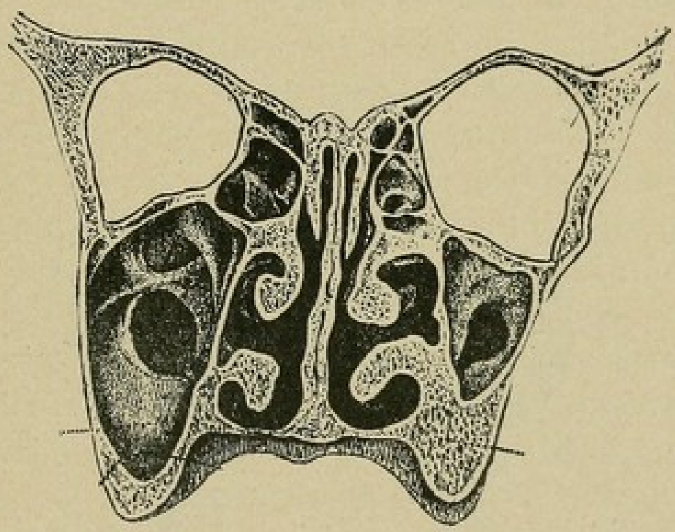

Fig. 89.

olar process had been going on for many years. The roundness of the alveolar process, the ridge of bone in the vault and the vault itself, indicate this to be the case. An alveolar process the size and shape illustrated here could only develop with the second set of teeth. It will be observed that the left antrum is unusually large; that it extends up to and encroaches upon the left orbital cavity and quite a distance along the inner border. It also encroaches upon the left nasal cavity and downward into the alveolar process. The right antrum is very small, as a result of which the alveolar process is very large and extends quite a distance into the floor of the nose. To compensate for this want of harmony in the development of the antrum, the turbinated bones have become enlarged, and although the nasal cavities have developed considerably to the right of the face, all the bones of the nose have so arranged themselves that there are uniform spaces between them. If the teeth in this individual remain the usual number of years (this drawing represents a person from forty-five to sixty-five years of age) the only absorption that could possibly take place would be at the outer border of the alveoli.

Fig. 90 not only shows the antra extending toward the median line upon both sides, encroaching upon the nasal cavity, but there are also ridges of bone and septa extend-

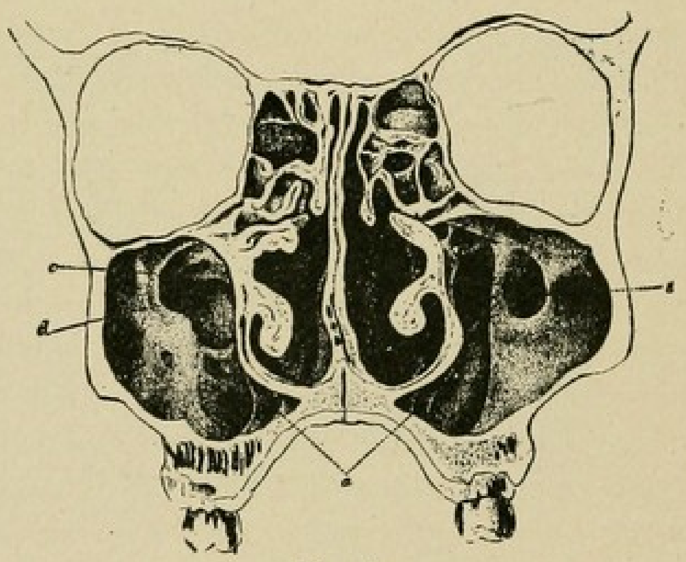

Fig. 90.

ing through the cavity. This is likewise the case in Fig. 89. To say that absorption of tissue can take place and produce these large and abnormal cavities encroaching upon other cavities, developing these to one side, does not, with our knowledge of absorption and deposition of bone, account for these conditions. That the building up of abnormal tissues went on at the time of the original formation and shaping of these cavities there can be no question, and until a better reason is given it must be said that it is due to a want of balance in nerve function, which presides over development, or they are stigmata of degeneracy.

The following cases are given to show the different shapes and locations of the antrum:

Case I.—Is that of a prostitute. Width of dental arch, 2.25. The antrum upon the right side extends back as far as the third molar, forward to the canine eminence; from the lower border of the alveolar process to the floor of the orbit, the cavity was triangular in shape; the apex being downward at the alveolar process; the base being the floor of the orbit. Its length at the lower part was 1.50; at the upper, 1.75; height at the posterior part, 1.75; anterior part, 1.50; width below, .25; at the upper, .62 of an inch. The cavity was divided into two separate parts by a septum of bone .50 of an inch in height; another septum of bone extended horizontally along the inner side opposite the inferior orbital ridge. The left side of the superior maxilla was very much arrested in its development, with a marked protrusion of the alveolar process and teeth to make a respectable dental arch to correspond to that of the other side. The antrum extended from the third molar forward to the second bicuspid. The length of the antrum at its lowest part measured 1; upper part, 1.50; height at the anterior part, 1.24; at the posterior part, 1.60; width at lower border, .36; at upper border, .50. The apex in this case was located at the malar process, its base being the outer wall of the nose. A drill passed into the cavity of the first bicuspid upon the right side would penetrate only one-half of the antrum, while it would require an opening at the second molar to drain the posterior cavity. In either case the drill would have to travel only about .25 an inch from its outer border. If a drill were carried into the antrum at the anterior root of the first permanent molar upon the left side, it would have to pass .75 of an inch to reach it.

Case II.—Is that of an Irishman, a degenerate and epileptic. Width of dental arch, 2.75; vault is .84 in height; jaws are very large and massive. The antrum upon the right side extends from the posterior surface of the third molar forward at lower border to the anterior root of the first permanent molar; at the upper border, on a line with canine eminence. Over the root of the second bicuspid there is a very marked depression, showing that the walls of the antrum unite at that point. The cavity is almost square, as will be seen by the figure; length of lower border, 1.12 of an inch; upper border, 1.52 of an inch; height of anterior part, 1.25; posterior, 1.20; width below, .75; above, .80. To reach the antrum at the second bicuspid the drill would have to travel 1.25 from the lower border of the alveolar process; at the anterior root of the first molar, .75 from lower border. The antrum upon the left side extended .50 of an inch back of the second molar (the third molar not being present) forward to a point over the root of the second bicuspid; the upper part extended as far as the canine eminence. Length at lower border, 1.25; upper, 1.75; height anterior, .7; posterior, 1.25; width, .75; lower border, .78; upper border, .80. To reach the antrum at second bicuspid the drill would have to pass 1, with difficulty in reaching it; at anterior root of first molar, .84. Both cavities are free from septa.

Case III.—Is that of a criminal. The third molar was never present upon the right side. The antrum, therefore, extended .50 beyond the second molar forward as far as the anterior root of the first permanent molar, on the upper border to a point above the canine eminence. This cavity possesses a very peculiar shape, as will be noticed in the figure. Length of the lower border, 1; upper, 1.50; height anterior, 1; posterior, 1.25; width lower, .50; upper, .84; triangular in different directions. First apex at outer surface of malar bone; base outer plate of the nose; second apex anterior near the nose, and base toward posterior surface. The roots of the first and second molars penetrate the antrum as in drawing. The antrum could only be reached by going through the outer plate of the alveolar process at the first permanent molar. The antrum upon the left side extended from the posterior surface of the second molar forward to the first permanent molar. Length of lower border, 1.25; upper, 1.75; height anterior, .75; posterior, 1.25; width lower, .50; upper, .60. This was a very remarkable cavity. The roots of the second and third molars penetrated the floor of the cavity; an abscess had appeared upon the buccal roots of the first molar, without injury to the floor of the antrum. The outer wall of the nose had bulged into the antrum its entire length and width from the lower turbinated bone to the floor of the nose. The inner and outer walls of the antrum had become united at about its middle by a septum, making two distinct cavities.

CASE IV.—Is that of a pauper. The antrum upon the right side extended .50 of an inch beyond the third molar; forward at lower border as far as the second bicuspid; at upper border to a point over the canine eminence. The apex of the triangle in this case is located at the junction of the wall of the nose and floor of the orbits. The base was formed by the outer surface, the malar process; a ridge, dividing the anterior part of the antrum into two cavities, extends from the floor of the orbit down about half the depth of the antrum at a point of exit of the inferior orbital nerve and artery. The outer wall of the nose curves into the antrum, filling it about one-third full. It will be seen, therefore, that the cavity is very irregular in shape. Its length at the lower border is 1.12; upper border, 1.38; height, anterior part, .75; posterior, 1.25; width lower border, .36; upper, 1 inch. The molar teeth extend into the floor of the cavity. Arrest of development of the maxillary bone upon the left side necessarily causes the antrum to be much smaller than upon the right side. Like the right antrum it extends .60 of an inch beyond the molar; its lower border extends forward to the anterior root of the first permanent molar, its upper border to a point over the cuspid tooth. Length of lower border, 1; upper, 1.25; height anterior, .75; posterior, 1.12; width lower edge, .25; upper, .92. The palatine roots of the first and second molars penetrate the floor of the antrum.

CASE V.—Is that of a prostitute. The right antrum is very small and extends back to the posterior surface of the second molar, the third molar not being present. From the lower border of the antrum to the lower border of the alveolar process is .75 of an inch; the roots of the teeth therefore do not reach within .25 of the floor of the cavity. The length of the lower border is .75; upper, 1.12; height of the antrum, .60; posterior, 1; width of lower, .25; upper, 1. A septum extends the entire length of the outer and inner walls, except a space about the size of a lead-pencil, dividing the antrum into almost two distinct cavities. The left antrum extends to the posterior border of the third molar; the cavity is slightly larger than the other, although the alveolar process is just as large, and therefore, the anterior border, so far as the teeth are concerned, has no relation to this. The length of lower border, .86; of the upper, 1.22; height of antrum, posterior, .62; anterior, 1; width, .28; upper, 1.02. This cavity contains a number of septa running in every direction. The nasal bone bends inward, and in every way shows stigmata of degeneracy. If a drill were to carried into the antrum through the roots of the bicuspids it would have to travel .60 of an inch, and then would not reach the lowest point. We are not warranted in making openings into the antrum through the root canals of the molars, because they rarely incline in that direction. The drill would pass either into the floor of the nose or out at the cheek.

The following illustrations, here referred to, show stigmata of the antra and the difficulty of always reaching the floor of the antrum by passing a drill up through the alveolus for the purpose of drainage. Fig. 77 illustrates the left antrum excessively developed. The base of the cavity located at the floor of the orbit, the apex near the borders of the alveolar process, extends quite a distance toward the median line and under the nasal cavity. It even encroaches upon the left nasal cavity at its upper border. A drill would pass without trouble into this cavity through the palatine or even buccal roots of any of the molar teeth. Quite a different state of things is noticed upon the right side. The nasal cavity is carried over and occupies the space where the antrum should be located. The antrum is very small upon the inner surface of the malar process under the eye. A drill passed through the alveolus would certainly enter the floor of the orbit. Fig. 78 also shows both antra located in such a position that the drill passing through the alveoli would not penetrate, but in both cases the floors of the nasal cavities would be punctured. The left antrum in Fig. 79 is almost entirely obliterated. Stigmata are not only seen in the antra, but also throughout the nasal bones and ethmoidal cells.

It is possible to reach both antra by drilling through the alveoli, but it could not be accomplished without difficulty. The cross section of Fig. 80 was taken so far forward that a description of the antra is out of the question.

Fig. 81 shows the antra so small as to be almost obliterated. The nasal cavities, however, are so large that the floors of these cavities would be punctured if a drill was passed through the alveoli.

Some years ago I recorded a case where a patient, in having an opening drilled through the cavity of the second bicuspid to relieve the antrum, the drill passed into the floor of the nose. At that time it occurred to me that there was gross ignorance on the part of the operator as to the location of the antrum. My attention has since been called to several cases by specialists.

In my examination of skulls for the purpose of preparing this chapter, I have discovered some seven or eight cases where the floor of the nose was so wide and the facial bones so deformed that the long axis of the roots were directed into the floor of the nose. In each case the floor of the nose would be perforated were the operator to drill through the palatine buccal roots of the first or second molars. Again, I have frequently observed arrest of development of the maxillary bone on a line with the alæ of the nose, when the alveolar process (in order that the teeth might antagonize with the lower teeth) extended outward to such an extent that the apices of the roots of the bicuspids would point entirely outside of the line of the antrum. It will be seen, therefore, that the alveoli are not a reliable route by which to reach the lowest point in the floor of the antrum, nor is the operator sure of reaching it at all. It is easy to see how in a very few cases the development of the antrum and nasal cavities might be so arranged, together with the thinness of the alveolar process, that the roots of the teeth may penetrate the floor of the antrum, as illustrated in Fig. 91. These cases, however, are very rare, as we shall see later. Again, we can also observe how in most cases, owing to the thickness of the alveolar walls and the position of the antrum, the roots of the teeth will not reach it. As will be noticed it is very rarely and almost never the case that the roots of the first and second bicuspids enter the floor of the antrum. The roots of the first permanent molar in its relation to the antrum are such that it is almost impossible to penetrate them.

Of the 11,000 skulls examined for deformities only 3,000

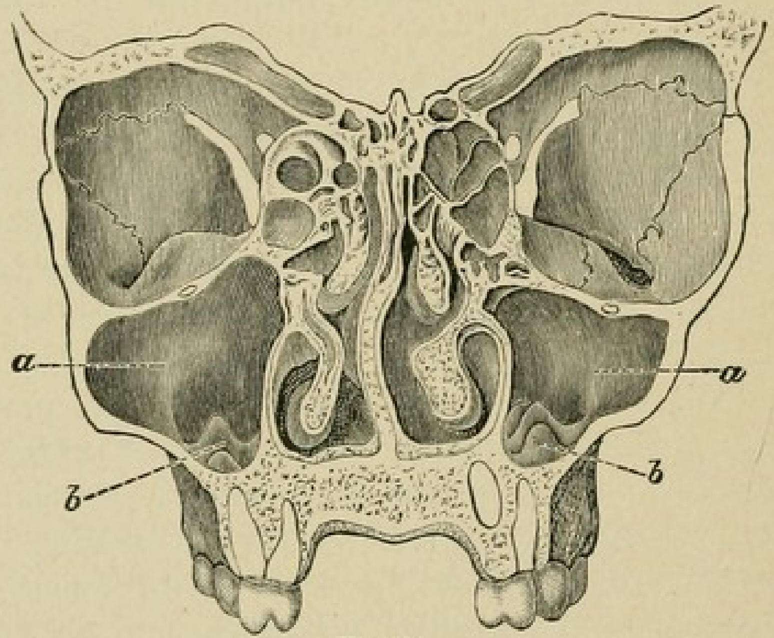

Fig. 91.

were in a broken condition, so that the antra could be examined, making 6,000 antra in all. Of this number 1,274, or about 21 per cent, had abscessed molar teeth. Of this number 76, or about 6 per cent, extended into and apparently discharged into the antrum. Taking into consideration the fact that specialists were unknown among the people whose skulls were examined, we would expect to find a larger percentage of abscessed cavities than at the present day, which has been shown by the examination of both skulls and patients. Septa were found in 963 cases. These ranged all the way from a simple ridge running along the floor to a partition extending two-thirds the height of the cavity. Again, several septa occurred in all directions, which gave the appearance of of ethmoidal cells extending throughout the entire cavity.

In the treatment of 367 cases of pulpless teeth, in connection with the superior molars, in the past twenty-two years, only three cases of diseased antrum were noticed, making less than three per cent of diseased antrum.

Dr. M. H. Fletcher found in 224 cases of pulpless molar teeth, treated by him, only one case of pus in the antrum. These statements, therefore, would show that antral difficulties are very rarely connected with the teeth. The author is of the opinion that most cases of diseased antrum seek the specialist because most cases are connected with the nasal lesion, and therefore the dental surgeon sees only a small percentage of actual cases. The author, therefore, is of the opinion that disease of the antrum is very rarely due to diseases of the teeth, and that like diseases of the mucous membrane of the nose; the mucous membrane of the antra is to a great extent the result of—*first*, a very abnormal development of the osseous system, and, *second*, of improper tonicity of the nervous system acting upon a badly developed mucous membrane.

My experience has been that disease of the antrum is most often observed in persons who have been exposed to cold weather, and that both sides are more or less affected. This was a common occurrence with the epidemic of la grippe. If only one side is involved, the other frequently is or has been at a previous time. In the large number of skulls examined, the floor of the antrum was found to be nearly on a level with the line of the alveolar process as far as the anterior roots of the first molar. It then curves upward and forward, terminating at a point above the apex of the root of the cuspid tooth. That being the case, a drill passed through the alveoli of the first and second bicuspid would reach a point quite a distance above the floor of the antrum. From what has been said in regard to the shape and location of the antrum, it will be seen that the lowest point, and always safest locality to puncture the antrum, is at a location just between the roots of the first permanent molar and the root of the second bicuspid. The opening should be made with a drill directed backward and inward. This part is nearly always on a level with the floor of the antrum, and the outer wall is very thin at that point. The patient should be requested to lie first upon the back and then upon the face. Should there be any septa the fluid will in this way be easily drained.

Since this was written Dr. M. H. Fletcher, of Cincinnati, Ohio, read the paper "Some Suggestions as to the Relation of the Teeth to Empyema of the Maxillary Sinus," before the Section on Oral and Dental Surgery of the American Medical Association, held in Milwaukee, Wisconsin, June 1, 1893. I consider this contribution of so much importance that I take the liberty to quote his results:

"The summing up or *rationale*, then, of the evidence herewith seems to be, *first*, that the anatomical relations between the teeth and the antrum are not generally understood, since the sections here shown give evidence of much more cancellous bone than is usually considered to exist.

"*Second.* Small septa are present in a large per cent of cases, and these septa or ridges have no direct relation to the position of the teeth.

"*Third.* Statistics seem to show that a very small per cent of abscessed teeth have any connection whatever with the antrum; this per cent probably not being over seven to ten.

"*Fourth.* The evidence seems to indicate that the protrusion of the teeth into the cavity is very largely the exception instead of the rule, and that if they do protrude, it is not evidence that an alveolar abscess would break there, since these tubercles are usually formed of dense, hard bone.

"*Fifth.* A number of cases have been found where there is a perforation of the bone by the apices of the teeth and no protrusion; but that these apices are simply covered with mucous membrane, thereby the teeth may be affected by inflammation of the antrum, causing their death and loss or a continuance of the trouble in the antrum by their presence in consequence of this special feature of the anatomy, and that pulpless and inflamed teeth are thought to be the usual cause of antral trouble, where the reverse is often probably the case.

"*Sixth.* That seemingly the best place to perforate the antrum of Highmore for pus, is between the apices of the second bicuspid and first molar."

It will therefore be observed that the experience and conclusion of Dr. Fletcher are not unlike my own. Nov. 9, 1893, I received the following letter from Dr. Fletcher:

"Since writing this paper, I have examined an additional 400 skulls, and find the figures changed in regard to the per cent of abscessed molars which are connected with the antrum. In 500 skulls (making 1,000 antra) I find 252 upper molars abscessed, making twenty-five per cent of antra which have abscesses in this locality, or every fourth antrum. This per cent is probably smaller than it should be, since many teeth were lost and the alveolar process absorbed away, and undoubtedly some of these lost teeth have been abscessed. Out of these 252 possible cases, perforation into the antrum was found only twelve times; thus showing over four and one-half per cent, or about one in every twenty-one of the abscessed teeth in this locality, which are connected with the antrum."

The extended examinations and observations made by Dr. Fletcher and the author present similar results.

CHAPTER XXVI.

NEUROSES OF DEVELOPMENT OF THE BONES OF THE ORBITS.

In the development of the osseous system the orbital cavities take different shapes and positions in neurotics and degenerates. Sometimes they are placed near each other, and, again, far apart. Thus, in a measurement of 2,600 skulls, from the junction of the lachrymal and frontal bones of one orbital cavity to the same point on the other, the nearest measurement was .84 of an inch, and the greatest width was 1.25, thus showing that the sight in those farther apart possess the greatest field of vision. In degenerates especially, the orbital cavities deviate from a horizontal line. In some cases the lateral halves of the face will be normal, while one orbit will be located higher than the other. This is illustrated in Fig. 64. Again, the face would present the appearance of having been made in two halves and placed together, so that one half would be higher than the other. The author has observed quite a number of such cases. This would cause the orbital cavity to be situated higher on one side than the other. The depth of the orbits also varies not only in different skulls, but also in the same skull. Thus from the supra-orbital notch to the optic foramen is 1.70 of an inch to 1.12 inches in different skulls, and from .12 to .18 of an inch in same skull. The shallowness of some of these skulls would indicate neuroses as well as degeneracy.

Dr. G. Frank Lydston, in speaking of orbital deformities, says:* "This is well shown by comparison with some of the other types already described, the measurements being $1\frac{3}{4}$ inches from the upper margin of the orbit to the optic foramen, while in the Indian and negro skulls, in this series, the orbits measure two inches in depth. The outer walls of the orbits encroach upon the cavities, giving a still more marked

* *The Alienist and Neurologist*, Oct. 1891.

appearance of shallowness. The form and index of the orbit are given considerable weight by anthropologists as a criterion of racial type.

"It is claimed by Dr. Lydston, and verified by him by comparative studies of orbital development, that the form of the orbit is even of greater importance as bearing upon the question of degeneracy of type. That marked variation of the form and measurements of the orbit is incidental to differentiation, is seen by observation of the anthropoids. There is a striking difference between the members of the Simian group in this respect, and a still greater difference is noticeable between the *simiadæ* and *lemuridæ*." The shallowness and obliquity of the orbits is strikingly similar to the characters observed in the gorilla and chimpanzee, which are quite different from those noted in the orangs. The outer surface of the orbits not only differs in shape in different skulls, but they also differ from each other in the same skull. Thus, the cavity is supposed to be quadrilateral in shape. The angles, however, differ in degree; some are nearly round, others square with round corners; still others in which the lower outer corner extends outward and downward quite a little beyond the inner corner. The walls of the inner part of the orbit are not infrequently deformed or twisted out of shape. It is easy to see how, when the maxillary bones and antra, the ethmoidal bones and cells (the frontal lobes of the brain) are deformed, the walls of the orbit will correspond to these deformities. None of the special organs of sense are so liable to become affected in cases of neuroses and degeneracy as the eyes, and these deformities are to be found more among the neurotics and degenerates than any other class of individuals. Quite a difference was also noticed in the size, shape and position of the optic foramen and fissure. These, however, were not studied with sufficient intention to give scientific descriptions of their different positions and shapes. The author will only say that owing to stigmata of degeneracy of surrounding parts it would be natural to expect abnormal development in connection with these cavities.

OCULAR AFFECTIONS ASCRIBABLE TO DEFORMITY OF THE ORBITS.

That orbital deformities have a causal relation to certain ocular affections cannot be well denied. Among the more frequent conditions arising from or directly traceable to inflammation of the orbits may be mentioned exophthalmus, or protrusion of the eyeball from the orbit; slighter degrees of this affection are only perceptible in case the trouble lies in the one eye, when, by comparison, a diagnosis is readily obtained. In higher degrees the difference is quite perceptible even to the casual observer. In diagnosticating this condition, a nice point to remember is that ordinarily if a straight-edge be applied vertically to the supra and infra-orbital margins it comes in contact only with the apex of the cornea, but does not compress it. The two chief predisposing factors of exophthalmus are: (1) Increased orbital tissue; (2) diminution of the orbital capacity; both of which conditions are regulated by orbital deformity as a result of degeneracy. In the consideration of the question of orbital deformities we must not lose sight of the fact that the conformation and size of the orbit keep pace with the enlargement of the eyeball. Thus, if the eyeball is retarded in growth from any cause, or, if indeed, enucleation becomes necessary in early life, the orbital dimensions are necessarily narrowed and contracted, so that if it becomes requisite in later life to adjust an artificial eye, we find it impossible to insert an eye approximating its fellow in size. Furthermore, we should also note that the position of the eyeball in the orbit varies in different individuals, and that there may be a difference in the two eyes of the same individual; this being associated with an asymmetrical face, which, in turn, may be directly traceable to degeneracy. These conditions usually entail a difference in the refraction of the eyes, and in such cases the exophthalmus may be only apparent, as the myopic eye is usually larger, and, therefore, might simulate an exophthalmus.

Another ocular affection that is prone to ensue as a result of orbital deformity is optic neuritis, which probably arises from pressure upon the nerve at the site of the optic foramen.

Von Graefe was the first to point out this fact, and since his time many cures have been recorded. Nettleship has recorded cases of post-papillitic atrophy as a sequence of congenital hyperostosis.

Among other frequent ocular malformations consequent upon degeneracy may be mentioned coloboma iridis, and, rarely, coloboma of the choroid, lens and lids. Coloboma of the iris is explicable as a sequence of coloboma of the choroid. Inasmuch as the iris projects from the anterior border of the choroid at a time when the fœtal ocular fissure is closed, it has no fissure; but if the choroid experiences abnormal development at the retinal fissure, the deformity may be imparted to the iris, and the latter fails to develop at the abnormal area, and is lacking at this site, constituting coloboma of the iris.

Anophthalmus, microphthalmus and buphthalmus are likewise conditions that are seen at times arising from orbital deformity. The results of degeneracy implicating the ocular development are sometimes peculiarly striking. Thus, we have retinitis pigmentosa, which Leber has cited as persistent throughout generations. Congenital aphakia, or total absence of both lenses, has been noted. Typical albinoism with congenitally displaced lenses, tremulous irides, etc., is a somewhat frequent result of degeneracy.

Double amiridia, or absence of both irides, has been likewise noted, as well as cases of sclerectasia poscterior. The ocular affections which are most typically illustrative of the effects of degeneracy, manifesting itself in the form of defects of orbital contour, and those too that are most frequent, may be grouped under the general heading of refractive errors, which are of variable degree and type. Thus, as a result of a contracted eyeball antero-posteriorly, we have hyperopia, a condition of the refraction in which parallel rays of light impinging upon the eye are not focused upon the retina, but behind the same, this being ordinarily ascribable to an axial defect. Precisely opposite in its characters is the short-sighted eye, which ordinarily arises from an elongated antero-posterior axis, which causes an increased refractivity of the eye whereby parallel rays are focused in front of the retina instead of upon it, as they are in the emmetropic or normal eye. Combinations of the above types are found in conjunction with the normal or emmetropic eye, constituting different types of astigmatism, so that we find these defects as a natural consequence of degeneracy entailing orbital deformity, and while we recognize that degeneracy is not necessarily the rule as a predisposing cause of such conditions of the refraction, yet they are sufficiently frequent to make it highly suggestive. The prevalence of such a large number of young people wearing glasses in some of our Eastern cities has led to the common remark that it denoted intellectual ability. The author would suggest that it denotes physical defects often due to neuroses and degeneracy.

Perhaps there is no lesion so common, as the result of degeneracy of the osseous system in its relation to the eyes, as stenosis of the naso-lachrymal duct. Occasionally only one side will become involved, and again both sides. These cases are more noticeable where there is arrest of development of the bones of the face, as illustrated in Fig. 80. In this class the bridge of the nose is undeveloped, as well as all the other bones of the face which are on a level with the bridge of the nose, the result of which is one or both canals are partially or nearly undeveloped. The same condition is frequently found where the bridge of the nose is very narrow and high, as illustrated in Fig. 70. In such cases degeneracy of the bones of the face is even more noticeable than in the other cases. The results of such deformities are familiar to all specialists.

In an examination of 207 patients, taken as they came, the following deformities of the face were found:

TOTAL DEFORMITIES IN THE JAWS OF THE BLIND.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Arch.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
107	M	53	8	9	10	20	4	3	6	7
100	F	52	8	7	5	18	3	6	5	3
207	..	105	16	16	15	38	7	9	11	10
Per cent.		50.7	7.7	7.7	7.2	18.3	3.3	4.3	5.3	4.8

One case cleft palate.

In twenty-seven examinations of congenitally blind patients, all possessed either deformities of the head, face, jaws or teeth.

CHAPTER XXVII.

NEUROSES OF DEVELOPMENT OF THE BONES OF THE EAR.

It is scarcely necessary to refer to the fact that aural affections are frequently a result of degeneracy, exhibiting itself under the various forms of deformity implicating the auditory apparatus. Thus we have total absence of the external ear, together with an embryonic internal ear. The mere fact of the exceedingly primitive structure of the internal auditory mechanism necessitates abnormal or defective hearing power as a consequence. It is to this fact that many cases of congential deaf-mutism owe their origin, inasmuch as the auditory mechanism is not in a condition to appreciate sound, even though the individual may not have been born deaf, the state of deaf-mutism from inability to appreciate sound and the whole auditory apparatus subsequently degenerates. Of course, a mental defect is sometimes superadded, thus aggravating the case.

As in the case of the congenitally blind and persons who become blind early in life, the author has so far been unable to study particular cases of deaf-mutism, owing to the fact that it is so difficult in this country to obtain skulls, the history of which is known.

Speaking upon general principles, and what is known about the congenitally deformed ears, it stands to reason that if deformities of the head, face, jaws, nose, antra, vaults, etc., are common in neurotics and degenerates, stigmata of the bones of the ear certainly must occasionally take place. Taking into consideration the complicated structure of which the bone and sundry parts of the ear are composed, lesions of the ear must in many cases be attributed to such deformities. In an examination of 1,935 patients, taken as they come, the following deformities of the jaws were observed:

TOTAL DEFORMITIES IN THE JAWS OF THE DEAF AND DUMB.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
1111	M	538	197	41	116	241	91	115	108	51
824	F	363	108	51	89	177	78	77	95	62
1935	..	901	305	92	205	418	169	192	203	113
Per cent.		45.3	15.7	4.7	10.5	21.7	8.7	9.9	10.4	5.8

Two cases cleft palate.

In an examination of 143 cases of congenital deaf mutes 93 per cent of them possessed deformities of the head, face, jaws and teeth.

CHAPTER XXVIII.

NEUROSES OF DEVELOPMENT OF JAWS OF APPARENTLY NORMAL INDIVIDUALS.

That the deformities of the jaws of the neurotics and degenerates as found in our asylums may be compared with those whom we meet in every-day life, the author examined the mouths of 1,000 school children over twelve years of age and 1,000 adults, patients and friends, with the following results:

TOTAL DEFORMITIES IN THE JAWS OF CHILDREN.

No.	Sex.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Saddle-Shaped Arch.	Small Teeth.
396	M	303	11	3	5	26	5	18	12	13
604	F	463	8	4	2	30	6	43	21	17
1000	..	766	19	7	7	56	11	61	33	30
Per cent.		76	1.9	.7	.7	5.6	1.1	6.1	3.3	3.0

TOTAL DEFORMITIES IN THE JAWS OF ADULTS.

No.	Sex.	Normal.	Large Jaw.	Height of Vault.	V-Shaped Arch.	Partial V-Shaped Arch.	Semi-V-Shaped Arch.	Saddle Arch.	Partial Saddle.	Semi-Saddle.
284	M	211	9	48	16	16	10	14	27	9
716	F	403	23	62	19	56	8	29	24	25
1000	..	614	32	110	35	72	18	43	51	34
Per cent.		61	3.2	11.0	3.5	7.2	1.8	4.3	5.1	3.4

In comparing the figures in the two tables it will be seen that there is 15 per cent more deformities in grown people than in children. This can be accounted for in three ways: (1) That as people grow older it is possible for some of the slight forms of irregularities of the teeth to become more prominent, owing to the movement and permanent arrangement of the teeth later in life. (2) As the examination of the mouths of the children was made some years ago, it is possible that the eye was not as well trained as it is at the present time. It will also account for the difference in the classification of deformities. (3) Part of these examinations are those of my patients, which would also swell the list of deformities. The percentage of deformities, however, compares very favorably with the percentage of deformities of the face. Taken as a whole they give an approximate idea of the percentage of deformities in this community at least. It is possible, however, for the facial bones to become excessively developed or arrested and the jaws normal, and it is also possible for the jaws to be deformed and the face apparently normal. As compared with degenerate classes found in our asylums the percentage is from 25 to 33 per cent less.

CHAPTER XXIX.

NEUROSES OF DEVELOPMENT OF THE MAXILLARY BONES.

Excessive growth of bone-tissue is frequently seen in connection with the superior and inferior maxillæ. It may be a natural growth or the result of disease. If the jaw is naturally large, it will develop gradually, and will not attain its full size before the age of from twenty-six to thirty-six years. The size of the jaw corresponds quite closely to the size of the head, other things being equal, the large head containing the large jaw. We occasionally find, however, a very small jaw in a very large head, and *vice versa.* The upper jaw is more subject to morbid influences than the lower jaw, because of its development in connection with the bones of the head. The lower jaw rarely exceeds the average size. It is possible, however, by constant use, to increase the size of the jaws, as is shown in acrobats and those who use their jaws in performing various feats, like "the man with the iron jaw." The jaws of tobacco-chewers, singers, public speakers, and the skulls of the early races who lived upon corn, shells, roots, etc., show that the jaws may be increased, or at least favored in their development, in size, by use.

Enlargement of the jaw-bones is an occasional cause of dental irregularities. It may occur in either jaw, but generally in the upper, and is due to hypertrophy on the one hand, or hyperplasia upon the other; also to osteitis, periostitis, continued irritation drawing blood to the part, and, in some cases, to disease of the antrum and nasal *fossæ*, producing the same effect. Disease of the antrum may cause either periosteal or osteal enlargements. Hereditary syphilis has an especial predilection for the cones, particularly at the junction of epiphysis and diaphysis. The growth of the teeth does not proportionately increase, and the consequent disproportion between the teeth and jaws necessarily produces a deformity. The forms of irregularities of the teeth that co-exist with crowded arches are not seen in enlarged jaws. Rachitis in children, whether due to syphilis or not, causes hypertrophy and hyperplasia of the jaws. The hypertrophy and hyperplasia may be localized in some portion of the jaw, causing it to be unevenly developed. As illustrative of the interesting character of some of these conditions described, I take the liberty to present a few cases which have come under my notice.

Case I.*—Arrest of development. Girl, aged ten years. Father and mother have well-developed jaws. Consumption on father's side; cancer on mother's side. Child scrofulous, with small bones, especially the maxillary bones, which are unusually small. The teeth of both jaws (permanent first molars and incisors, temporary cuspids and molars) are in a very crowded condition. The teeth are normal in size. With such unusually small jaws, and the teeth at this age being very crowded, I shall watch this case with great interest.† I shall expect to find marked V or saddle-shaped arches. I have observed similar results in like cases.

Case II.—Arrest of development. Girl, aged sixteen years. When quite young had a severe attack of scarlet fever, and the arrest of the development of the bony framework resulted. The jaws are unusually small, and the teeth are crowded to such an extent that the cuspids remain outside the arch.

Case III.—Enlargement of the superior maxilla. George W., aged fourteen years. This boy was sent to me for an opinion in regard to his teeth. Upon examination I found the teeth of the normal size. Spaces existed between all the teeth as far back as the first permanent molars. The bicuspids were not fully developed, but were through the gum sufficiently to notice their position in connection with the other teeth. The spaces were not uniform, those between the incisors being the largest. The widest space was between the central incisors; the incisors of the lower jaw coming in

* This case was noticed in the second edition. 1890.

† This girl is now under treatment. The jaws are arrested in their development, and a marked V-shaped arch was produced.

contact with the mucous membrane of the mouth posterior to the superior incisors.

Case IV.—Hypertrophy of the jaw. J. B., aged nineteen years. This patient came under my treatment in June, 1887. When fourteen years of age he received a blow upon the side of the jaw. He is of a scrofulous nature. The blow produced a low form of inflammation, and hypertrophy of the bone supervened. The teeth of that side of the jaw were carried laterally, and spaces existed between the bicuspids and molars.

Case V.—Antrum disease. Boy, aged seven years. German descent; born in this country; scrofulous. Quite a deformity was noticed upon the left side of the face, produced by the bulging of the antral wall. Hypertrophy of the alveolar process also existed. The temporary teeth on the left side of the upper jaw extended beyond those of the lower jaw. Upon opening into the antrum a thick, ropy fluid exuded. After three months' treatment no improvement has been noticed.

DEVELOPMENT OF THE INFERIOR MAXILLA BY EXERCISE.

The superior maxilla is influenced to a greater degree by the various causes of jaw-deformities than the inferior maxilla. The bones of the upper jaw are in direct contact with the other bones of the body, while the lower jaw, unlike all the other bones, develops independently, and is only attached at its remote extremities by articulation. The growth of the body of the bone is free to develop or to remain in a dwarfed condition, depending wholly upon its nerve and blood-supply for its nourishment. The superior maxilla, as has been stated, shows indications of gradually diminishing in size. The inferior maxilla, although under the same influences, has a powerful factor to aid its preservation, viz., motion and exercise. On this account the question presents itself, as to what extent certain properties of the jaws, influenced by habit (use), may be transmitted. The tissues of the body, especially those of the osseous and muscular systems, possess a certain degree of plasticity, by which they are enabled to change their weight or shape. This quality depends upon the use of muscles and bones. Among vertebrates we find a close relation between the muscles and the bones upon which they are inserted. The union is made up of tendons, which are prolongations of the muscles to the periosteum, and the periosteum is attached to the bones. Powerful muscles and large bones are always associated, exercise developing them both simultaneously. As outward changes occur in the life of human beings or animals, adjustment to environment tends to alter the physical characteristics. These changes often occur through such gradual modifications that from one generation to another but little marked difference is noticed, but the structure, in the course of a number of generations, will so change that a new species will be developed. Any animal domesticated from a wild life shows this change, and among human beings the negro imported from Africa will, after several generations have a less prominent jaw-bone, and the frontal bone will become more prominent.* The changes, although existing in the white races, after intermarriage with other nations, are not so pronounced and rapid as in the negro cross-breed, but are gradually occurring. No part of the body demonstrates these changes so forcibly as the superior or inferior maxilla. The extremities must be measured and weighed to compare the two halves of the body.

The accustomed eye can at a glance compare the jaws and teeth and observe the slightest deviation. Whatever views are held regarding the origin of man, it cannot be denied that the human jaws of the earlier races resembled those of the anthropoid ape, whose upper and lower maxillæ protruded and appear to be uniform. Observation will show that the changes in the shape of head and jaws are not confined to one race nor to past generations, but are continually progressing. These changes are not uniform in the two jaws. The superior maxilla is a fixed bone, and the inaction, from lack of

* In some instances the laws of hereditary and sexual selection necessarily co-operate with environment in producing this change.

exercise, gradually affects and diminishes the volume of bone-tissue from one generation to another.

The inferior jaw, on the other hand, is constantly in motion, which causes a flow of blood to the part, and the activity of nutrition in the muscles and bone increases their size and strength. This increase of the bone by exercise of the part has been alluded to by C. Harting in reports of examinations made. He says that "the bones of the right upper limb are generally larger than those of the left." This increase in size was not confined to one bone, but to all the bones of the right limb. The weight of the right arm without the hand is to the weight of the left arm without the hand as 106.2: 100, a difference of about six per cent, which would indicate not only an increase in the volume of muscle, but in the weight of the bone. Exercise of the inferior maxilla, which has always existed, has developed the jaw, while the superior maxilla has dwarfed from non-exercise. The contour and expression of the face depend, to a great extent, upon the shape of the inferior maxilla. Frequently this bone will exhibit peculiar family characteristics in early life. Oftener, family resemblances are not established until the individual has attained his full growth, from the thirtieth to the fortieth year. Hereditary peculiarities may exist at birth, like the transmission of features, or color of eyes or hair, but family likenesses may not appear until middle life, like the contour of the face, shape of the nose, or shape or size of the inferior maxilla. Such being the case, it may be assumed that motion and exercise are the prime factors in assisting the development of the inferior maxilla.

ASYMMETRY OF THE LATERAL HALVES OF THE MAXILLARY BONES.

Asymmetry of the lateral halves of the maxillary bones exists in the present era of the human race, and, like other irregularities and imperfections in the structure of the body, it prevails to a greater extent among neurotics and degenerates, and among the offspring of mixed races, than in clannish tribes or nations. Each lateral half of the body develops independently of the other. The jaws, like other members, are influenced by the independent growth of the two halves, so that each has its own peculiarities. Asymmetry, therefore, is caused from an inharmonious lateral development of the parts. The superior and inferior maxillary bones, growing independently of each other, may be subjected to peculiar conditions of environment, so that the result of their development may be asymmetry of the jaws. Extreme asymmetry of the lateral halves of the human body is frequently observed, and, as some of the recorded cases are of special interest, I will mention a few of them.

These cases are so marked that they are noticeable by the most casual observer. In measuring the lateral halves of the body by the system of measurement of criminals and convicts, introduced some years ago by M. Bertillon, we shall find that the halves do not harmonize in a single instance. These differences are not altogether inherited or natural, but have been acquired, to a certain extent, by exercise of the part. Marked illustrations of development by exercise are seen in the blacksmith, whose right arm is larger and will weigh heavier than the left. The peddler who carries a pack has the side most in use developed more than the other.

If exact measurements of the maxillary bones could be made, a lack of harmony in the lateral halves would be observed in weight, shape and size. The difference is generally not sufficient to affect the contour of the face, but causes faulty articulation to the teeth upon that side of the face. This is generally due to the number of teeth that remain in the jaw late in life. Thus a molar or bicuspid may never have developed upon one side, while the full number are in position upon the other side, or they may have been extracted upon one side, while the full number remain upon the other. Again, owing to an irregularity of the teeth in the anterior part of the mouth the posterior teeth, although all are present, may have moved forward. In any of these conditions the alveolar process and jaw would become shorter upon one side than upon the other, owing to absorption of the alveolar process. The deformities of either lateral side of the superior maxilla are not necessarily like those of the inferior. Excessive growth or arrested development appear upon both sides of the jaws, sometimes on the right and again upon the left. Examinations of these deformities can be made only when the second teeth have been extracted and the alveolar process has been absorbed.

Fig. 92 shows the superior maxilla after absorption has taken place. If a line be drawn through the jaw at the median line, it will be seen that the left half is fully developed, while the right half is contracted at the bicuspid region. The following statistics show the deformities in the contour of jaws modeled by Dr. L. P. Haskell, of Chicago, who has a large

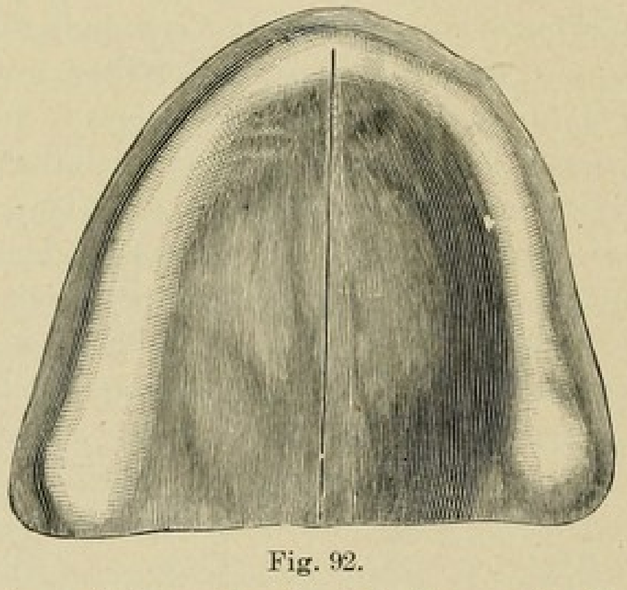

Fig. 92.

collection of models, and who kindly assisted me in their examination:

UPPER JAW.

Total number examined, - - -	298
Total number normal, - - -	137
Total number abnormal, right side, -	73
Total number abnormal, left side, - -	88

Fig. 93 illustrates the inferior maxilla after the teeth have been extracted and absorption of the alveolar process has taken place. By drawing a line through the center of the lower jaw at the median line, a wider space may be seen to exist between the line and the left side than on the other side.

LOWER JAW.

Total number examined, - - -	154
Total number normal, - - - - -	54
Total number abnormal, right side, -	12
Total number abnormal, left side, -	88

In the study of irregularities of the teeth during the past eight or ten years, I have observed that, although no two cases of irregularities of the teeth are exactly alike, there is a general similarity of shape and outline of alveolar process and jaw, owing to similar environments during eruption of the teeth. Upon the hypothesis that the two halves of the

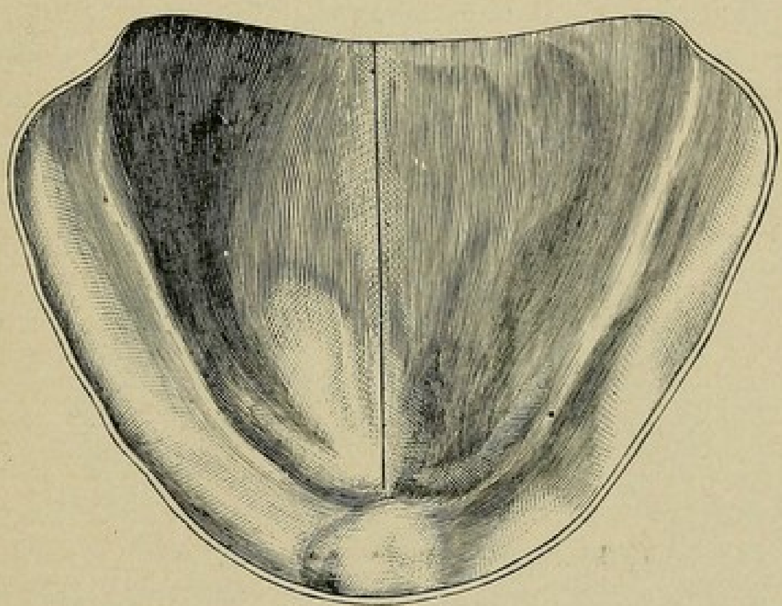

Fig. 93.

superior maxilla are developed in proportion to the excess of food masticated on one side or the other, depending upon right and left-handedness of the individual, we suppose that the case illustrated is that of a left-handed person, as the left side of the jaw is larger. But it appears that this side is normal in size and the right is deficent in development. By examining carefully the contour of patients' teeth, we shall observe that but few arches are uniform. While one side may be normal the other will be depressed. Fig. 94 shows such a deformity. This cut is taken from a model of an extreme case of irregularly-shaped jaw. It represents a perfect semi-V-shaped arch. (I find in my collection of models thirty-eight of this variety of deformity, twenty-four of which are on the right side and fourteen on the left.) Most of these irregularities are not quite as depressed at the cuspid region as the cut indicates. No two are exactly alike as regards the position of the teeth, and yet the similarity is so complete that a non-professional man would immediately take notice of it. The asymmetry of the jaw illustrated in Fig. 92 is probably caused by the peculiar arrangement of the permanent teeth in the arch, since the deformity is not apparent during the first set of teeth, the alveolar process and maxillary bones being molded into this peculiar shape thereby. Since but few people are left-handed, this percentage is very large, showing twenty-four out of thirty-eight cases with deficiencies on the right side, when we might look for normal or exces-

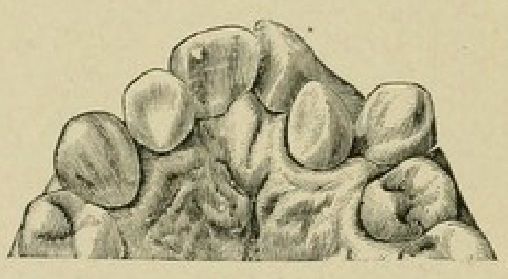

Fig. 94.

sive development on that side. The cause of this irregularity I believe to be local in its origin, viz., too early extraction of the temporary teeth upon the affected side, thus showing that one side is as liable to be affected as the other. The mechanism of this irregularity will be found under the head of local causes.

The asymmetry upon the lower jaw may be traced to two causes:

First. The full number of teeth retained upon the long side. If the third molars should develop on one side only, the jaws on that side would expand by the crowded condition of the teeth and extend farther from the median line than otherwise. The loss of the third molars by extraction or non-development would prevent the other side from increasing to the natural size.

Second. The relation of the upper teeth to the lower teeth. The articulation of the inferior maxilla with the cranium is so remote, and the contour of the two bones so unlike, that uniformity of bone-structure cannot be looked for. When we consider the complexity of the development of bone-tissues, first of the maxillary bone, then of the alveolar process, and lastly of the two sets of teeth, it is a wonder that harmony ever prevails.

ASYMMETRY OF THE MAXILLARY BONES.

*Haskell's Deformity.**—When we examine models of the superior maxilla after absorption of the alveolar process has

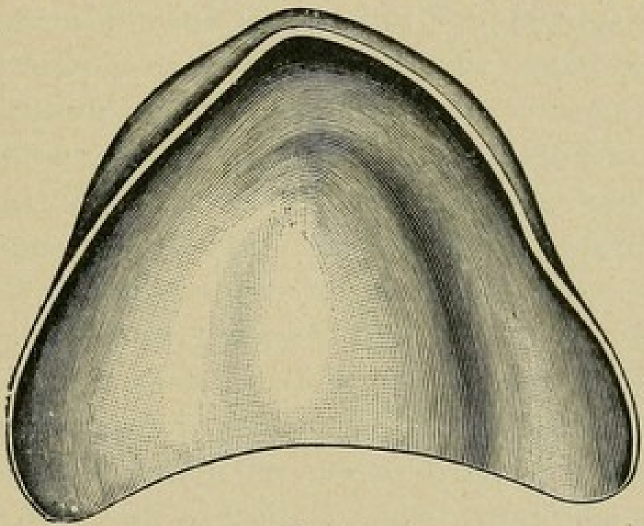

Fig. 95.

taken place, we observe that in the cuspid and bicuspid region, high above the alveolar border, a marked depression exists on either side. Fig. 95 shows a base-plate which has been formed over such a model. The plate is more depressed at the left than at the right side. This peculiar deformity is familiar to the operator who arranges teeth and waxes up plates for the purpose of restoring the contour of the face. Upon closer inspection of the model it will be seen that there is an asymmetry of the lateral halves of the maxillary bones. With Dr. Haskell's assistance, I have examined 298 models,

* I have named this deformity "Haskell's Deformity," for the reason that Dr. Haskell called the attention of the profession to this peculiar condition of the maxillary bones years ago, personally and through the journals, and says he has found but one dentist who had observed it.

finding 268 out of the number with marked depression on the left side, and twenty-four with the depression on the right side, and only six cases showed both sides to be alike. It is remarkable that so large a proportion of the cases of this deformity should be found existing on the left side.

Dr. Haskell says: "For many years I have observed a marked difference between the right and left sides of models of both the upper and lower jaws, but more especially noticeable in the upper jaw. It is not so apparent upon a casual glance at the model, for it is not so much in the alveolar process as in the maxillary bones. But a plate swaged upon a model from an impression taken high over the region of the cuspids (as ought always to be done) shows at once the depression of the left side, which occurs, to a greater or less extent, in ninety-five per cent of cases. The difference becomes apparent in arranging artificial teeth. Every dentist of experience must have observed that greater length of teeth and gums is required upon the left side than upon the right. How often it is seen that the left side of the lip rises higher, in talking and laughing, than the right side. The difference in the two sides of the lower jaw does not occur as often, but is apparent in the divergence of the left side from a line drawn through the centre of the model, so that the posterior teeth on that side must be set farther in upon the plate."

Dr. Haskell has, during the past twelve years, frequently called my attention to this peculiar deformity of the jaw. My own observation of models and patients has also indicated the probability that the majority of deformities of this nature exist on the left side. The following theory for this deformity suggests itself as worthy of our consideration: Man, like some other members of the animal kingdom, moves the lower jaw from right to left in mastication. (As people are sometimes left-handed, so it is possible to find cases where the jaws moved from left to right. I have, however, found only three such cases.) The constant friction of the lower teeth against the upper, carries the superior arch with the alveolar process toward the left. By pressing the index finger over the cuspid and bicuspid roots, above the alveolar process, we shall find that the majority of mouths contain teeth with their roots standing out more prominently upon the right side than upon the left side. The right superior dental arch, like the arch of a bridge, resists such inward force because of the lateral contact of its teeth. On the contrary, the left superior dental arch may thus be carried slightly outward. The limited lateral motion during occlusion prevents the teeth and alveolar process from being carried farther. The cuspid tooth may be prevented from being carried in as far as it otherwise would be owing to the lateral motion of the lower jaw to the left. The alveolar process is thus carried beyond the border of the maxillary bones. After the teeth have been removed, absorption of the alveolar process occurs, leaving only the alveolar ridge. The ridge then overhangs the maxillary bone, thus producing a depression upon the left side. This is the reason that, in arranging artificial dentures in many cases, the teeth are carried over the alveolar border farther than upon the right side to obtain proper articulation with the natural teeth upon the lower jaw.

On examining the model upon which the base-plate was formed, it will be seen that both the right and left alveolar borders are symmetrical. The alveolar border in most cases indicates the contour of the teeth when in position.

ASYMMETRY IN THE RAMI.

A case recently seen with Dr. G. Frank Lydston, of this city, is a marked illustration of congenital maxillary asymmetry. The man is thirty years of age. The inferior maxillary is small and the chin pointed and narrow. There is a difference of one-half an inch in the length of the rami, the left ramus being the shortest. The difference is sufficient, when the face is smoothly shaven, to produce a noticeable deformity. The teeth are irregular in both jaws, the irregularity, however, being most marked in the superior jaw. The cranium partakes of the asymmetry, and the frontal suture is plainly marked. Numerous irregularities of the surface of the skull are observable. The larynx is displaced at least one-half an inch from the median line toward the left side.

There is no history of injury, and a point of interest in this case is the fact that the asymmetrical and small jaw is a family characteristic, and has been noticed for several generations. The jaw, in this case, resembles the father's, while the arrangement of the teeth is similar to that of the mother. The upper portion of the body appears to have been developed in two lateral halves, and when brought together the left side of the body was higher than the right side. The cranium and maxillary bones show this deformity quite conspicuously. The teeth, which are comparatively sound, are all present. The left superior maxilla is considerably higher than the right. Occlusion is perfect, thus compensating for the short left ramus.

Another very interesting case, and similar, is that of a young lady, twenty years of age. Has arrest of development of the upper jaw; the body of the lower jaw is excessively developed. Length of right ramus, 2.25 inches; left, 1.50 inches. The result of which is the lower jaw thrown to the left the width of the right central incisor tooth. I am informed that the father and uncle possess a similar deformity.

ASYMMETRY IN THE BODY AND IMPROPER OCCLUSION.

The daughter of an old patient came to me for treatment September 14, 1888. She was about seventeen years old, and had quite a prominence upon the right side of the lower jaw, and another, although not so marked, upon the left upper jaw. The left corner of the mouth was nearly one-quarter of an inch higher than the right. The face was full and had a peculiar expression, owing to the mouth and jaw being at an angle when closed. Upon examination, I found the left superior maxilla one-quarter of an inch higher than the right side. The alveolar process and teeth shared the same irregularity, thus placing the line of the teeth on the same plane as the lips. The body of the inferior maxilla, from the symphysis to the angle, seemed to be longer upon the left side than upon the right. When the jaw closed, the median line of the lower jaw was half an inch to the right of the upper.

The lingual cusps of the bicuspids and molars on the right side of the lower jaw occluded with the buccal cusps of the bicuspids and molars of the upper, and *vice versa* upon the left side.

Asymmetry may be due to excessive development of the body of the jaw on one side, and arrest of development on the other.

The two cases just described are interesting from the fact that while the causes and the external appearances of the face are entirely different, the alveolar processes and the occluding surfaces of the teeth are on the same angle, the inclination being in the same direction. This deformity is frequently found in the mouths of patients over forty years of age, where all the teeth have been removed upon the side of one jaw and upon the opposite side of the other, the alveolar processes containing the teeth elongating upon the side where there is no antagonism, and throwing the occluding line of the teeth out of position at an angle similar to that above described.

By examining the mouths of 1,977 idiots there were found to be 159 with protrusion of the superior maxilla, and 92 with protrusion of the inferior maxilla. These deformities do not exist to such an extent among healthy individuals. This inharmonious development of the maxillary bones may extend from the articulation to the incisor teeth. Such deformities are rarely found in connection with the first set of teeth. When the alveolar process protrudes during the period of the temporary teeth, it is usually caused by thumb-sucking or an arrest of development of the inferior maxilla. Protrusion of the inferior maxilla is the result of the abnormal development of the rami or body of the jaw, or an arrest of development of the superior maxilla. As these abnormal conditions usually correct themselves when the temporary teeth are shed, they consequently receive little attention. But when these deformities arise during second dentition the jaws are determined toward false positions, thus endangering the beauty of the face. We occasionally see excessive growth or physiological hypertrophy of the superior maxilla when the inferior maxilla is unusually developed. When the teeth are normal in size they appear small in proportion to the abnormally large jaw. They are carried forward with the alveolar process to such a degree that the teeth and lips may protrude. In such cases it appears as if the body, or rami, of the inferior maxilla were much shorter than is natural, but by close inspection we shall see that the inferior maxilla is normal, and quite a space exists between the superior and inferior central incisors. A slight protrusion of the superior teeth is a common defect; it is usually accompanied by a depression of the face at the root and alæ of the nose, and a protrusion of the anterior alveolar

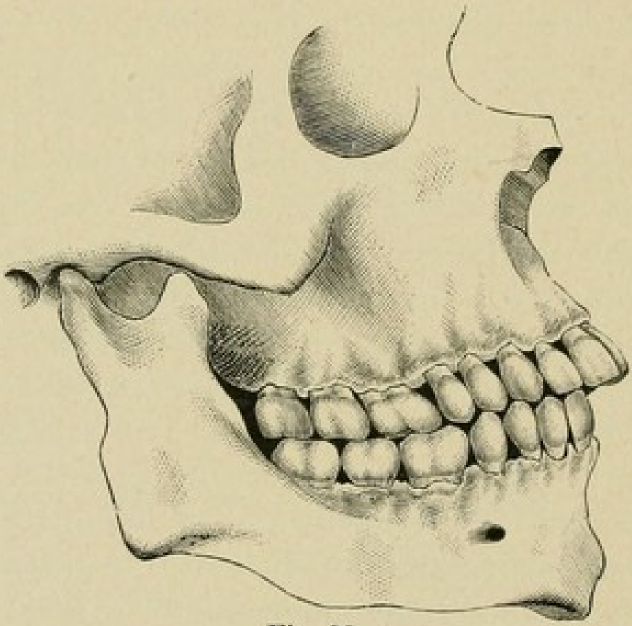

Fig. 96.

process and upper lip. If the maxillary bones, as well as the alveolar process, are enlarged, the teeth will stand perpendicularly with the alveolar process. If the superior maxillary bones are small, the teeth will protrude from the perpendicular to an angle of 45°. Such a case is illustrated by Fig. 64, page 131, Kingsley's "Oral Deformities." This is a deformity frequently met with in practice. A common cause of protrusion of the superior maxilla is illustrated in Fig. 96.* The teeth in the upper jaw are fully erupted, but are directed downward and forward; the teeth in the lower jaw are in their proper position. It will be observed that the rami

* These cuts represent cases in my practice.

of the jaw are inharmoniously developed, the rami being so short when the jaws close that the occlusion throws the superior teeth and alveolar process forward. In this case the alveolar process is quite thin, because the arch is high and the teeth, having long slender roots, are easily carried forward. The inferior maxilla is large, the structure dense and hard, and the teeth firmly fixed in position in the jaw. When occlusion takes place, the weaker structure (the superior maxilla) is carried forward by the stronger (the lower maxilla), thus forcing the alveolar process forward, producing harmony throughout the articulation. The shortness of the rami of the inferior maxilla, causing improper closing of the jaws, is

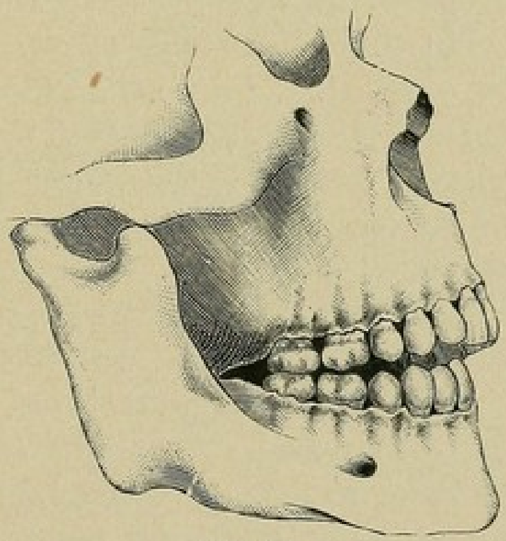

Fig. 97.

a feature strongly impressed upon the dentist who undertakes to insert artificial dentures. The tendency of the lower jaw to force an upper denture out of the mouth, by striking the teeth at an angle instead of perpendicularly, is a marked illustration of the inharmonious development of the jaws. The same difficulty is frequently experienced with the partial lower plate when it presses against the anterior teeth and alveolus, forcing them both forward by improper articulation. The occasional grinding of the surfaces of the artificial molars to produce proper articulation affords another illustration of the effects of this inharmonious development.

IMPERFECT OCCLUSION.

Fig. 97 illustrates a deformity produced by the before-mentioned cause; yet the result is very different. The case is that of a boy fourteen years old. Before the eruption of the second molars, the articulation was perfect; but as soon as the second molars occluded the jaws were forced open. The rami are so short that when the second molars and the alveolar processes of the superior and inferior maxilla come together, a space exists between the central incisors.

Unlike the former case, the superior alveolar process is remarkably well developed, and the teeth are firmly fixed in the jaw. The vault of the mouth is quite low. The position of the teeth, in the alveolar process, is such that when the lower teeth occlude they strike directly on a line with the long axes of the roots, thus preventing the forward movement of the teeth and alveolar process. The inferior maxilla is not well developed, nor has it the power to overcome the resistance, and force the superior alveolar process and teeth forward, as exemplified in Fig. 96. When the rami are short, so that they do not harmonize with the maxillary bones, the movement of the jaws may be likened to the arms of shears: the farther the points are from the centre, the greater the distance they have to travel. A slight movement at the centre will cause them to move a considerable distance. In a similar manner, a slight excessive protrusion of a molar will cause the anterior teeth to become separated. The shorter the rami, the less the harmony between the jaws and teeth; the farther back the protruding molar, and the more it projects, the greater the anterior separation of the jaws. The excessive eruption of the second and third molars is very often due to the persons sleeping with the mouth open, the pressure upon the posterior teeth being removed the teeth, and even the alveolar process, will elongate. Not infrequently the mal-occlusion of the teeth is due to the inability to close the jaws on account of the inharmonious development. Occasionally there are mouths in which the molars and bicuspids occlude, and there is just enough space between the centrals to admit a thin spatula. January, 1887, a patient was brought to me for advice whose jaws, when closed, showed a space of half an inch between the incisors. Such cases are due to arrest of development of the anterior alveolar process —the superior dental arch being too small for the inferior. The pressure of the jaws upon the molar teeth is, in some instances, so great that normal eruption is impossible. In such cases the molars will protrude through the gum, and the superior and inferior processes will occlude when the jaws meet.

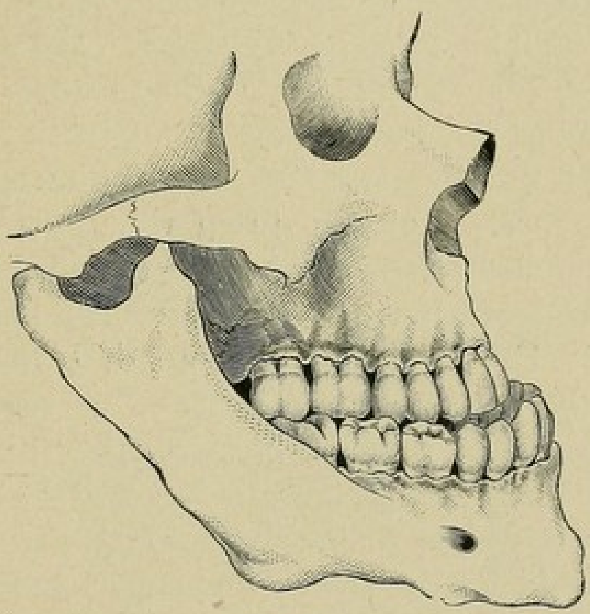

Fig. 98.

PROTRUSION OF THE INFERIOR MAXILLA.

Protrusion of the inferior maxilla produces one of the most repulsive deformities of the face, and should be corrected as early in life as possible. When it is caused by or associated with arrested development of the superior maxilla, it is extremely difficult to restore the features to a natural expression. A case of considerable interest, illustrated by Fig. 98, came to my notice in 1887. A commercial traveler from New York called at my office for the purpose of having a gold crown re-set. I noticed a marked deformity in the jaws, consisting of a depression at the alæ of the nose and an unusual protrusion of the inferior maxilla. Upon examination I found that the second molar on the upper jaw and the third molar on the lower jaw were the only teeth that occluded. This was caused by arrest of development of the bones of the face and an excessive length of the rami of the lower jaw. The body was normally developed, but was carried forward by a lengthening of the rami. To add to this deformity, there was a marked arrest of development of the bones of the face. There are cases where the lower jaw projects beyond the upper; but by closely examining the deformity, we find that another cause exists for this appearance.

A girl, fifteen years of age, was sent to me for treatment by a dentist from a neighboring state. He desired me to "force the inferior maxilla back into place." I found the rami and body of the jaw apparently normal. The external appearance of the chin and cheeks was in keeping with the outline of the face. I observed that the upper lip was much depressed, and that deep lines extended from the alæ of the nose to the corner of the mouth. The cheek bones were also undeveloped. Upon opening the mouth I found arrest of development of the superior maxilla. The superior incisors closed inside of the inferior incisors; the first and second bicuspids, first and second molars, were in position, but had crowded forward close to the lateral incisors. The cuspids were quite outside of the arch. The superior dental arch had to be forced out, instead of carrying the inferior maxilla in, which would tend to further complicate the case.

Another instance is that of a young man with what seemed at first, and what an old practitioner had regarded, as a "prognathous lower maxilla." This I found upon inspection to be caused by arrested development of the upper maxilla. This dentist had spent five years in trying to reduce the deformity. It was fortunate, however, that he was unsuccessful, for had he succeeded the deformity would have been made greater than it was. Instead of moving the lower teeth back, the upper teeth should have been moved forward. In six months' treatment by this plan the teeth were corrected and the face was greatly improved.

In the majority of cases which appear to result from a protrusion of the lower jaw, we shall find that the lower maxilla does not project abnormally, but the superior maxilla, being arrested in its development, gives the protruding appearance to the lower jaw. Before undertaking to correct such a deformity the general contour of the face should be carefully studied. My experience has been that many mistakes have been made by operators who did not understand the true condition of the patient.

A peculiar but common deformity of the inferior maxilla is illustrated in Fig. 99. The body of the jaw is very short. A line dropped perpendicularly, and touching the chin at the median line, would pass through the bicuspid region of the

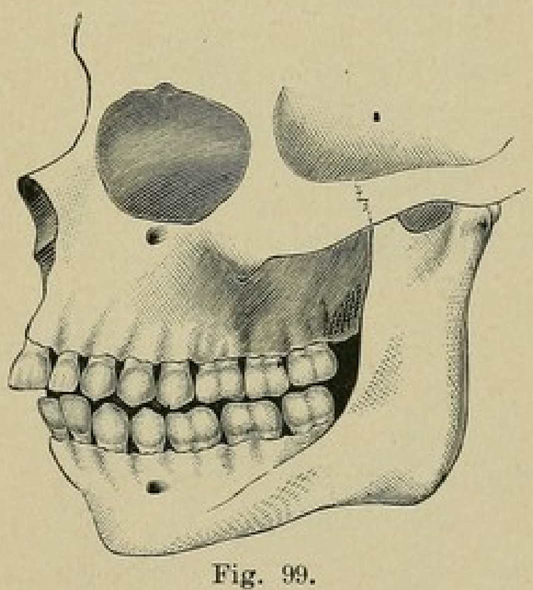

Fig. 99.

superior maxilla. A front view of such a deformity gives an appearance as though the lower jaw were absent, and a side view throws the nose out prominently, while the chin and forehead retreat. The rami of the jaw are larger than the body. The articulation is good, the defect being that in the incisor region the teeth strike quite a distance posterior to the superior incisors. Arrest of development of the lower jaw frequently results when the superior incisors are crowded inward irregularly, or when there is arrest of development of the superior maxilla the lower incisors coming in contact with them, thus preventing the forward development of the body of the jaw. The anterior portion of the lower jaw remains stationary, while the development is in the posterior direction.

Fig. 100 represents jaws such as are frequently seen. The long body and protruding chin, narrow and contracted alveolar process on the lower jaw, a small superior maxilla and thin protruding alveolar process are in keeping with the thin faces and sharp features of the class. The body of the inferior maxilla is small, thin and very delicate; the rami unusually short—just the opposite to the one last described. A line drawn parallel with the occluding surfaces of the teeth would

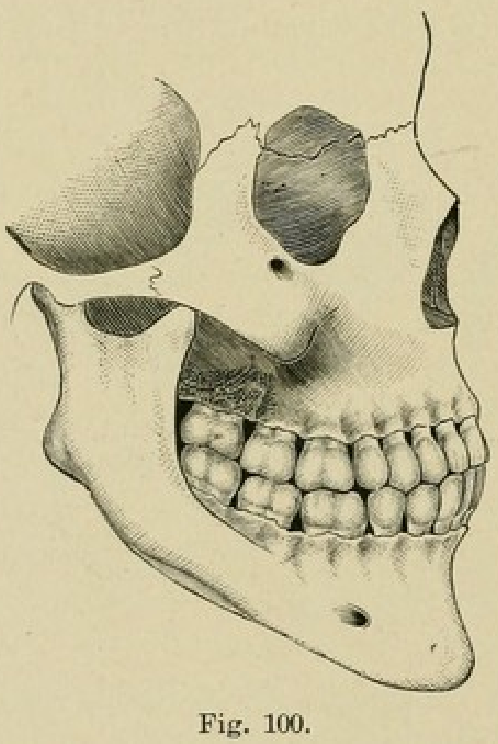

Fig. 100.

meet the angle of the jaw, which, in a normal jaw, would extend from one to one and a half inches below the line. Naturally slender, delicate muscles and tendons are associated with such bones. In these cases dislocation of the inferior maxilla is liable to occur while yawning or during dental operations, so great is the leverage. In this instance the length of the jaw compensated for the width, so that in this particular case the teeth are not irregular; although irregularity frequently accompanies this peculiar formation of the jaw. This is particularly the case with the saddle or V-shaped arches on the upper jaw, and the saddle-shaped and forward inclination of the molars, bicuspids and cuspid teeth on the lower jaw. The roof of the mouth is also very high and the alveolar process very thin, giving the roots of the teeth but

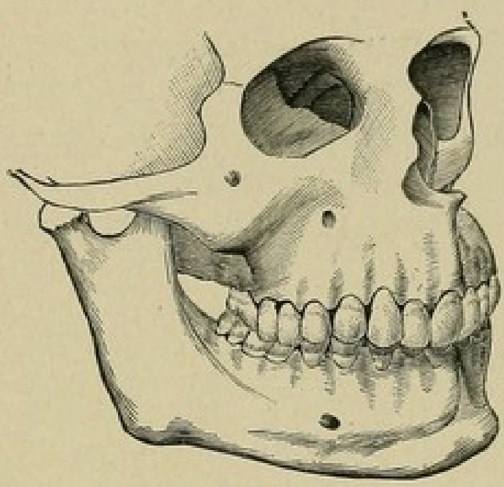

Fig. 101.

slight support. The same principle of organization and structure is operative in the alveolar process and teeth of the lower jaw.

Fig. 101 represents the jaws of a patient, twenty-six years

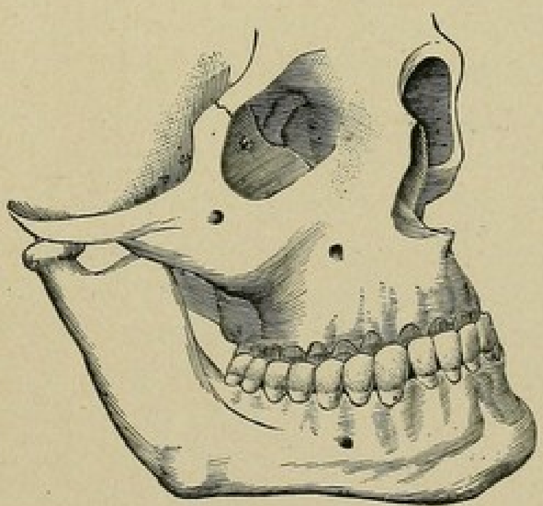

Fig. 102.

of age, who came to me for treatment. Upon examination I found a small normal inferior maxilla, well protruded, and in harmony with the other features of the face. The superior maxilla and alveolar process were excessively developed, the first molar and anterior teeth describing a much larger circle than the lower. The second molars were the only teeth that articulated properly. The anterior alveolar process had taken on a prolific deposition of bone-cells until the teeth impinged upon the gum of the lower jaw, producing absorption and expansion. The upper lip was covered with a mustache which completely hid the deformity. Under such conditions a prominence is observed at the alæ of the nose—the upper lip being drawn over the alveolar process.

Fig. 102 represents a case rarely met with. The body of the inferior maxilla is excessively developed, the extent of the irregularity depending on the degree of development. When only a slight protrusion exists the incisors strike beyond the superior incisors. In extreme cases only the molars articulate. When only the anterior teeth articulate the alveolar process develops so that the teeth extend to the superior alveolar process. The features may be quite regular otherwise. This deformity is common among negroes, and is called prognathism. Asymmetry of the jaws frequently continues to develop until the osseous system has obtained its growth.

CHAPTER XXX.

NEUROSES OF DEVELOPMENT OF THE VAULT.

It is a singular fact that depressed palates and irregularities of the teeth were first observed and described by medical men. Langdon Down called the attention of the medical profession to the fact that high vaults, as well as irregular-shaped jaws, were very common among idiots and congenital imbecility. In a paper, read before the Odontological Society of Great Britain, he says, among other things, speaking of idiots in the Earlswood asylum: "Of the most significant value, however, is the condition of the palate. I have made a very large number of careful measurements of the mouths of the congenitally feeble-minded, and of intelligent persons of the same age, with the result of indicating with some few exceptions a markedly diminished width between the posterior bicuspids of the two sides. One result, or rather, one accompaniment of this narrowing, is the inordinate vaulting of the palate. The palate assumes a roof-like form. The vaulting is not simply apparent from the approximation of the two sides; it is absolute—the line of juncture between the palatal bone occupying a higher plane. Often there is an antero-posterior sulcus corresponding to the line of approximation of the two bones. An appeal to the condition of the mouth is an important aid in determining whether the lesion, on which the mental weakness depends, is of intra-uterine or post-uterine origin. In the event of the mouth being abnormal, it indicates a congenital origin; while if the mouth is well formed, and the teeth are in a healthy condition, it would lead to the opinion that the calamity had occurred subsequently to embryonic life." Indeed, he went so far as to state that these conditions, when observed in young children, were pathognomonic of idiocy. Upon further observation, however, it was found that many idiots and feeble-minded individuals possessed low, narrow vaults. It was also observed that many sane persons possessed high vaults, and V, and saddle-shaped arches.

Dr. Clay Shaw* made extensive observations and accurate measurements of the mouths of idiots, and decided that "there is no necessary connection between a high palate and the degree of mental capacity of the individual."

Dr. Clay Shaw believed that a high palate is invariably associated with narrow, pterygoid width, and a narrow skull, but this theory is of little value. By a close examination of the vaults of the dolichocephalic heads, it will be seen that such is not the case, but that they are also to be seen among the brachycephalic and mesocephalic heads.

Cuylitz,† a Belgian authority, accepting the views of Langdon Down, and others, as to the connection of a high-vaulted palate with mental deficiency, explains it as follows: "The brain tends to develop transversely, but it meets in some cases a resistance in the parietal region which crowds it back. This pressure, transmitted by the zygomatic, temporal and molar processes, pushes together the alveolar borders of the superior maxilliaries like a workman's tongs, the approximation of the main branches of which—that is, of the parietals—brings the ends together, the hinge being represented by the body of the sphenoid, and the occipital. This bringing together, therefore, of the alveolar borders, or the original palate, is only the expression of a cerebral collapse or abnormal effort, which in the psychic life reveals itself by degeneracy."

The advantages of a law like the above are obvious, provided always that it is a definitely established one. Even for a working hypothesis a certain amount of substantiating evidence is needed, and this cannot, it seems to me, be considered as yet as anything more than an ingenious suggestion, which, however, is worthy of consideration.

THUMB-SUCKING AND SIMILAR CAUSES PRODUCING HIGH VAULTS.

As early as 1834, J. Imrie stated, in Parents' Dental Guide, that "rabbit-mouth is due to keeping the thumb in the

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* *Journal of Mental Science*, July, 1876.

† Quoted by *Regis. Mental Medicine*, 2d Edition, Paris, 1891.

mouth for hours after going to sleep." Since this time different authors have asserted that thumb, finger, lip, tongue and sugar-teat sucking are the cause of the high or deformed vault.

When we consider the size of the vault, especially its antero-posterior diameter, and compare it with above-named articles, it would seem absurd to suppose, for a moment, that there was any comparison in size between the two, or that a depression made by any one of these agencies could produce uniform width and height throughout the entire length of the vault.

Children commence to suck their fingers soon after birth, and as absorption and deposition of bone cells take place faster at this time than at any other in the life of the individual, one would naturally expect to find high, narrow vaults in connection with the first set of teeth or before the sixth year; but such is not the case. We frequently find children sucking their fingers who have very low vaults.

Dr. Thomas Ballard read a paper on the "Constitutional Ill-effects of Fruitless Sucking, and the Diagnostic Value of Deformed Jaws in Relation Thereto," before the Odontological Society of Great Britain in 1864, in which he said: "And as in idiots are seen the worst forms of defective growth, so also do they exhibit the most aggravated forms of deformed jaws and teeth; the habit of sucking being retained by them to an advanced age."

I think I am correct in stating that there are very few, if any, gentlemen connected with schools of idiocy who agree with Dr. Ballard in this statement.

I am prepared to state that there are no more deformities of the palates among idiots than there are to be found among other defective classes. The worst deformed vault and dental arches I have ever observed were those of a murderer, sentenced for life in the Joliet Penitentiary. There are to be found among normal individuals, such as seek our services in our offices, just as marked deformities as are ever observed among the inmates of our schools of idiocy, who are also known not to suck their fingers. The attendants, who are constantly watching over them and caring for their welfare, would be very likely to notice if such vicious habits were being practiced, but such is not the case.

FALLACIES OF CLOUSTON'S THEORIES.

In 1891, Dr. T. S. Clouston published a paper in the *Dental Record* upon "The Hard Palate in its Relation to Brain Development," in which he divided the vault into three groups. The first he calls "Typical," or "Normal" (Fig. 103, No. 1). It corresponds to Ivy's section of the "horse-shoe arch;" the low, but regular wide dome, he says, is characteristic of the sanguine temperament. The second he calls the "Neurotic" (Fig. 103, No. 2), because he says "The deformity of the palate occurs during the brain-growth early in life, probably *in utero.*" He believes that it is a "bad initial neurotic heredity," just as we refer to a bad type of face or irregular teeth, or an asymmetrical head to such heredity. The third class he calls "Deformed" palate (Fig. 103, No. 3). It is of various shapes, all abnormal, but the most common form is very high, narrow, and at the top either V or saddle-shaped on account of the shoulder on each side of the teeth, he had described.

While there is a certain amount of truth in the arguments used for the names, as we shall see later, he does not quite take in the situation. The terms "Normal," "Neurotic," and "Deformed" hardly define the conditions of the vaults. Thus, a normal jaw may contain a vault ranging all the way from .21, the lowest I have ever seen, to .88, the highest, and all in a perfectly normal condition. If, then, a normal arch is like the horseshoe arch of Ivy's, what shall we call a normal arch that is .25 of an inch higher or lower? The neurotic arch, he says, "is more of a Gothic arch, with the alveoli tending to run more parallel and narrow down, the roof of which is formed by a larger part of a smaller circle."

I have observed neurotic arches very high and narrow, high and broad, low, and both narrow and broad, with marked neurotic jaws, face and head.

The third class, which he terms "Deformed," compose

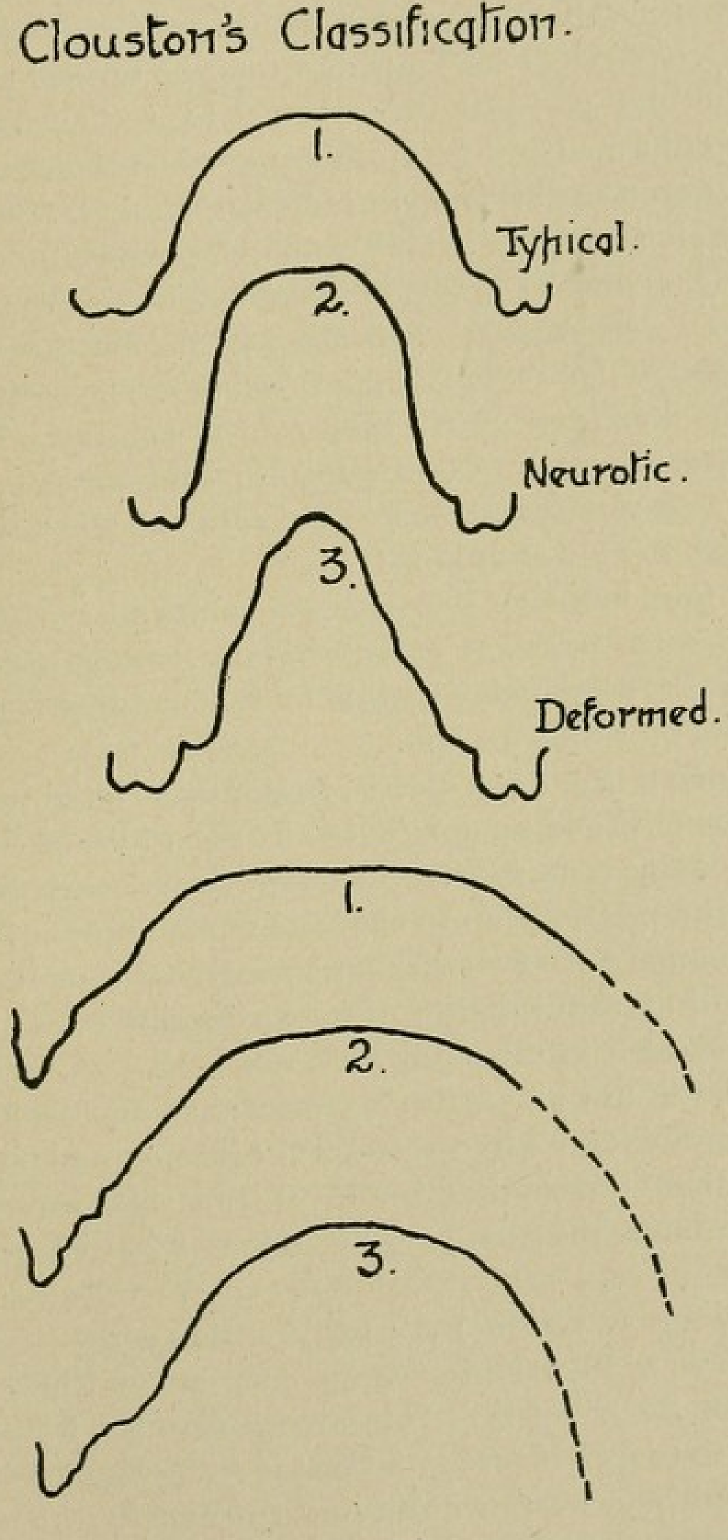

Clouston's Classification.
1.
Typical.
2.
Neurotic.
3.
Deformed.
1.
2.
3.

Fig. 103.

the V and saddle jaws. We shall see later that Clouston does not quite grasp the situation. Instead of reasoning himself, he allows himself to be carried away by the absurd theories of others. We shall see later that what he termed a deformed jaw is nothing more nor less than a neurotic condition, and that the deformed and neurotic are one and the same.

Clouston uses the same argument that J. Langdon Down did in 1871, and Cole in 1881, that "excessive vaulting of the palate is due to arrest of development of the sphenoid bone," and "premature ossification of the suture at the base of the skull." He says, "in considering the palate and upper maxillary bone, one must take into account the following considerations, viz.: Its relations to the base of the skull in man. This relation is seen to be close and absolute as compared with the lower animals.

"If a perpendicular line be drawn, marking the most anterior point of the brain, it is seen to fall, in man, through the center of the hard palate, while in the monkey it only just touches its posterior margin.

"In man it thus has a direct relationship to the brain base, and its shape would be dominated by the width of this; while in the monkey it is nearly a part of the alimentary system, having little relationship to the base of the brain at all. No one can compare the two without seeing that its conformation in man will naturally follow any changes that take place during development in the skull-base.

"If the skull in its growth, size, shape, dome and base, is absolutely dominated by the brain it contains, and on which it depends, then the brain-growth will, in this way, secondarily determine the shape of the upper maxillary bone and palate."

I have quoted this part of Clouston's paper, because anthropologists invariably use this as one of the points in favor of the theory of the evolution of man, but I have never been able to see what relation the jaws and vault had to the base of the brain, or how any force directed by the sphenoid bone, through the vomer (if it were possible), could in any way affect the vault or shape of the jaw.

If the intervening space between the base of the brain and the vault were solid, I could easily see how a change in the shape of one might exert an influence upon the other. The space occupied by the nares being located between the two, with the two strong pillars of the superior maxillary bone upon either side as a resistance, to my mind precludes such a theory. The fact that the jaw has become less normal, or that the anterior lobes of the brain have developed and become more prominent, would lead me to believe in a general way that the roof of the mouth should be less vaulted, or, in other words, the base of the skull, which is situated above the vault, instead of posterior to it, would occupy much of the space necessary for the anterior and posterior nares, thus crowding down the vault. That any force, produced by the development of the bones at the base of the skull, or early or retarded ossification of suture in that locality, could exert any influence through the vomer, to my mind is not well taken. The fact that the vomer does not ossify until puberty, the thinness of the bone, after ossification has taken place, and that it is most always crimped or deflected in one direction or another, would be conclusive proof that no effect could be produced upon a vault of bone supported by the anterior alveolar process, and with a rib or suture extending its entire length, which ossified years before any changes in the vault were noticed. We frequently observe the ridge and the two vaults, one on either side, extend anteriorly through the alveolar process nearly or quite to the incisor teeth. No one would think for a moment that the vomer could exert any influence upon the palate, either up or down, through the maxillary bone and alveolar process. If the argument were true, the vomer, before it could draw up the vault, would necessarily have to be drawn taut, but we rarely observe such a condition, although the high vaults are numerous.

Clouston says, further on in his paper: "Those palates, where the deformity consists in a ridge down the center, antero-posteriorly, seem to show that in them the deformity took place at a later period than in other deformed palates where the nasal septum was getting stronger and kept the center of the palate down, while on each side of it, the palate was drawn up, making two vaults, side by side, instead of one."

This theory, however, is not correct. I have frequently observed this deformity in the center of the vault as early as the second year, or at the time of ossification. If his theory is correct, that the contraction at the base of the skull, producing pressure through the vomer, causes the high vault, and when ossification of the vomer stops this procedure what carries up the sides of the vault? Again, in such cases the vomer would be perfectly straight, which is not observed in such cases.

Clouston reiterates a statement which has been made many times, that "the deformity of the palate (which, of course, must include the jaw) occurs during brain-growth, early in life, probably *in utero*." This theory can hardly be based upon a sound hypothesis, for the reason that the brain continues to grow until the seventh or eighth year. We shall see later that the vault does not change very much in height till after the sixth or eighth year; therefore a high vault cannot be said to develop early in life, much less *in utero*.

THE VAULT IN ITS RELATION TO TEMPERAMENTS.

Dr. Robert S. Ivy, in *The American System of Dentistry*, in the article "Dental and Facial Types," looks on them as being part of the morphology of the temperaments. He says: "The shape of the alveolar arch and the dome of roof of the mouth, also the articulation of the teeth, and the manner in which the gum is festooned over each tooth, are all indicative of the several temperaments, and present varieties worth attention. [Illustrated in Fig. 104.]

"The arch of the bilious temperament, from cuspid to cuspid, is almost flat, the lines backward from these points slightly diverging in an almost straight line. The dome of the mouth is high and almost square. When articulated, the upper central incisors overlap the lower, and are closely locked. In general form the teeth are large, the corners tending to squareness, and are rather long in proportion to

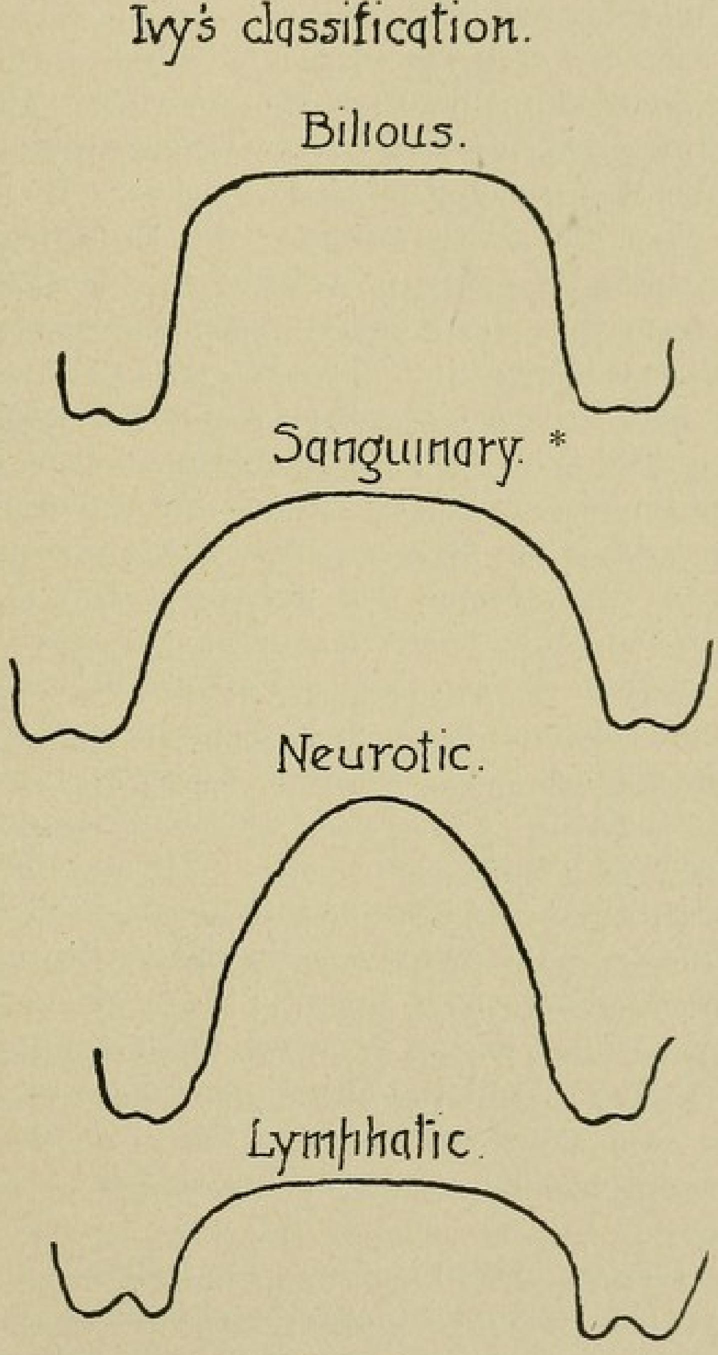


Fig. 104.

*Sanguinary should be sanguine.

their breadth; in texture they are dense and strong. The proximal surfaces are in close contact two-thirds of the distance from the cutting edge to the neck, rendering the festoon of the gum short and heavy.

"The sanguine arch resembles a horseshoe in shape. The dome of the mouth is high and semi-circular. The articulation of the teeth is close and firm, and their structure is dense. The masticating surfaces of teeth in this class frequently bite edge to edge, and as age advances they are gradually worn down to the gum unless protected by artificial means. In general form they are well proportioned, length predominating in less degree over breadth, and their outlines are rounded and curved. The distal and mesial surfaces are in contact a little more than half the distance from the cutting edge, and the festoon is long and delicate in outline.

"The arch of the nervous temperament presents a strong contrast to either of the two preceding, and is sometimes spoken of as Gothic, from its pointed character. From the central incisors, which often overlap for want of space, the line of the remaining teeth continues backward with a slight curve, the greatest prominence being between the cuspid and the first bicuspid. The roof of the mouth partakes of the same curve and angle as the arch. The articulation of the teeth is not close but long, and the teeth belonging to this temperament are of average density and structure. In shape, length predominates over breadth; the distal corner of the centrals is rounded, giving the whole tooth almost the appearance of a lateral, and the cusps and cutting edges are long and fine. The point of contact of the proximal surfaces is near the cutting edge, giving a long, delicate festoon to the gum.

"The lymphatic arch is almost semi-circular in its outline, and somewhat resembles that of the sanguine temperament. The dome, or roof of the mouth, is flat and low. The articulation is irregular, and the front teeth are apt to protrude. In shape, breadth predominates over length, and the normal depressions and elevations are either entirely absent or undefined. The festoon of the gum is thick and indefinite in outline. The lateral on either or both sides is frequently out of line."

This classification would seem on general principles to possess some merit, but upon close observation it will not hold good.

The temperament, as far as the shape, size and character of the jaws and teeth are concerned, has nothing whatever to do with it, and the vault, least of all, cannot share in any such division.

In mouths of the bilious, sanguine, nervous or lymphatic temperaments we can find dental arches in each temperament measuring 2.50 across from the inner surface of one second bicuspid to the inner surface of the other. We can also find the dental arch ranging all the way down to .96 in width, and the antero-posterior diameter ranging from 1.86 to 2.43. The vaults must necessarily range in height and shape to correspond to the width and length of the dental arch.

It is easy to see why temperament has very little to do with the shape of the dental arch. Two individuals are married, one a nervous, the other a lymphatic, bilious, or sanguine temperament; the offspring inherits the jaws of one, the teeth of the other, and the temperament of the child is changed. The local condition is such that the shape of the jaw may change the character of the vault entirely. One child may possess a broad dental arch, but very short, another a very narrow and long dental arch. Hence, classifying the dental arch and vault with temperament is wholly out of the question.

That it may not seem presumptuous on my part to advance such positive assertions, let us examine the individuals from which the following drawings were taken and compare the temperaments with the antero-posterior and lateral outlines.

In selecting the temperament I was governed by the description of each as laid down in the article by Ivy in *The American System of Dentistry*. I did not, however, rely entirely upon my own judgment, but called to my assistance a physician of standing and ability.

Under the heads brachycephalic, mesocephalic and dolichocephalic, there are sixty drawings (Plates 19 to 28) from models of white individuals. The height of vault varies from .31 to .81, with a width from 1 to 1.86; the antero-posterior ranges from 1.87 to 2.50.

In examining the drawings, in outline, they are as different as it is possible to make them and not produce a deformity. Thus, in the antero-posterior direction, Figs. 1 and 7 (Plates 19 and 21), brachycephalic, with only a difference of .03 in width of head, has its highest part in the vault about the second molar, while Fig. 6 (Plate 19) has its highest at the first and second bicuspids. Fig. 6 (Plate 23), mesocephalic, has its highest part midway between the highest part of Figs. 6 and 7, brachycephalic.

Looking at the lateral outline we notice that Figs. 1, 2 and 6 (Plate 20), brachycephalic, are pinched or contracted, and this contraction is not uniform upon both sides. Figs. 3 and 7 (Plates 20 and 22), brachycephalic, and Fig. 6 (Plate 24), mesocephalic, are broad; Figs. 3 and 7 are not uniform upon both sides, while the teeth do not stand in the same direction—some stand vertical, others at an angle of 45°.

Figs. 11 and 12 (Plate 22), brachycephalic; Figs. 1, 3 and 4 (Plate 24), mesocephalic, and Figs. 4 and 5 (Plate 27), dolichocephalic, are sanguine.

Could there be a greater difference possible in comparing the antero-posterior and lateral drawings? Fig. 12 (Plate 22), is very high at the middle, or about the first permanent molar, while Fig. 4 (Plate 23), mesocephalic, and Fig. 4 (Plate 27), dolichocephalic, are very flat, and the soft palate of Fig. 4 (Plate 27), dolichocephalic, extends back considerably farther than in Fig. 4, mesocephalic.

Figs. 1, 3, 5 and 11 possess graceful curves, but not on the same circle. The teeth also stand at different angles, as in the last group. In looking over the lateral drawings, Fig. 4, mesocephalic, and Fig. 5, dolichocephalic, possess a slight resemblance, although the width and height vary .12 and .31 of an inch, respectively. The lowest vault has the widest jaw, while the highest vault the narrowest. There is a depression at the median line, which is quite marked, in the antero-posterior drawing, Fig. 4, mesocephalic, that is not in the other. The sides of the arch in Fig. 4, mesocephalic, diverge to a greater extent than those in Fig. 5, dolichocephalic. Thus in a general way no two resemble each other.

It is claimed by some that the neurotic possess the highest vaults. Let us see how far this can be carried out. Figs. 8, 9 and 10, brachycephalic; Figs. 2, 7 and 10, mesocephalic; Figs. 1 and 6, dolichocephalic, possess a nervo-bilious or neurotic temperament. We have the extreme highest vault .75, and the extreme lowest .37. In the lateral measurement the extreme narrowest, 1, and the extreme widest, 2.50. As far as the shape of the dental arch and teeth are concerned, my observation does not correspond with Ivy's in the least degree.

To illustrate the wide difference in two individuals of the same temperament, let us take Figs. 3 and 4, mesocephalic —both medical students, and of sanguine temperament. Fig. 3 weighs 195 pounds, is six feet two inches, while Fig. 4 weighs 163½ pounds, and is five feet eight inches. Both measure seventy-nine lateral index. The two heads are exactly alike. The width of vault in Fig. 3 is 1; Fig. 4, 1.37. Height of vault Fig. 3, .56; Fig. 4, .50. The smaller man possesses the widest and lowest arch. The shape of the dental arch, the gums and teeth, are wholly unlike. The smaller man has the larger teeth, while the gums are long and pointed. The larger man has short, broad gums.

There were only three lymphatic individuals, Fig. 5 (Plate 20), brachycephalic; Fig. 9 (Plate 26), mesocephalic, and Fig. 3 (Plate 27), dolichocephalic. Fig. 5 possesses height of vault, .62; Fig. 9, .44; and Fig. 3, .75; while the width of vault is, Fig. 5, 1.25; Fig. 9, 1, and Fig. 3, 1.25.

In looking over the drawings, I find none resembling Ivy's illustrations, nor do any look alike. It will, therefore, be noticed that the same rule holds good in the lymphatic temperament as in all others, that there is no uniformity in shape, size or height.

SHAPE OF THE VAULT COMPARED WITH THE SHAPE OF THE HEAD.

It has been stated that the shape of the vault resembles the shape, or contour, of the head. Thus a brachycephalic, or broad head, contains a large, broad jaw with a low vault, while a dolichocephalic, or long, narrow, high head, possesses a long, narrow jaw with a high vault. In order to study the relation of the shape of the vault with the contour of the head, a large number of models were secured, and measurements of the head taken. The shape of the jaws were taken in modeling compound in such a manner that the soft palate could also be outlined. From these impressions plaster models were obtained, measurements then taken, and the models sawed at the median line. One half was placed upon paper and an outline obtained. The two halves were then glued together and the saw passed through the model laterally between the second bicuspid and first permanent molar. The anterior half was then outlined.

The shape of the head was obtained by the use of a heavy strip of lead carefully moulded to the head in the antero-posterior direction from the nose to the base of the skull, then removed, laid upon paper, and outlined. The lateral contour was obtained by moulding the lead over the head, just back of the ears. These outlines were reduced by means of the pantagraph to about one third the natural size. Unfortunately, craniologists are not yet in accord as to the best method of taking the measurement of the head. This want of harmony precludes uniformity of action in deciding what shall constitute a broad head and a long head.

Vogt says, in his work on man: "Taking the tables of Welcker as a basis, and assuming the longitudinal diameter of the skull—100, the following results are obtained for the various races; where the mean of the transverse diameter is below 72, they may be termed long heads; where it exceeds 81, short heads; where it varies between 74 and 81, middle heads."

BROCA'S DIVISION (FRENCH).

1.	True dolichocephalic, -	below 750.
2.	Sub-dolichocephalic, -	750 to 778.
3.	Mesocephalic, - -	778 to 800.
4.	Sub-brachycephalic, -	800 to 833.
5.	True brachycephalic, - -	above 833.

Professor Flower, of the Royal College of Surgeons, England, simplifies this table by the following:

Dolichocephalic, - - -	below 750.
Mesocephalic, - -	750 to 800.
Brachycephalic, - - -	above 800.

I adopted the rule of Flower, for the reason that the difference between the broad heads and the long heads is more pronounced. I could more easily distinguish any deviation that might exist between the vault and the shape of the head.

This measurement was also taken with the instrument used by hatters. I found it of no value, however, except to give an outlined demonstration of the shape of the circumference of the head. I secured models and measurements of the heads of white and colored persons, so that I might note any deviation in the shape of the heads of the two races, should there be any, and for another reason which I shall explain further on. I found it very difficult to pick out individuals possessing brachycephalic, mesocephalic, and dolichocephalic heads; that is, I could not decide until the measurement of the head was taken, whether it was a proper case or not. I, therefore, invariably took the measurement of the head first.

It may seem an easy matter to secure individuals with lateral indexes below 70, or long heads, especially among colored people, since they have been classed by craniologists as a long-headed race, but when I state that I spent my noon hour for over three months visiting the hotels and restaurants in Chicago with a view of securing twelve, and was only able to obtain six, we can have some idea of the scarcity of these persons. When they were found, it required the greatest amount of tact to get them to come to my office for the examination, owing to their sensitive nature.

It is a singular fact that the dolichocephalic head of the negro has been changed in this country to a mesocephalic and even brachycephalic head by climate, soil and the mixture of white and Indian blood. Hundreds of heads measuring over 75 could be found, when only one below 70 was obtained. To find white dolichocephalic heads was still more difficult. I have sufficient, however, for the purpose which required them. The children were classified according to their ages, and in most cases with the broad heads at the top of the list. This plan, however, was not always carried out, but by referring to the lateral index number, they can easily be compared. We could hardly expect to find a uniformity between the contour of the vault and the head (if such a thing were possible) before the twelfth year, because both head and vault are undergoing the formative process. They are given, however, for the purpose of showing the changes that do take place in the transitory period.

Below is given a description of the diagram of the shapes of the vaults of forty-eight adults,* white and colored; twelve brachycephalic (Plates 19, 20, 21 and 22); twelve mesocephalic (Plates 23, 24, 25 and 26); six dolichocephalic (Plates 27 and 28), white; and six brachycephalic, six mesocephalic and six dolichocephalic (Plates 29 to 34), colored. The index width outside first permanent molar, width outside second bicuspid, width inside second bicuspid, antero-posterior measurement when the third molar was present, height of vault, and temperament were noted.

The special instruments already described were used for the last two measurements, for the reason that in the antero-posterior measurement frequently only one third molar was present, or a tooth anterior to the third molar might have been extracted, in which case the third molar upon that side would have moved forward. In such case the T-square (Fig. 10) when placed upon the posterior surface of the furthermost third molar, and the long arm brought forward to a point

* The shapes of the heads were taken, but are not illustrated in this work.

between the central incisors, a very accurate measurement could then be obtained. The vault varies so much in height at different localities that, in order to obtain the measurement at the highest part, it was necessary to invent an instrument that could be moved backward, forward and at any angle, in order that these points could be reached, and at the same time have a fixed point (the alveolar process between the second bicuspids and first permanent molars) to start from.

The instrument is illustrated in Fig. 11. The figures 1, 2, 3, etc., together with the same figures of antero-posterior and lateral diameter of the mouth, correspond to the same individual; upon close examination, there is not the slightest resemblance between them. Occasionally, by a stretch of the imagination, we think that we can discover a slight similarity, but upon a critical examination there is no resemblance. Let us now examine the extreme in the brachycephalic (Plates 19, 20, 21 and 22) and dolichocephalic (Plates 27 and 28).

If we cannot find a uniformity in the vault and contour of the heads of these individuals, we certainly cannot expect to find them in the mesocephalic individuals (Plates 23, 24, 25 and 26).

BRACHYCEPHALIC—WHITE.

NO.	INDEX.	WIDTH OUTSIDE 1ST MOLAR.		WIDTH OUTSIDE 2D BICUSPIDS.		WIDTH BETWEEN 2D BICUSPIDS		ANTERO-POSTERIOR.		HEIGHT OF VAULT.		TEMPERAMENT.
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	
1	84	2.37	60.19	2.12	53.84	1.25	31.75	1.87	47.49	0.44	11.17	Nervo-sanguine
2	84	2.12	53.84	1.87	47.49	1.25	31.75	2.12	53.84	0 50	12.70	Nervo-sanguine
3	84	2.62	66.53	2.37	60.19	1.37	34.77	2.37	60.19	0.50	12.70	Nervo sanguine
4	84	2.12	53.84	1.87	47.49	1.25	31.75	....	.....	0.56	14.22	Nervo-bilious
5	84	2.37	60.19	1.87	47.49	1.25	31.75	2.12	53.84	0.62	15.74	Lympho-sanguine
6	84	2.12	53.84	1.75	44.45	1.00	25.40	2.25	57.15	0.62	15.74	Sanguino-bilious
7	81	2.37	60.19	2.12	53.84	1.37	34.77	2.18	55.37	0.50	12.70	Nervo-sanguine
8	81	2.00	50 80	1.87	47.49	1.31	33.27	1.87	47.46	0.56	14.22	Nervo-bilious
9	81	2.12	53.84	1.87	47.49	1.06	26.92	....	.....	0.37	9.39	Nervous
10	82	2.00	50.80	1.75	44.45	1.00	25.40	2.50	63.50	0.56	14.22	Nervous
11	82	2.00	50.80	1.87	47.49	1.06	26.92	2.25	57.15	0.62	15.74	Sanguine
12	82	2.25	57.15	2.00	50.80	1.12	28.70	2.12	53.84	0.68	17.27	Sanguine

MESOCEPHALIC—WHITE.

NO.	INDEX.	WIDTH OUTSIDE 1ST MOLAR.		WIDTH OUTSIDE 2D BICUSPIDS.		WIDTH BETWEEN 2D BICUSPIDS.		ANTERO-POSTERIOR.		HEIGHT OF VAULT.		TEMPERAMENT.
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	
1	79	2.25	57.15	2.00	50.80	1.18	29.97	2.00	50.80	0.56	14.22	Sanguine
2	79	2.25	57.15	2.00	50.80	1.25	31.75	....	.....	0.56	14.22	Nervo-bilious
3	79	2.00	50.80	1.62	41.15	1.00	25.40	....	.....	0.56	14.22	Sanguine
4	79	2.50	63.50	2.25	57.15	1.37	34.79	2.25	57.15	0.50	12.70	Sanguine
5	78	2.12	53.84	1.75	44.45	1.86	26.92	....	.....	0.68	17.27	Nervous
6	78	2.37	60.20	2.12	53.84	1.37	34.79	2.25	57.15	0.56	14.22	Nervo-sanguine
7	77	2.25	57.15	2.00	50.80	1.18	29.97	....	.....	0.56	14.22	Nervo-bilious
8	77	2.25	57.15	2.00	50.80	1.00	25.40	2.25	57.15	0.44	11.17	Nervous
9	76	2.06	52.32	1.75	44.45	1.00	25.40	....	.....	0.44	11.17	Lymphatic
10	76	2.37	60.20	2.12	53.84	1.25	31.75	2.37	60.20	0.56	14.22	Nervo-bilious
11	75	2.00	50.80	1.75	44.45	1.00	25.40	2.00	50.80	0.31	7.87	Neurotic
12	75	2.18	55.37	2.00	50.80	1.25	31.75	....	.....	0.50	12.70	Neurotic

DOLICHOCEPHALIC—WHITE.

NO.	INDEX.	WIDTH OUTSIDE 1ST MOLAR.		WIDTH OUTSIDE 2D BICUSPIDS.		WIDTH BETWEEN 2D BICUSPIDS.		ANTERO-POSTERIOR.		HEIGHT OF VAULT.		TEMPERAMENT.
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	
1	72	2.25	57.15	2.12	53.84	1.50	38.10	2.12	53.84	0.75	19.05	Nervo-bilious
2	72	2.25	57.15	2.00	50.80	1.25	31.75	2.12	53.84	0.62	15.74	Bilious
3	72	2.00	50.80	1.87	47.49	1 25	31.75	2.18	55.37	0.75	19.05	Nevro-lymphatic
4	72	2.37	60.19	2.00	50.80	1.44	36.54	2.31	58.67	0.75	19.05	Sanguine
5	71	2.06	52.32	1.87	47.49	1.25	31.75	....	.....	0.81	20.75	Sanguine
6	66	2 25	57.15	2.00	50.80	1.31	33.27	....	.....	0.75	19.05	Nervo-bilious

BRACHYCEPHALIC—COLORED.

NO.	INDEX	WIDTH OUTSIDE 1ST MOLAR.		WIDTH OUTSIDE 2D BICUSPIDS.		WIDTH BETWEEN 2D BICUSPIDS.		ANTERO-POSTERIOR.		HEIGHT OF VAULT.	
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
1	87	2.87	72.90	2.00	50.80	1.31	33.27	2.18	55.37	0.56	14.22
2	87	2.50	63.50	2.25	57.15	1.62	41.15	2.12	53.84	0.50	12.70
3	85	2.37	60.20	2.00	50.80	1.37	34.77	....	.....	0.62	15.74
4	84	2.25	57.15	2.00	50.80	1.31	33.27	2.00	50.80	0.75	19.05
5	84	2.50	63.50	2.12	53.84	2.50	63.50	2.25	57.15	0.50	12.70
6	81	2.50	63.50	2.00	50.80	1.37	34.79	2.25	57.15	0.75	19.05

MESOCEPHALIC—COLORED.

NO.	INDEX	WIDTH OUTSIDE 1ST MOLAR.		WIDTH OUTSIDE 2D BICUSPIDS.		WIDTH BETWEEN 2D BICUSPIDS.		ANTERO-POSTERIOR.		HEIGHT OF VAULT.	
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
1	80	2.50	63.50	2.25	57.15	1.62	41.15	2.31	58.67	0.62	15.74
2	79	2.81	71.37	2.50	63.50	1.62	41.15	2.25	57.15	0.62	15.74
3	79	2.25	57.15	2.00	50.80	1.50	38.10	2.00	50.80	0.62	15.74
4	78	2.50	63.50	2.50	63.50	1.50	38.10	2.37	60.20	0.62	15.74
5	78	2.12	53.84	1.50	38.10	1.31	33.27	2.12	53.84	0.62	15.74
6	75	2.37	60.20	2.00	50.80	1.37	34.79	....	.....	0.50	12.70

DOLICHOCEPHALIC—COLORED.

NO.	INDEX	WIDTH OUTSIDE 1ST MOLAR.		WIDTH OUTSIDE 2D BICUSPIDS.		WIDTH BETWEEN 2D BICUSPIDS.		ANTERO-POSTERIOR.		HEIGHT OF VAULT.	
		In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
1	70	2.12	53.84	1.87	47.49	1.18	29.97	2.18	55.37	0.56	14.22
2	69	2.50	63.50	2.12	53.84	1.50	38.10	2.25	57.15	0.62	15.74
3	67	2.50	63.50	2.18	55.37	1.50	38.10	2.25	57.15	0.62	15.74
4	67	2.25	57.15	2.00	50.80	1.18	29.97	2.25	57.15	0.62	15.74
5	63	2.25	57.15	2.12	53.84	1.50	38.10	2.25	57.15	0.62	15.74
6	60	2.50	63.50	2.25	57.15	1.75	44.45	2.37	60.20	0.68	17.27

BRACHYCEPHALIC, AVERAGE—WHITE AND COLORED.

RACE.	WIDTH OUTSIDE 1ST MOLAR.		WIDTH OUTSIDE 2D BICUSPIDS.		WIDTH INSIDE 2D BICUSPIDS.		ANTERO-POSTERIOR.		HEIGHT OF VAULT.	
	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
White	2.22	56.38	1.98	50.29	1.19	30.22	2.16	54.86	0.54	13.71
Colored...	2.33	59.18	2.06	52.32	1.53	38.86	2.16	54.86	0.61	15.49

MESOCEPHALIC, AVERAGE—WHITE AND COLORED.

RACE.	WIDTH OUTSIDE 1ST MOLAR.		WIDTH OUTSIDE 2D BICUSPIDS.		WIDTH INSIDE 2D BICUSPIDS.		ANTERO-POSTERIOR.		HEIGHT OF VAULT.	
	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
White	2.21	56.13	1.95	48.53	1.16	29.47	2.18	55.37	0.52	13.20
Colored ...	2.42	61.36	2.12	53.84	1.49	37.55	2.16	54.86	0.60	15.24

DOLICHOCEPHALIC, AVERAGE—WHITE AND COLORED.

RACE.	WIDTH OUTSIDE 1ST MOLAR.		WIDTH OUTSIDE 2D BICUSPIDS.		WIDTH INSIDE 2D BICUSPIDS.		ANTERO-POSTERIOR.		HEIGHT OF VAULT.	
	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.	In.	Mm.
White	2.19	55.62	1.97	50.03	1.50	38.10	2.18	55.37	0.74	18.79
Colored...	2.35	59.69	2.09	53.08	1.42	36.06	2.26	57.40	0.62	15.74

Upon examination of the figures of the brachycephalic, white, the first six lateral indexes are 84. Taking the width of the dental arch we find that it varies from 2.12 to 2.62; outside second bicuspids, from 1.75 to 2.37; width of vault between second bicuspids, from 1 to 1.37; antero-posterior, from 1.87 to 2.37, while the height of the vault varies from .44 to .62. In the mesocephalic, white, the range varies from 2 to 2.50 in width of dental arch; width outside of second bicuspids, from 1.62 to 2.25; width inside second bicuspids, from 1 to 1.86; antero-posterior, from 2 to 2.37, and height of vault, from .31 to .68. Dolichocephalic: The range width of dental arch is from 2 to 2.37; width outside second bicuspids, 1.87 to 2.12; width between second bicuspids, from 1.25 to 1.50; antero-posterior, from 2.12 to 2.31; height of vault, from .62 to .81.

The range of figures in each group is so great, and differs so much from each other, that it will be impossible to say that any two possess the slightest resemblance to each other. By comparing one group with another, it will be seen that there is very little difference as regards width and length of dental arch, and width of vault. There is, however, quite a difference in height of vault.

By comparing the figures in the table of the lateral index, we do not observe the slightest resemblance in width, height or temperament, nor can we observe the slightest resemblance in the contour of the vault and head. It has been claimed that the shape of the vault is influenced by the intellect of the individual; that is, the most intellectual people possess the highest vaults. With a view of ascertaining the correctness of this theory, I measured the heads of six brachycephalic (Plates 29 and 30), six mesocephalic (Plates 31 and 32), and six dolichocephalic (Plates 33 and 34), colored people—waiters in hotels and restaurants. The white people examined consisted of bankers, editors, medical men, students, architects, bookkeepers—in fact, the most intelligent men that I could find.

By comparing the brachycephalic heads we notice that the highest lateral index in the white individuals is 84, in colored 87. The highest width, outside of first permanent molar, is white 2.62, colored 2.87. This seemed to me quite remarkable. The lowest white 2, colored 2.25. In width of vault, between second bicuspids, highest, white 1.37, colored 1.62; lowest, white 1, colored 1.31. Antero-posterior, greatest length, white 2.50, colored 2.25. Height of vault, highest white 68, lowest 37, with an average of 54; colored highest 75, lowest 50, with an average of 61.

Mesocephalic—Highest lateral index, white 79, colored 80. Highest width outside first permanent molar, white 2.50, colored 2.81; lowest, white 2, colored 2.12. Width of vault between second bicuspids, highest, white 1.86, colored 1.62; lowest, white 1, colored 1.31. Antero-posterior, highest, white 2.37, colored 2.37; lowest, white 2, colored 2. Height of vault, highest, white .68, colored .62; lowest, white .31, colored .50; average, white .52, colored .60.

Dolichocephalic—Highest lateral index, white 72, colored 70. Greatest width outside first molar, white 2.37, colored 2.50; lowest, white 2, colored 2.12. Width of vault between second bicuspids, highest, white 1.50, colored 1.75; lowest, white 1.25, colored 1.18.

Antero-posterior—Greatest length, white 2.31, colored

2.37; smallest, white 2.12, colored 2.18. Height of vault, highest, white .81, colored .68; lowest, white .62, colored .56; average, white .74, colored .62.

In reviewing the figures we notice that the colored people possess the roundest heads, while the width of jaw is larger in white, but in the other divisions the jaws are more uniform in width.

A point which must not be lost sight of, and one that I have frequently noticed in ancient skulls, is that in the colored race the jaw does not diminish in width anterior to the first permanent molar as it does in the white race. The height of vault seems to be much higher in the colored race than in the white, with the exception of the dolichocephalic heads, where it is higher in the white race. The height of vault, like other measurements, is more uniform in the white race. Comparing the figures of the colored with white people, it will be seen, in the average, that the width and antero-posterior measurements of the colored people are the largest.

Since the highest vaults in the brachycephalic and mesocephalic heads are found among colored people, and in the dolichocephalic among the white, we must conclude that intelligence has nothing whatever to do with the contour of the vault, and that there is no more comparison between the vault and the contour of the heads of colored people than there is in white individuals.

MOUTH-BREATHING NOT THE CAUSE OF CONTRACTED JAWS AND HIGH VAULTS.

One of the theories which has been advanced as a cause of high vaults, and one that is still held to by some dentists and many medical men, is that of mouth-breathing. Mouth-breathing is caused by sleeping with the mouth open, by enlarged tonsils, by adenoid growth, by hypertrophy of the mucous membrane of the nose and turbinated bones, and by arrest of development of the bones of the jaw and nose. It is claimed by these men that when the mouth is opened, pressure is produced upon the sides of the jaws and teeth by the tension of the buccinator muscle, causing a contraction of the sides of the jaw, a protrusion of the teeth, and an elevation of the vault.

I will direct attention to a few facts as they have been presented to me during a constant study of the deformities of the jaws and teeth for the past eighteen years.

In the first place, let us consider the parts involved. The superior maxillary bones are fused at the median line. Their under surfaces have imposed upon them the alveolar processes. The maxillary bones proper are made up of dense, compact tissue, and are so arranged as to best resist certain forces. The outer surface of the bone is fortified and supported by the malar process, which is situated midway between the maxillary process and the canine eminence at the first permanent molar. At the canine eminence we have the strong, thick plate of bone extending from the bridge of the nose to the alæ, the mesial portion forming the outer surface of the nasal cavity. We also observe that the nasal septum is situated at the center of the nares and is attached to the maxillary bone at and along the place of union of the two halves of the maxillary bone. A saw passed through from one canine *fossa* to the other discloses in the section the strong trilateral pillars of bone which go to make up the outer surfaces of the nasal cavity. These strong pillars of bone are situated just at the point of the location of the permanent cuspids, and, together with the nasal septum, form a strong support to the hard palate.

The maxillary bones are for the attachment of muscles and the resistance of force in masticating food. The hard palate does not assume the normal shape until the twelfth year, or after the teeth are all in position. The vault may be high or low, ranging from one inch vertically from the alveolar plane on a tranverse line intersecting the alveolar crests between the second bicuspids and first molars (which is the highest vault I have seen) down to one quarter of an inch from the same plane (which is the lowest vault I have observed). In either case the vault may be normal; each variety depending upon the shape of the maxillary bones and teeth for its peculiar form.

The alveolar process, on the other hand, is made up of soft cancellated structure, and is solely for the purpose of protecting the germs of the teeth before they have erupted, and for supporting the teeth after they are in place in the jaw. From the time the teeth make their first appearance until they are finally shed, the alveolar process has developed and been absorbed three distinct times. The alveolar process being therefore solely for the protection and support of the teeth, it is logical to infer that the position and shape of the alveolar process depend upon the location of the teeth. The bone proper, therefore, as we shall see later, is not

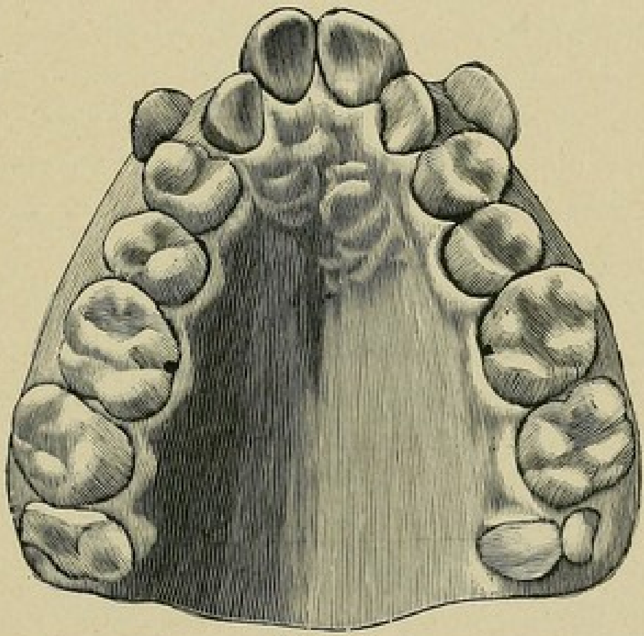


Fig. 105.

influenced to any great extent by the movement of the teeth.

The buccinator muscle is composed of striated muscular fibers, and is therefore under the control of the will. It is penniform in shape. It has its origin and insertion along the body of the jaws, above the alveolar process on the upper and below the alveolar process on the lower jaw. It extends from the first bicuspid anteriorly to the wisdom-tooth posteriorly. The center of the muscle in one direction therefore would be on a line with the grinding-surface of the teeth, and in a tranverse direction at the first permanent molar. It serves to compress air in the act of blowing, whence its name.

Its chief function is to convey and hold the food under the teeth during mastication.

There are many cases of contracted arches and high vaults where mouth-breathing does not exist; there are also many cases of normal arches and vaults where it is present. As many are aware, mouth-breathing frequently commences very early in life; contracted jaws, on the other hand, never begin to form until the seventh or eighth, and in most cases the tenth year, except in cases of monstrosities, or from traumatic causes. When these conditions exist, they are wholly unlike the usual contracted arches and can be diagnosticated

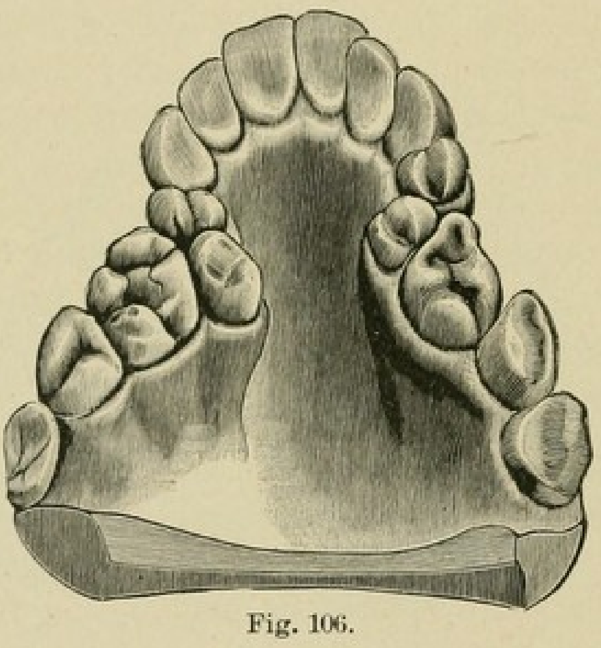


Fig. 106.

at once, and therefore they should not enter into this discussion. Contracted arches are of two kinds—V (Fig. 105) and saddle-shaped (Fig. 106)—all the other varieties being modifications and blendings of these two. It is apparent that the cause which produces the one does not produce the other. My observation has been that there are two-thirds more V and saddle-shaped arches among the low vaults than among the high vaults, taking .58 of an inch as the average; but where one of these deformities exists with a high vault it is always more marked, for the reason that in the high vault the alveolar process is long and thin, with very little resistance, and the teeth are more easily carried in one direction or the other.

In the V-shaped arch, commencing at the first permanent molar, there is a gradual narrowing of the dental arch and alveolar process toward the median line, where the incisors may approximate a V point or may stand in their normal position to each other. Invariably there is a protrusion of the teeth and alveolar process, and not of the jaw. On the other hand, in the saddle-shaped arch the bicuspids are carried inward and the deformity is invariably situated between the first permanent molar and the cuspid. Unlike the V-shaped variety, the anterior teeth and alveolar process never protrude in this class of deformities. The contracted hard palate is always associated with the V-shaped variety, and in most cases extends backward to the second bicuspid. It is never seen with the saddle-shaped variety.

The high vault is never seen in the first set of teeth, nor does it develop until the second set are all in place, which is at the twelfth year. The vault commences to slope slightly from the neck of the incisor until it reaches an imaginary line drawn across the roof of the mouth from the right first bicuspid to the left first bicuspid, and then it gradually or abruptly slopes upward until a point is reached which is central and vertical to a line drawn across the jaw from crest to crest between the second bicuspids and first molars. From this point posteriorly to the soft palate the dome is usually nearly level and parallel with the plane of the alveolar crests of the bicuspids and molars when it gradually slopes and unites with the soft palate. Occasionally we see a slight relative depression, and occasionally a corresponding slight elevation, but these are so inconsiderable as to escape notice unless one were looking for the peculiarity.

In mouth-breathing the lower jaw usually drops only sufficiently for the passage of the same volume of air that would pass through the nasal cavities when in a normal condition, each of the openings to which is equal to only about one-half an inch in transverse area. Old people often sleep with the mouth open and frequently to the fullest extent, but these deformities of the jaws and teeth never occur after the eruption of the teeth, say at the twelfth or fifteenth year.

When one opens his mouth he is conscious of a tension of the orbicularis oris, but not of a pressure of the buccinator, no matter how wide the mouth may be opened. This muscle being under the control of the will, is always passive except in the act of blowing or eating; therefore contraction during sleep is wholly out of the question. As the buccinator muscle extends anteriorly to the first bicuspid only, it cannot be productive of the V-shaped variety of deformity, in which is also found the contracted vault. Therefore the only deformity that is likely to be so produced is the saddle-shaped variety, which is, in fact, out of the question for reasons which I shall explain later. The orbicularis oris muscle cannot produce the contraction, because when the mouth is open the pressure exerted on the six anterior teeth is backward. Thus the teeth should be carried in the opposite direction from that which must be taken to produce this deformity. Again, the pressure is just as great upon the incisors as upon the cuspids, thus holding them in place. More force is exerted by the orbicularis oris upon the six anterior teeth when the mouth is open than could be exerted, were it possible, by the buccinator muscle, which would tend to hold the anterior teeth in place. It has in years past been demonstrated by dentists, in regulating teeth, that it is very rare for the apices of the roots of teeth to move when pressure is brought to bear upon their crowns for the purpose of regulating them. This being the case, teeth having long roots like the cuspids are less liable to move than teeth with short roots like the lateral incisors and bicuspids. Since in the moving of a tooth the greatest change which takes place is at the neck, it stands to reason that the greatest absorption and deposition of bone takes place at that point. The roots of the cuspids are larger and longer than those of any other teeth in the jaw; unlike other teeth, the germs are situated considerably higher and farther toward the outside of the alveolar process, so that when they come closely into position they diverge from the apices to the crowns, while all the other teeth stand nearly or quite perpendicular, thus showing that the roots of these teeth do not influence the hard palate. I have shown that the first permanent molar and the teeth posterior to it are never involved, except from local causes. I have also shown that the center of the buccinator muscle in both directions is located at this tooth. How, then, is it possible, since all the teeth are covered by the muscle upon one side, that half are carried inward and the other half remain normal?

Again, if mouth-breathing is the cause of the contraction, both sides should contract alike, and the deformity be uniform upon both sides, which is never the case. By observing the figure the want of uniformity of the two sides is easily

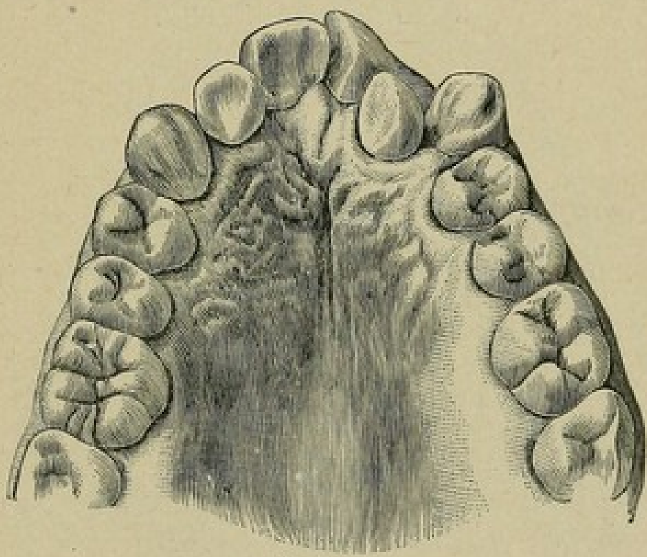


Fig. 107.

observed. Such muscles do not contract to a degree sufficient to induce the pressure necessary to produce a deformity. That they should, is inconsistent with our knowledge of the influence exerted by muscular structure in other parts of the body. Some of the muscles of the chest exert much more pressure in respiration than it is possible for the buccinator to do during sleep, yet no one would expect to find the ribs modified by this process. The pressure of the contractile tissue upon the crowns of teeth is not sufficient to affect the alveolar process through the roots of the teeth, but even if it could modify that spongy structure, its force would stop there and would not extend to the osseous vault and result in bending it out of shape. In most of these cases the diameter of the superior maxilla, its alveolar process and teeth, is less than that of the inferior maxilla, alveolar process, and teeth. This is always the case in the worst forms of irregularities. In such cases the muscles and cheek could not press upon the teeth and alveolar process of the upper jaw. The changes which take place in the bone are not a bending in at one place and a forcing out at a weaker point to compensate for the space lost, but are an absorption and deposition of bone at the point of pressure. And even if such were the case, the strong pillar of bone situated at the very point of contraction

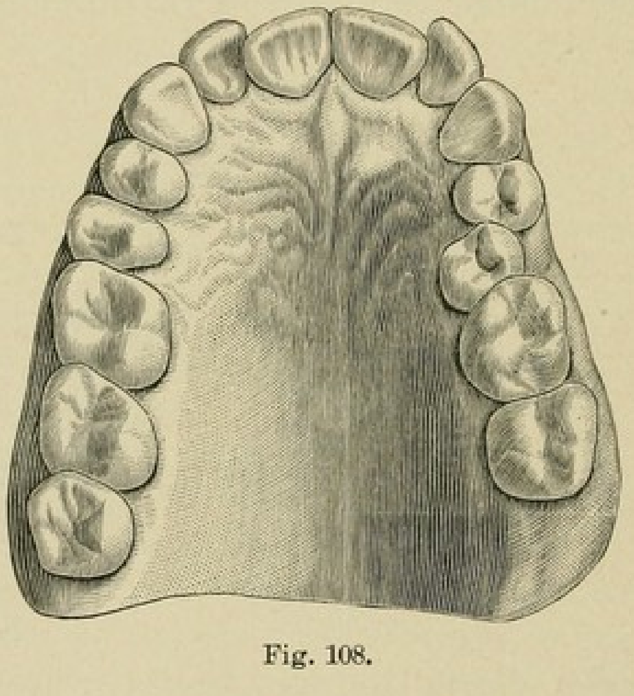


Fig. 108.

of the alveolar process, together with the nasal septum, constitute a strong bulwark for resistance to the pressure, which is suppositiously acting at a distance from the top of the vault. Again, it would be as impossible to so produce pressure sufficient to break the dental arch as it would be for the weight of a building to break the arch of a door or window. The tongue exerts a much greater force in the act of swallowing, and would prevent inward movement of the teeth if so slight a pressure, as the muscles of the cheeks could exert, were the cause of the deformity.

For the sake of the argument, let us suppose it were possible for the buccinator muscle to produce this contraction; we should then expect to find the modification of the osseous structures uniform. This would shut out semi-V-shaped (Fig. 107) and semi-saddle-shaped arches (Fig. 108) entirely, and a majority of other irregularities of the teeth in which there is bilateral asymmetry, for however much one might incline to the prevalent theory, no one would dare to assert that the muscle will act on one side of the mouth, while that on the opposite side remains passive. Partial V-shaped (Fig. 109) and partial saddle-shaped (Fig. 110) arches make the theory still less tenable. In these varieties we meet with sudden

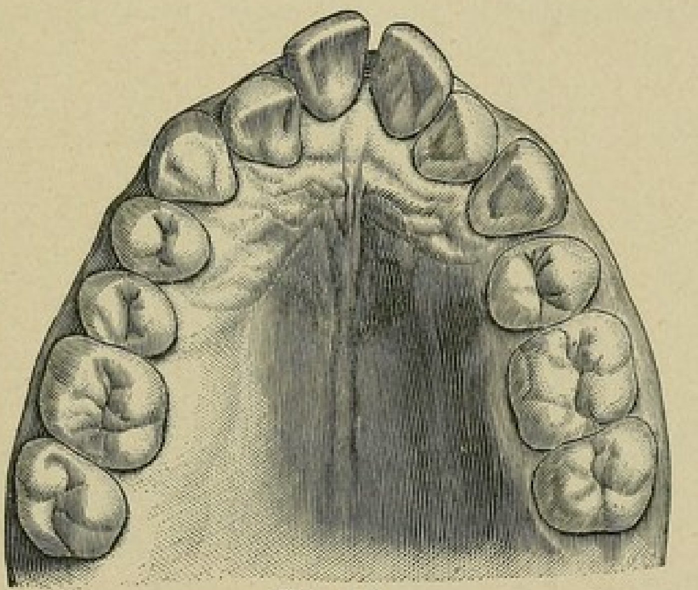


Fig. 109.

bends inward where only one or two teeth may be involved, which aberrations could only be produced by a centralization of force on one given point or fiber of muscle, a peculiarity of function that has never yet been ascribed to muscles. The muscle being penniform in shape, it would be impossible for one or two fibers of the muscle to exert their influence upon a bicuspid. It would naturally lap over two or more teeth. Lastly, if the buccinator acts as all muscles do—uniformly throughout its extent of contraction—it is just as efficient below a median bisecting line in producing a narrow, contracted arch as in its upper portion, and we should, therefore, expect to find the lower maxilla contracted whenever the upper one is, which is contrary to facts. A V-shaped arch can never occur upon the lower jaw, if the teeth articulate normally, because these teeth strike inside of the upper, and are thus prevented from moving forward. A saddle, partial saddle or semi-saddle arch may occur on the lower jaw, but these deformities are not often seen. When they do occur, they are the result of improper occlusion with the teeth of the upper jaw. We always observe in semi-V and partial V-shaped arches that the alveolar process is contracted upon the side of the deformity. If one side of the arch is contracted more than the other, we shall see that the alveolar process is contracted in proportion to the amount of deform-

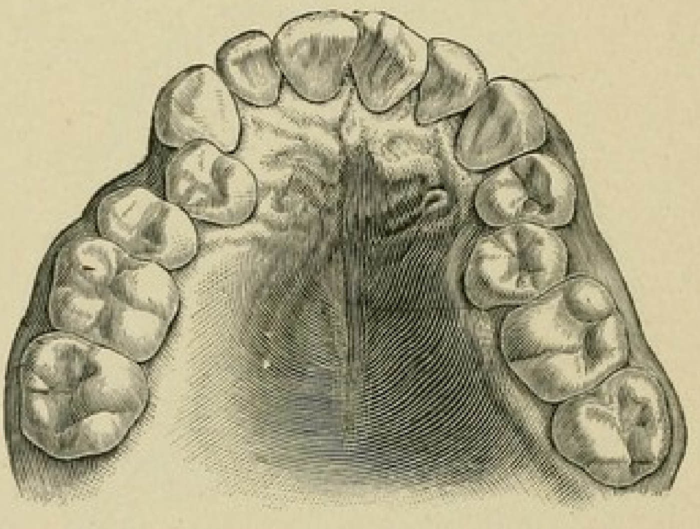


Fig. 110.

ity; the vault on that side is not carried up beyond the other side, which is normal. In the saddle, semi-saddle and partially saddle-shaped arches we find the alveolar process built up about the teeth in precise conformity to the nature of the shape of the arch. If we take three thousand models of the upper jaw and arrange them in groups, according to the forms here represented, and then examine very closely the arrangement of the teeth in each group, we shall be unable to find any two alike in either group; thus showing that an external force acting upon the jaws from the outside could not possibly be a cause. If that were possible, all the models of one variety would resemble some definite form.

The following tables will exhibit the differences in the heights of vaults, both in normal and defective jaws. The height is taken centrally and vertically from the gingival plane on a transverse line intersecting the gingival crests between the second bicuspids and first molars. For comparison with measurements of denuded crania, deduct .07 for the thickness of the soft tissues. Fig. 11 shows the instrument used, and the manner of making the measurements.

NORMAL JAW.

Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.
.21	1	.40	159	.56	936	.71	149
.25	2	.43	182	.59	218	.75	427
.28	70	.46	69	.62	514	.78	69
.31	171	.50	199	.65	150	.81	75
.34	169	.53	429	.68	568	.84	12
.37	146	...	...	...	...	...	...

Total number of cases, 4,614. Average, .58 of an inch.

SADDLE-SHAPED ARCH.

Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.
.21	..	.40	..	.56	6	.71	5
.25	..	.43	..	.59	5	.75	5
.28	..	.46	3	.62	4	.78	1
.31	..	.50	5	.65	..	.81	1
.34	..	.53	5	.68	3	.84	..
.37	1	...	..	...	..	...	..

Total number of cases, 44. Average, .60 of an inch.

V-SHAPED ARCH.

Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.
.21	..	.40	1	.56	15	.71	1
.25	..	.43	..	.59	4	.75	2
.28	..	.46	3	.62	9	.78	..
.31	2	.50	8	.65	..	.81	1
.34	..	.53	3	.68	5	.84	..
.37	4	...	..	...	..	...	..

Total number of cases, 58. Average, .55 of an inch.

SEMI-V AND SEMI-SADDLE-SHAPED ARCH.

Height of Vault.	No. of Cases.	Height of Vault.	No. of Cases.	Height of Vault	No. of Cases.	Height of Vault.	No. of Cases.
.21	..	.40	..	.59	1	.75	..
.25	1	.43	1	.62	4	.78	1
.28	..	.46	..	.65	2	.81	..
.31	..	.50	3	.68	..	.84	..
.34	..	.53	3	.71	2	...	..
.37	1	.56	5	...	..	...	..

Total number of cases, 24. Average, .56 of an inch.

In order to strengthen further the views herein suggested, I have taken impressions of the mouths of a large number of mouth-breathers, and have secured models of the same.

The following illustrations are from models of the mouths of patients over twelve years of age. They number from 1 to 24, in the order in which the impressions were taken. A sufficient number of cases are here illustrated to show the general outline of the jaws and teeth of the average mouth-breather.

In glancing over these illustrations (which are of natural size) it will be noticed that very few have contracted arches; as a rule, the vaults are less than the average in height. It will also be observed that no two cases are exactly alike, which would be the case if the contracted jaws were caused by lateral pressure of the cheeks.

I wish here to acknowledge my grateful obligations to Drs. Hawley Brown and Pyncheon, specialists in diseases of the nose and throat, for their kindness in sending me their private patients.

Case I, Fig. 111.—Hector M., aged thirteen years; nationality, French; born in Chicago. Height of vault, .53 of an inch. Has always breathed through his mouth. Adenoid growth in post-nasal spaces. Collapsed condition of alæ nasi.

Upon examining this cut we observe that the teeth are late in erupting, as the patient is thirteen years of age. The bicuspids are all through upon the right side and the cuspid is just coming into place, while upon the left side the second temporary molar is yet in position, the first molar having just been removed, and the first bicuspid coming in its place. The cuspid is not so far developed as its fellow of the opposite side. The second permanent molars should also be in place, but they are tardy in their development. While the general contour of the jaw is normal posterior to the cuspids, there is a tendency of the incisors to contraction, with a protrusion of the mesial surface of the centrals. It will be readily noticed that the cuspids are erupting anterior to their normal position, thus crowding the incisors together.

Case II, Fig. 112.—Paul F., aged nineteen years; nationality, American. Height of vault, .75 of an inch. Com-

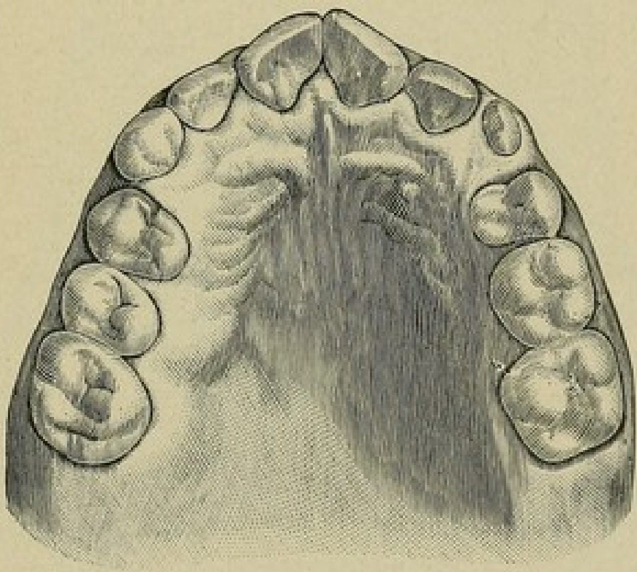


Fig. 111.

menced to breathe through the mouth at the age of nine years, at which time his nose was broken. Arrest of development of the bones of the nose. Adenoid growth. Hearing and eyesight are poor.

The jaw of this case is well developed, with a normal palate, but higher than the average, being three-fourths of an inch in height. All the teeth have erupted. The anterior teeth have a tendency to contraction, due to the fact that all the teeth tend to push forward; the central incisors do not protrude, as in Case I, because the lateral incisors overlap them. The right side of the arch tends to assume the saddle-shaped deformity, due to the position of the bicuspids, caused by too long retention of the temporary teeth. It will be observed that the two sides are markedly asymmetrical. This cut nicely illustrates the point previously mentioned: that if contraction of the jaw were due to contraction of muscles in mouth-breathing, both sides would be alike.

Case III, Fig. 113.—Miss Florence T., aged thirteen years; nationality, American. Height of vault, .46 of an inch. Had scarlet fever at five years of age. Commenced to breathe through mouth at the age of eight. Arrest of development of the bones of the face and nose.

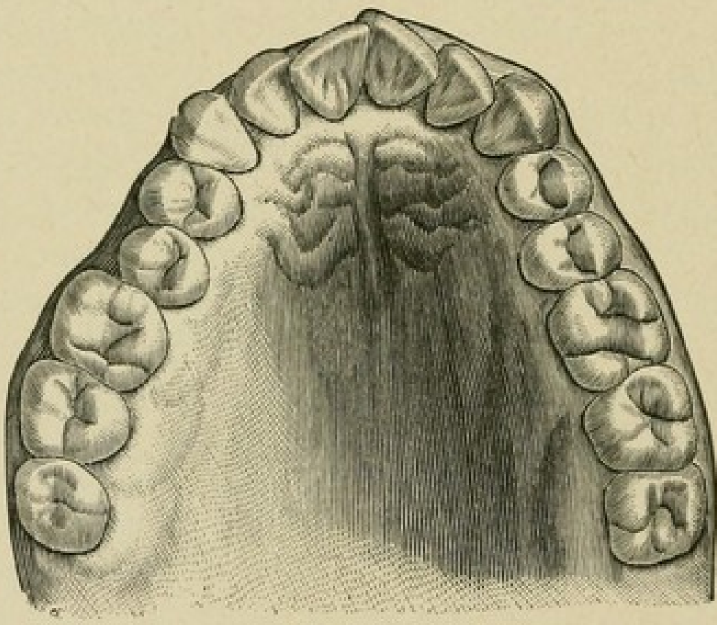


Fig. 112.

This is a well-marked illustration of defective development of the superior maxilla, and also of arrest of development of the bones of the face and nose. As in Case I, the second molars have not yet made their appearance. The central incisors overlap, but do not protrude. The right side of the arch tends to assume the saddle-shape deformity, due to the position of the bicuspids. The cuspid has not fully erupted on this side, and is still more tardy in its appearance on the left. As is true of Case II, the two sides are asymmetrical, and the height of the vault is quite a little less than the average. When the second and third molars appear, an unusual protrusion of the anterior teeth must necessarily result in order to give sufficient room for the molars. If this is allowed to progress without mechanical interference, a marked V-shaped deformity will result.

Case IV, Fig. 114.—Dr. H. S., aged twenty-one years; nationality, American. Height of vault, .68 of an inch. He

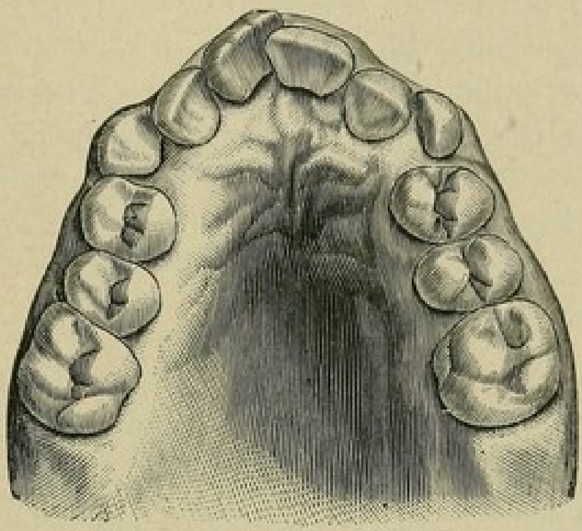


Fig. 113.

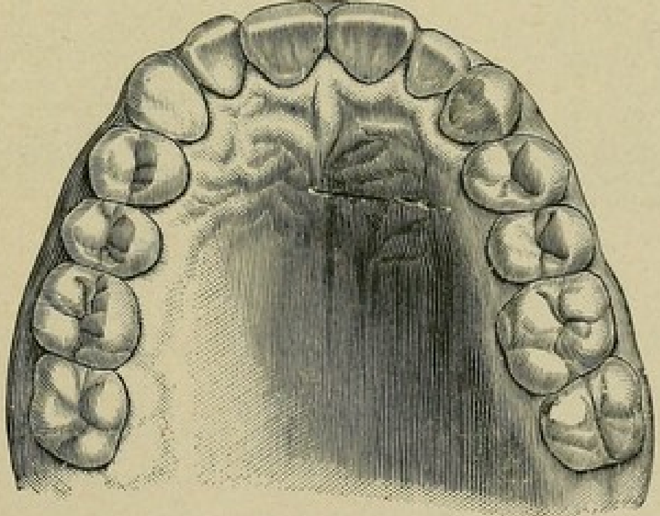


Fig. 114.

has been a mouth-breather all his life. Has deflection of the septum nasi, and, at the age of fourteen, was operated upon without any benefit. The bones of the nose are well developed, but those of the face are slightly arrested.

While the jaw is not quite as large as the normal jaw, the teeth are very regular, finely developed, and without a cavity.

It would be rare to find a more nearly perfect arch. The articulation with the inferior maxilla is at all points exact, and we have here a marked illustration of an orthognathous jaw.

CASE V, Fig. 115.—Mr. William M., aged fifty-two years; nationality, American. Height of vault, .43 of an inch. Always breathed through the mouth. Bones of the nose and face well developed. Last year had hypertrophied bone removed from the nose. Eyesight and hearing are good. The jaw is well developed, and shows no deformity.

CASE VI, Fig. 116.—Miss H. C., aged seventeen years;

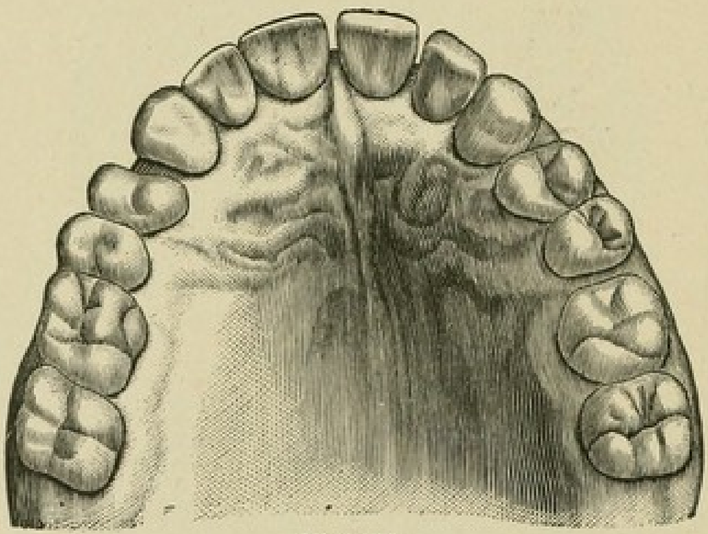


Fig. 115.

nationality, American. Height of vault, .65 of an inch. Has not always breathed through the mouth. Has adenoid growths. Has had measles and chicken-pox.

This jaw is considerably contracted throughout, but it is more noticeable through its lateral diameter. The alveolar process is hypertrophied on either side, the hypertrophy being more marked on the right side.

CASE VII, Fig. 117.—Kate K., aged seventeen years; nationality, American. Height of vault, .65 of an inch. Has always breathed through the mouth. Has post-nasal catarrh. Has had measles and whooping-cough. This jaw was arrested in its development, and the first bicuspids have been extracted to make room for the other teeth.

The lateral incisors overlap the centrals, due to a lack of room before the extraction of the bicuspids. The two sides are asymmetrical, the left side diverging to allow the eruption of the second molar.

Case VIII, Fig. 118.—Mr. H., aged eighteen years; nationality, American. Height of vault, .59 of an inch. Has

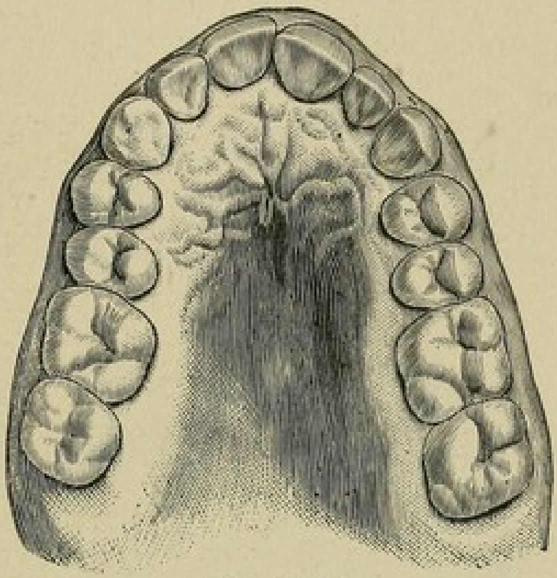


Fig. 116.

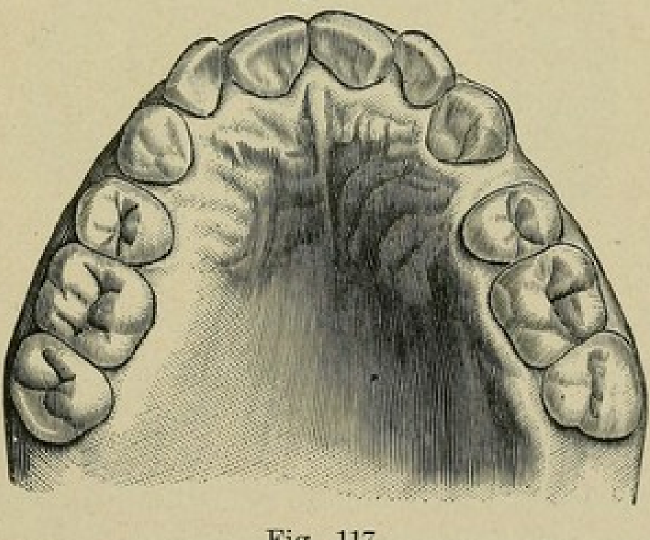


Fig. 117.

always breathed through the mouth. Had scarlet fever at the age of eighteen months. Received a blow upon the nose which caused a deflection of the septum nasi to the left. The left nostril is entirely closed by hypertrophy of bone and mucous membrane. There is slight hypertrophy of the mucous membrane of the right nostril, also hypertrophy of the mucous membrane in the post-nasal space. Arrest of development of the bones of the nose. Case VIII is an illustration of marked arrest of development of the entire jaw. The anterior teeth are much crowded, and on the left side the leteral incisor has erupted within the arch; that of the right side partially within the arch. The cuspids have erupted outside of the arch; on the right side the sixth-year molar has been extracted, in consequence of which the second molar has pushed forward.

In this case the small jaw is inherited from the mother (whose jaw was unusually small), and is in harmony with the bones of the face. The teeth, which are exceedingly large

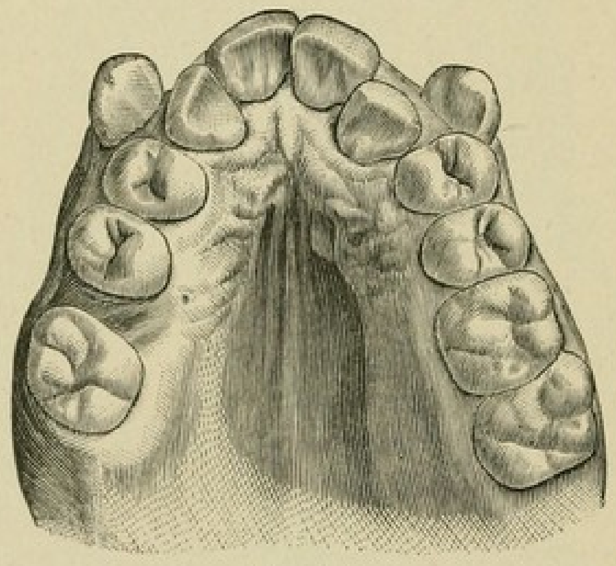


Fig. 118.

and have long roots, are inherited from the father, and are so out of proportion to the small jaw that the posterior teeth have moved forward and filled the spaces intended for the cuspids.

Case IX, Fig. 119.—Geo. H., medical student, aged twenty-five years; nationality, American. Height of vault, .71 of an inch. Commenced to breathe through the mouth at the age of ten. Marked arrest of development of the bones of the face and nose. The nasal cavities are small, and the nasal septum is deflected slightly to the right. Hypertrophy of cartilage on the left side; the mucous membrane is slightly thickened. The posterior nasal cavities are clean.

The patient has had measles, chicken-pox, mumps, and two attacks of pneumonia. Had severe rheumatism at the age of twenty-one, and at the present time there is tuberculosis of the left ankle.

An examination of the jaws revealed the following facts: The lower jaw is excessively large; although all of the teeth of the lower jaw tip inward, yet the outer cusps of the upper teeth just touch the inner cusps of the lower teeth. There is marked arrest of development of the upper jaw, and on the right side the arch has a tendency to assume the saddle-shaped deformity. On this side the cuspid has erupted externally

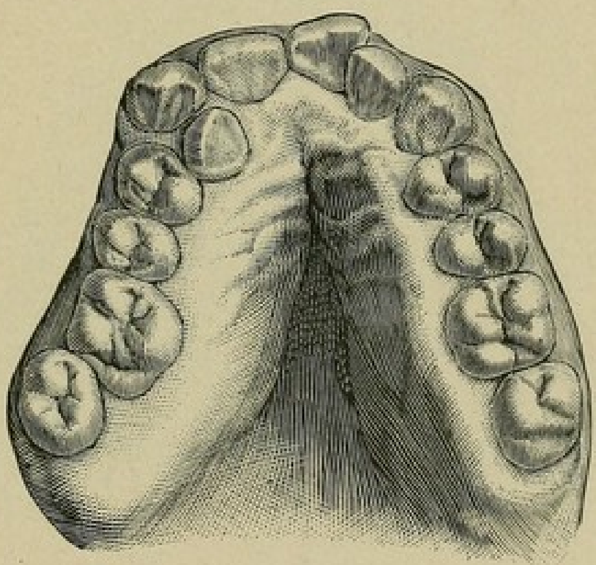


Fig. 119.

to the arch and between the central and the lateral incisors; its mesial surface is directed inward. The lateral incisor is internal to the other teeth. The lateral incisor on the left side is situated internally to the central incisor and cuspid, and has caused a slight rotation of the central incisor. The second molars are small, and have erupted externally to the first molar on account of lack of room in the jaw. The alveolar process and mucous membrane are hypertrophied.

This case clearly shows that at the time of the formation of the irregularities of the teeth the alveolar process and mucous membrane began to hypertrophy; coincident with these was arrest of development of the bones of the face, nose and jaw, and the habit of mouth-breathing was formed.

CASE X, Fig. 120.—Mr. William S., aged thirty-four years; nationality, German. Height of vault, .71 of an inch. Has always breathed through the mouth until an operation four years ago. He had scarlet fever and measles.

As will be observed, by examining the cut, this jaw is well developed. The central incisors overlap slightly, due to Rigg's disease. The left side has a tendency to assume the saddle-shaped deformity, due to the position of the bicuspids, which

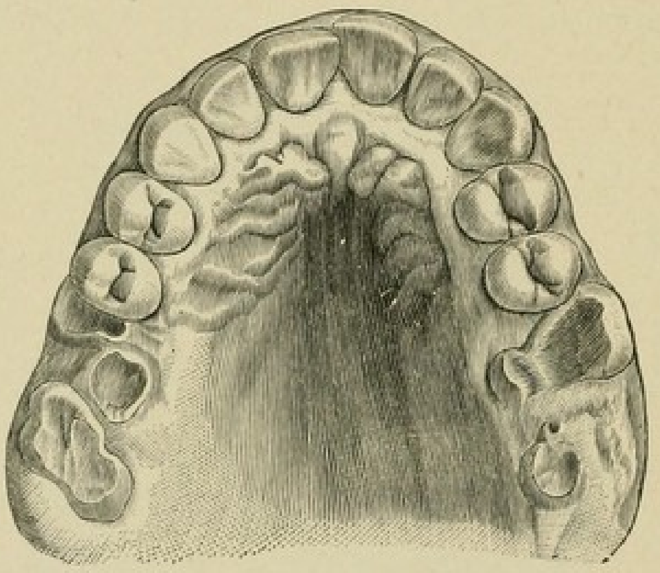


Fig. 120.

was probably assumed on account of the too long retention of the temporary teeth. The crowns of the molars have decayed and broken off. The thickening of the mucous membrane is the result of Rigg's disease.

CASE XI, Fig. 121.—M. W., aged thirteen years; nationality, American. Height of vault, .62 of an inch. Has breathed through the mouth for the past six years. There is arrest of development of the bones of the face and nose. The patient has considerable catarrh. Is now under treatment for irregularities of the teeth. The jaw is much contracted, especially in the anterior part. On the right side the lateral incisor is deformed, and is represented by a conical tooth situated internally to the other teeth. Posterior to this is the temporary cuspid; on account of the retention of this tooth the permanent cuspid is erupting externally to the other teeth and between the temporary cuspid and permanent central incisor. On the left side the lateral incisor is deformed in a similar manner to that on the right, but its position is normal. The temporary cuspid on the left side remains. Owing to the fact that there was insufficient room in the jaw for the second molars, the teeth anterior to these moved forward, producing the V-shaped projection of the central incisors.

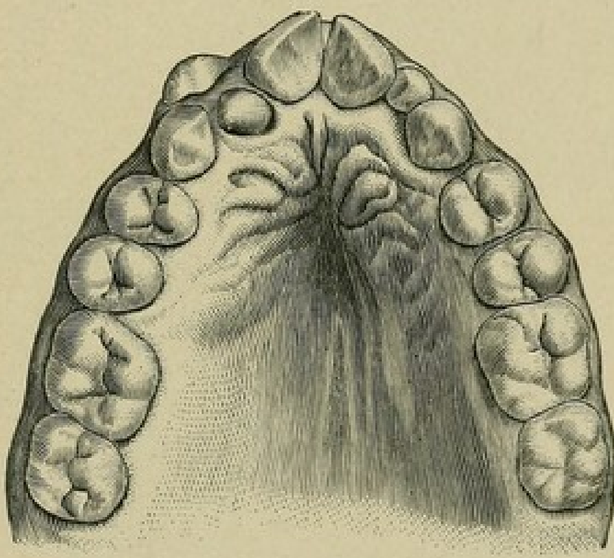


Fig. 121.

Case XII, Fig. 122.—Charles D., aged fifteen years; nationality, American. Height of vault, .53 of an inch. Deflection of septum nasi, and thickening of mucous membrane. The patient has always breathed through the mouth.

This case is similar to Case VIII, in that the small jaw is inherited from the mother, and the large teeth from the father. The dental arch is contracted anterior to the cuspids, and the anterior teeth are crowded; posterior to the cuspids the dental arch is normal. The first bicuspid on the left side has been removed to afford more room for the other teeth; the corresponding tooth on the right side should also have been removed. The fact that it was allowed to remain caused a crowded condition on that side, and the incisor has passed beyond the median line of the jaw, encroaching upon the other side. Owing to there being insufficient room in the jaw for the second molars, the teeth anterior to these have pushed forward, producing the V-shaped protrusion of the central incisors.

CASE XIII, Fig. 123.—Mr. H. B., aged twenty years; nationality, ——. Height of vault, .71 of an inch. Has always breathed through the mouth. The alveolar process is well developed, but the maxillary bones are arrested in their development. The left nostril is entirely closed. There

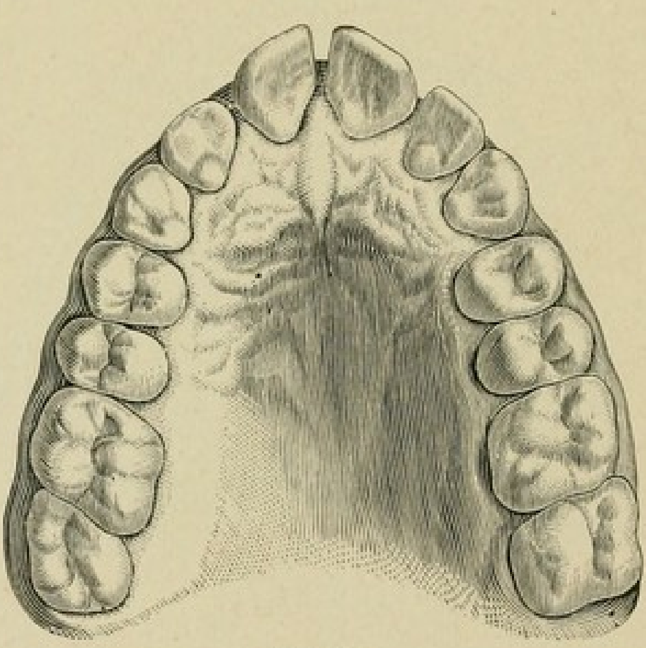


Fig. 122.

is hypertrophy of the mucous membrane of the right nostril. Has had scarlet fever and whooping-cough.

Although there is arrested development of the maxillary bones in this case, no deformity is produced, owing to the fact that the teeth have crowded the alveolar process upon the outer surface of the bone, thus forming a large arch. The only irregularity of the teeth is on the right side, where the lateral incisor, by erupting slightly within the arch, has pushed the distal surface of the central incisor slightly outward.

CASE XIV, Fig. 124.—Mr. M. C., aged thirty-nine years; nationality, Canadian. Height of vault, .71 of an inch.

Had always breathed through the mouth until he came to Chicago in 1884, since which time he has gradually improved, and can now breathe partially well. He has always suffered from catarrh, and now, when a cold is taken, the mucous

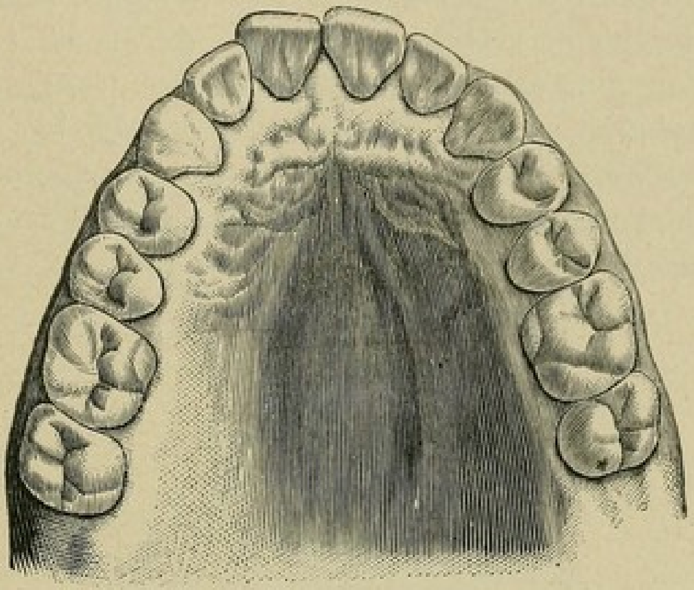


Fig. 123.

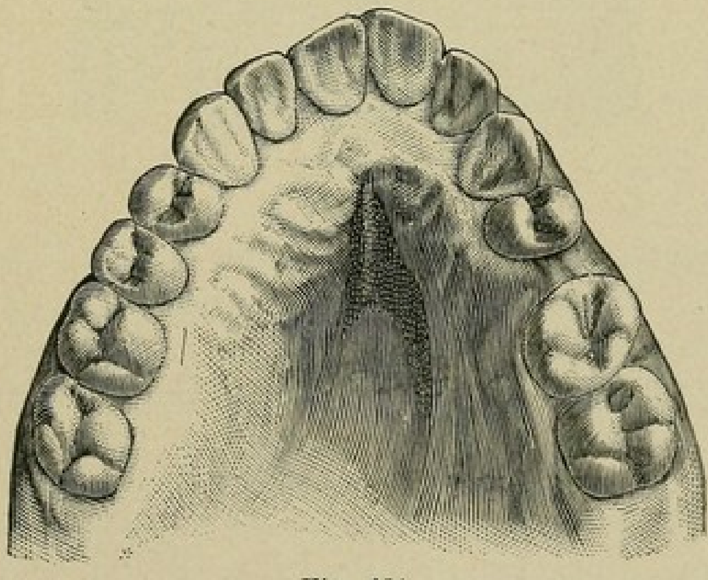


Fig. 124.

membrane of the nose becomes inflamed and mouth-breathing is the result.

This case illustrates a marked arrest of development of the jaw; on account of the small size of the jaw, the teeth anterior to the molars pushed forward and became crowded when the molars erupted. Upon the left side the second bicuspid has been removed, thus affording sufficient room for the eruption of the second molar on that side.

Case XV, Fig. 125.—Miss C., aged eight years; nationality, Canadian. Height of vault, .43 of an inch. Has always been a mouth-breather. Has suffered from catarrh for the past five years. Her general health has improved since her removal to Chicago, six months ago. This cut shows a marked arrest of development of the superior maxilla.

This case is illustrated at this age, eight years, as being of

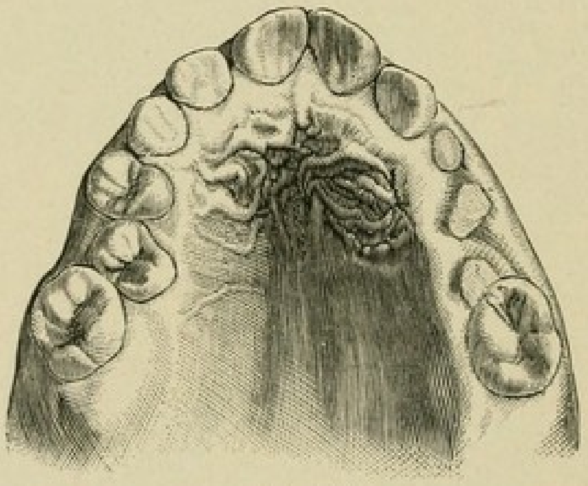


Fig. 125.

unusual interest in connection with the theories advanced in this work. The usually low elevation of the vault is due to lack of development; no doubt the normal height will be reached at the proper age. I extracted the temporary molars and cuspids upon the left side, and the temporary second molar upon the right side, just before securing the model. Although the permanent bicuspids and cuspids upon the left side are not visible, yet the appearance of the alveolar process leads me to believe that their position will be normal. Upon the right side all the teeth belong to the permanent set excepting the cuspid. The cause and manner of the production of the saddle-shaped arch upon this side of the jaw is nicely illustrated in the position assumed by the second bicuspid and first permanent molar. Upon removing the temporary molar, the crown of the bicuspid was observed to be situated exactly in the position represented in the illustration. The first permanent molar, having moved forward, has crowded the cuspid into the roof of the mouth. The V-shaped appearance of the incisors is due to lack of room in the jaw for their normal eruption.

Case XVI, Fig. 126.—Miss J., aged thirteen years; Hebrew; born in America. Height of vault, .59 of an inch. Adenoid growth in post-nasal space. She is unable to breathe through the nose.

This is a case of unusual interest; the arrest of develop-

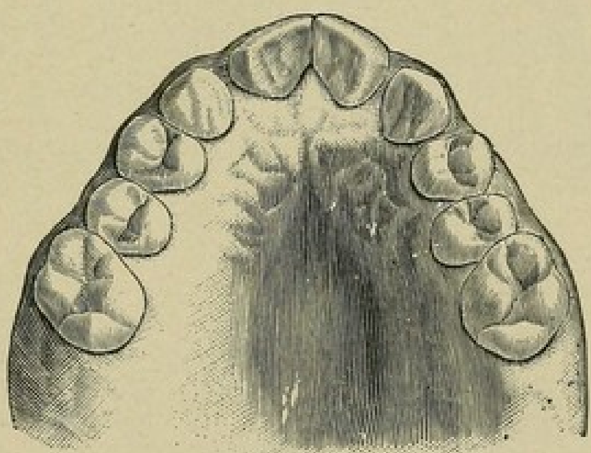


Fig. 126.

ment is very marked, and the maxilla is unusually small. The lateral incisors have never erupted, and the cuspids have moved forward and taken their places. The jaw is very narrow across at the bicuspids, and much contracted anterior to them. The jaw is of a marked V-shape.

Case XVII, Fig. 127.—M. L., aged thirteen years; nationality, American. Height of vault, .62 of an inch. He has breathed through the mouth for the past six years. There is considerable arrest of development of the bones of the nose. The left nostril has collapsed, and the right nostril partially, so that the patient can breathe through that side only, and with difficulty.

As will be observed, the jaw in this case is well developed.

The forward movement of the incisors is due entirely to a local cause, that of irritation, produced by the lower teeth striking against the roof of the mouth, which caused a deposit of bone-cells at that point.

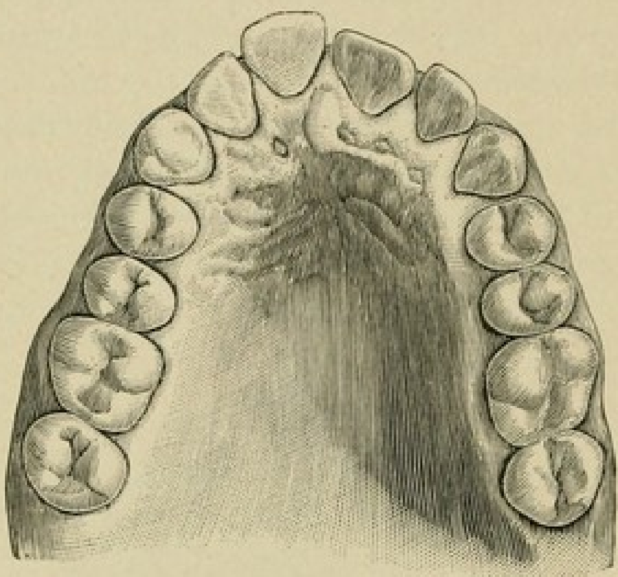


Fig. 127.

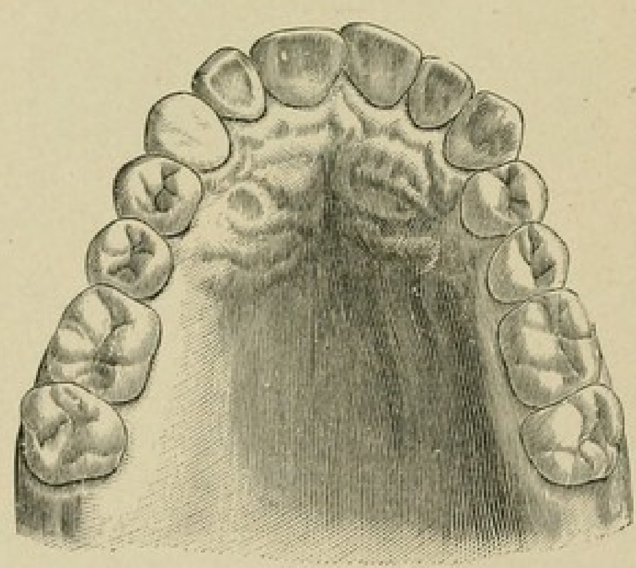


Fig. 128.

Case XVIII, Fig. 128.—Geo. W., aged fourteen years; nationality, American. Height of vault, .59 of an inch. Has always breathed through the mouth. The septum nasi is deflected; there is a hypertrophy of the mucous membrane, and the left nostril is closed.

In this case the jaw is well developed, and although the teeth are large there is no marked deformity. The central incisiors overlap slightly; the anterior teeth protrude on account of the pushing forward of the posterior teeth. A side view shows this forward inclination of all the teeth.

Case XIX, Fig. 129.—W. T. O., aged twenty-five years; nationality, American. Height of vault, .62 of an inch. He has been a mouth-breather for twelve years. The left nostril is entirely closed, the result of a blow received at the age of thirteen.

In this case the jaw is well developed. The slight saddle-

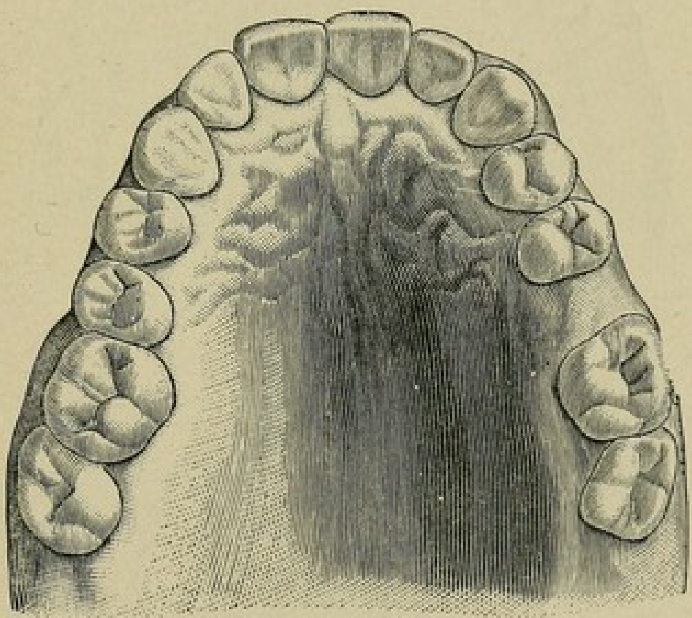


Fig. 129.

shaped appearance of the right side is due to the position of the second bicuspid and first molar. The second molar has crowded the first molar forward and inward. On the left side the first molar has been removed and the second molar has moved forward, partially filling the space.

Case XX, Fig. 130.—M. H., aged sixteen years; nationality, American. Height of vault, .59 of an inch. Has always been a mouth-breather. There is present a complete collapse of the nostrils.

This case represents a small jaw anterior to the cuspids. There is a slight protrusion of the anterior teeth and alveolar process. On the left side the lateral incisor has erupted slightly inward relatively to the central incisor and cuspid. The two sides are markedly asymmetrical; the left side is quite undeveloped.

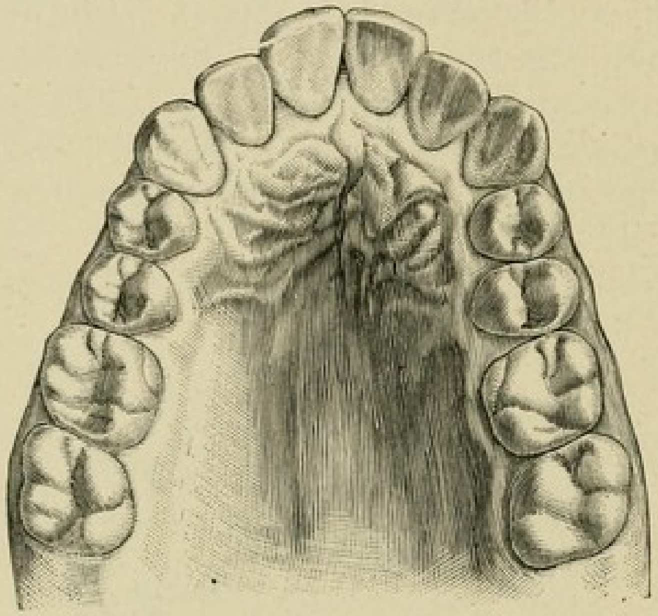


Fig. 130.

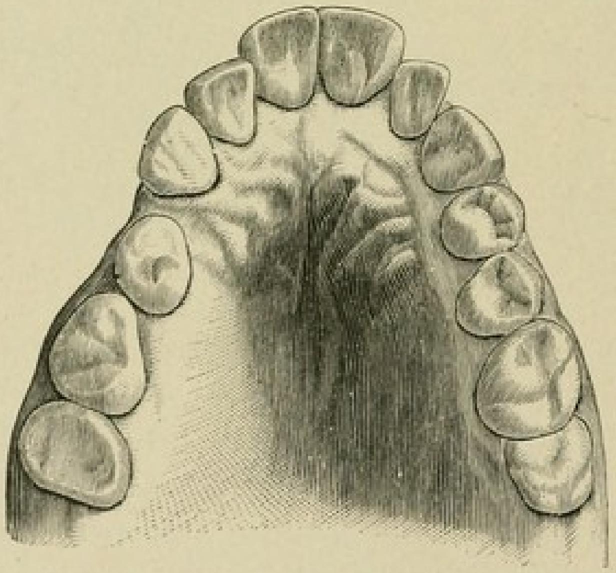


Fig. 131.

Case XXI, Fig. 131.—Miss H. T., aged ——; nationality, ——. Height of vault, .62 of an inch. Has always been a mouth-breather because of the thickening of the mucous membrane of the nose.

In this case the development of the maxilla has been arrested. There is considerable protrusion of the anterior teeth and alveolar process, due to lack of room; associated with this is Rigg's disease. The jaw is narrow and compressed in the region of the bicuspids. On the right side the first bicuspid has been removed to afford room for the other teeth. The left lateral incisor is small and the left bicuspids are situated within the arch, erupting in this position because of the retention of the temporary teeth. This side approximates the saddle-shaped deformity.

Case XXII, Fig. 132.—J. G., aged sixteen years; nationality, American. Height of vault, .50 of an inch. He has been a mouth-breather for ten years. The anterior part of the jaw is contracted, approximating the V-shaped deformity. There is no irregularity of the teeth.

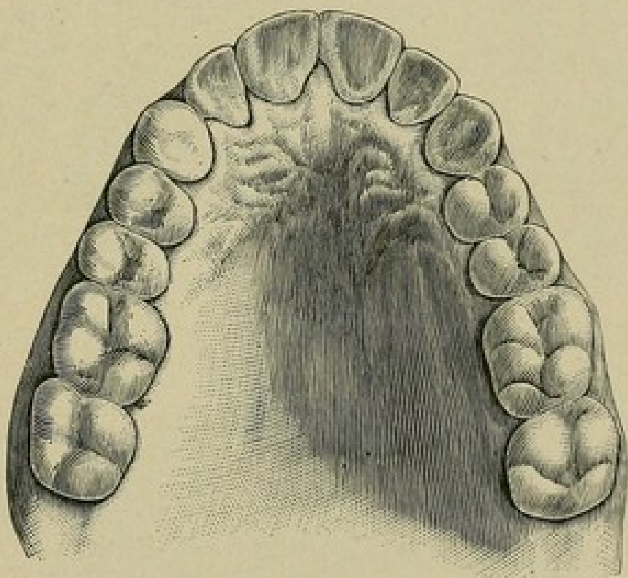


Fig. 132.

Case XXIII, Fig. 133.—Mr. G. C. A., aged twenty-six years; nationality, American. Height of vault, .75 of an inch. Has always breathed through the mouth.

This case illustrates the lack of harmony between the size of the jaw and the teeth, in consequence of which the anterior teeth have erupted irregularly. The central incisors overlap slightly; the approximal surfaces of the lateral incisors are internal to the palatine surfaces of the centrals. Posterior to the cuspids the dental arch is normal.

Case XXIV, Fig. 134.—Miss E. B., aged twelve years; nationality, American. Height of vault, .53 of an inch. Has

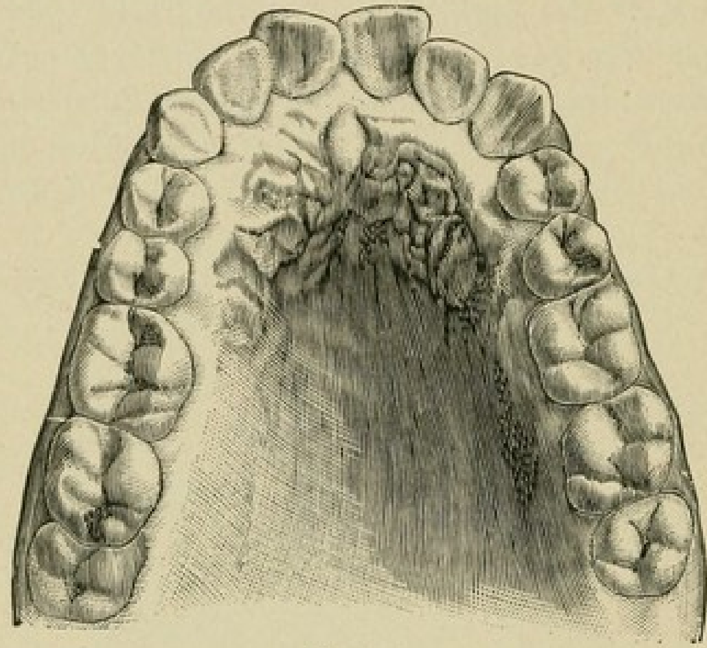


Fig. 133.

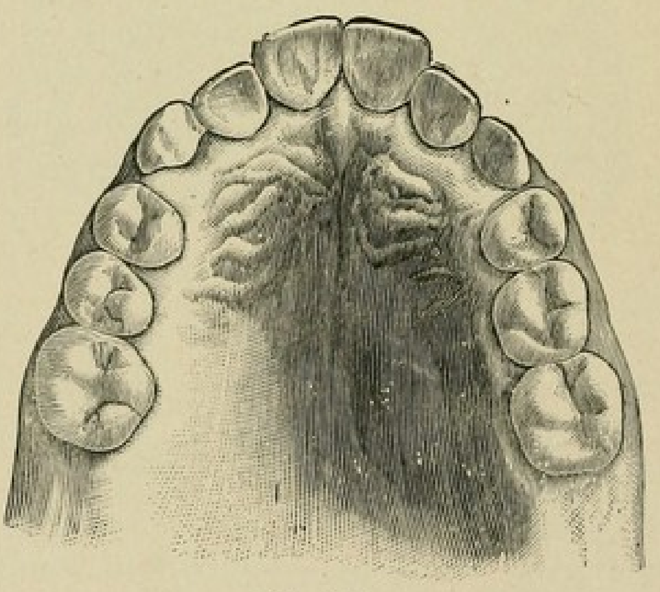


Fig. 134.

always breathed through the mouth. Septum nasi is deflected, and the left nostril is closed. The anterior part of the jaw is contracted, and in consequence of this contraction the central incisors protrude. The lateral incisors are slightly internal to the centrals, lack of room in the jaw preventing them from assuming their normal position. It will be noticed that the cuspids are erupting. On the left side the second temporary molar is seen.

With this presentation of a very considerable number of recorded observations, accompanied by many representative illustrations, the writer respectfully submits that his conclusions must be deemed to be fairly founded on facts, a refutation of which will require the citation of a like series of actual observations on the part of any objector to the views herein set forth.

DEVELOPMENT OF THE VAULT.

With a view of studying the true conditions of the vault, I have conducted a series of examinations with the following results:

I procured thirty-six impressions of the mouths of children, ranging from six to twelve years (see Plates 1 to 6), for the purpose of showing the development. These impressions were taken in modeling compound as the children came to me; therefore were not selected as regards conditions of the mouth. Two sets of models were prepared, one for the lithographer, and the other for my own use. A sufficient amount of compound was used so that the surplus would extend backward and downward in order that the contour of the soft palate could also be secured. This was accomplished by the patients placing the tongue against the compound and breathing through the nose. Measurements were first taken of the models, and then they were sawed at the median line. One half was placed upon paper and an outline taken, then the halves were glued together and the saw passed through the model transversely, just anterior to the first permanent molar, then the anterior part was outlined, thus, in this manner, the drawings were taken accurately. I am well aware that lithograph plates do not give as accurate an illustration of a model as we would like to have, but they are sufficiently accurate for the purpose for which they were intended, viz: to show the relation of the teeth to the jaw at the period indicated on each plate. These, together with the antero-posterior (Plates 7, 9, 11, 13, 15, 17), and lateral drawings (Plates 8, 10, 12, 14, 16, 18), give a very good idea of the progress of development from the development of the first permanent molar through the period of shedding the temporary teeth and their places filled with the second set.

I commenced my series of illustrations at the sixth year because it is a well-known fact that deformities of the jaws are rarely, if ever, observed before that period. I have demonstrated several times in different ways that the changes which do take place in the jaws and vault are observed between the ages of six and twelve years, depending upon the time of the eruption of the permanent teeth anterior to the first permanent molars. I secured only three models at six years and three at seven years, because the changes in the vault are so slight that it would be useless to occupy the space.

There are, however, certain conditions in the contour of the vault which must not be lost sight of, and which can be studied in these models as easily as though we possessed a large number. In a general way the vaults are quite low and without character.

Starting at the median line of the cross sections (Plates 8, 10, 12, 14, 16, 18), the vault is quite narrow at the upper portion, and the lines in either direction diverge until the teeth are reached. The teeth also diverge outward. Very few of the models contain bicuspid teeth until the eleventh year.

The alveolar process is quite thick in the sixth and seventh year-models, but lengthens and becomes thinner as age advances. The thickness is due to the fact that the antrum is located between the inner and outer plate of bone, and the alveolar process not only contains the roots of the temporary teeth, but also the crowns of the permanent teeth as well.

The height of the vault is very low, and while there is not always a gradual advance from year to year, yet, taken as a whole, from the sixth to the twelfth year there is quite a little advance in its height. The normal height of vault is not reached until all the permanent teeth are in place, which would be after the twelfth year. With but few exceptions, if a line should be dropped from the center of the arch, the two lateral halves would be nearly alike. A slight ridge at the top of the vault is noticed extending along the median line in Figs. 2, 5, 6, 8, 9, 12, 16, 24, 25, 30, 33, 34 and 36. I have seen a much more prominent ridge in the mouths of children at the age of two years, as will be seen in Plate A. Upon either side of the ridge there is an apparent groove, sometimes slight, and again quite marked, extending frequently only a short distance, then again quite an extent, and sometimes the full length of the suture. It is not always in the same location, sometimes in the alveolar process behind the incisors, again at the center and often at the posterior part of the vault; however, it is more frequently observed in the anterior part of the vault than in the posterior, and sometimes more marked upon one side than upon the other, and again only upon one side. In Figs. 3, 6, 12 and 19, Plates 1, 2, 4, the first permanent molars have been extracted.

In the models of the eleventh and twelfth years, the second bicuspids are coming down into place, although many of the temporary teeth are still in the jaw. Unlike the temporary molars, these teeth come down vertically, and although they have not fully erupted, yet we can see quite a change taking place in the length and width of the alveolar process and more character in both the antero-posterior and lateral curves.

In the antero-posterior section (Plates 7, 9, 11, 13, 15, 17) the following changes are noticed: In Fig. 1 the temporary incisors are decayed down to the gums; in Figs. 5, 6, 7, 8 and 11 the permanent central incisors are just making their appearance, while in others they are about half way through or are fully developed.

Just back of the incisors a thickening of the alveolar process is noticed; in some it is quite thick, and in others thin. This I believe to be due to the relation of the temporary incisors to the permanent ones. If the temporary tooth remains in the jaw until the permanent one comes nearly through, the alveolar process will be much thicker than it would be if the temporary tooth was removed earlier.

It is also the foundation upon which the long, thin alveolar process builds when the permanent teeth are in place. By following the line backward, we find very little character to the curves, but as the child grows older the evolution of development becomes more pronounced. The deviation in the curves result in a variation of ossification of the suture. Sometimes the ossification is uniform throughout, in which case the line will be uniform and graceful, as observed in Figs. 1, 2, 3, 7, 9, 10, 11, 15, 16, 17 and 21. If the ossification is irregular, then the lines will become wavy and irregular, as in Figs. 4, 5, 6, 8, 12, 13, 14, 18, 19 and 20.

The soft palate is very accurately illustrated in all of these drawings, and therefore shows its relation to the hard palate. It will be seen that the older the patient grows the longer the antero-posterior line becomes. This, of course, can naturally be expected, because the development of the jaw is in a posterior direction. The shape and inclination of the soft palate seem to depend upon the distance between the posterior surface of the hard palate and the forces.

In examining the models in Plate 1, at six and seven years, the six-year molars are in place, and all the temporary ones (except in Figs. 3 and 6, where the temporary incisors have all been removed); in Fig. 6 the left central is coming into position. As far as the contour of the teeth is concerned, it is in a normal condition.

Plate 2, at eight years, the first permanent molars and central incisors have erupted in all the figures except in Fig. 12, where the first permanent molars have been extracted; none of the other permanent teeth have yet made their appearance. In this plate we observe the change that takes place in the shape of the vault. The V arch is beginning to develop in Figs. 7 and 9, and the semi-saddle in Fig. 11; in Figs. 8 and 19 local irregularities of the teeth are observed.

Plate 3, at nine years, the deformities of the jaws are still more marked. In Fig. 13 a semi-saddle is nicely outlined; in Figs. 14, 15 and 16 a V-shaped arch is noticed, while in Figs. 17 and 18 the permanent teeth are not far enough advanced to tell what position they will occupy.

Plate 4, at ten years, the teeth are a little further advanced than at nine years. The bicuspids are just pushing their way through and the jaw seems to be taking on character. Fig. 19 shows the central incisors crowding their way to the right side, producing a marked deformity of the jaw. Fig. 20 also shows the incisors crowding to the right and the left cuspid just coming through the gums, producing a semi V-shaped arch. Fig. 21 illustrates all the temporary teeth shed and the bicuspids first coming through; the permanent teeth are not far enough advanced to decide just what kind of a deformity will be produced; from the lapping of the central incisors, and the fact that both bicuspids are erupting before the cuspids, it is safe to say that a V-shaped arch will be produced. The permanent teeth in Figs. 22, 23 and 24 are not far enough along to judge what the results will be.

Plate 5, at eleven years, the deformities are still more easily traced. Fig. 25 shows a local irregularity—a crowding inwards of the right central incisors—due to want of room, produced by the forward movement of all the teeth on the right side. The V and saddle arches are nicely illustrated in Figs. 28, 29 and 30. Fig. 28 shows arrest of development of the maxillary bones, and a marked V arch will result. This model illustrates the upper jaw of a boy, seventeen years of age; his body became arrested in its development at about nine years of age, caused by some of the eruptive fevers.

Plate 6, at twelve years, the temporary teeth are yet noticeable in many of these illustrations. It is easy, however, to outline the forms of irregularities that will be produced when all the permanent teeth are in place.

We have now fixed the date and the character of the deformity of the vault, that will be produced when all the permanent teeth are in place, namely, between the sixth and twelfth year, or at the time of the development of the permanent teeth, and the deformity of the vault will depend upon the manner in which the teeth came into the jaw and will be a V or saddle-shaped arch with their modifications, partial V or saddle, semi-V or saddle.

The shape of the vault is also changed by local irregular-

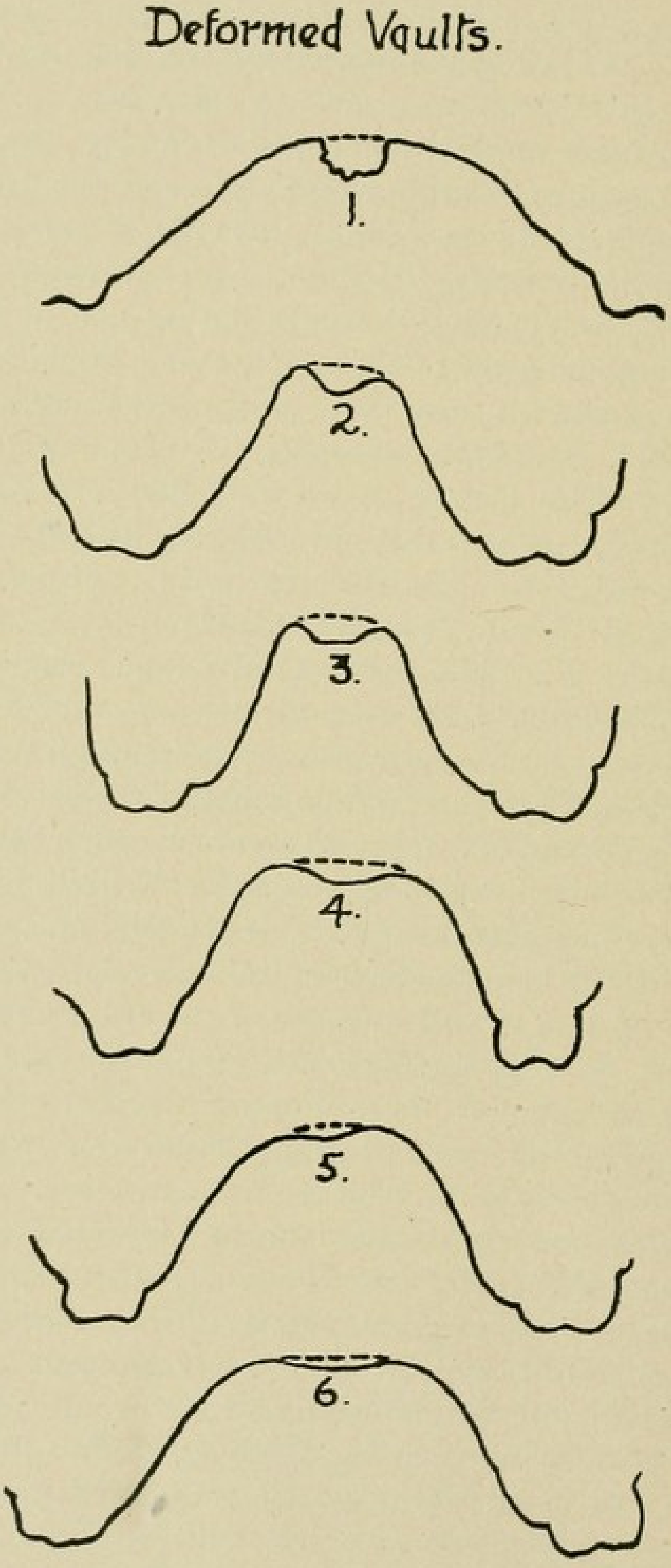


Fig. 135.

ities of the teeth. In such cases any of the teeth may stand inside or outside the dental arch and the vault will conform to the deformity.

DEFORMITY OF THE SUTURE.

We have shown that the deformity of the vault is not observed until at or about the sixth year, or the time of the eruption of the permanent teeth. The ossification of the suture, uniting the maxillary bones at the median line, however, takes place at different intervals—sometimes as early as the eighth week of inter-uterine life, and as late as the sixteenth. I have frequently demonstrated this in my treatment of the deformities of the jaw.

I have observed the formation of the excessive development of the suture as early as the second year and as late as the thirty-sixth year. This excessive development takes different shapes and forms; thus, in 228 Peruvian skulls, 240 Stone Grave skulls and twenty-one Mound Builders' skulls, sixteen Peruvians, thirty-nine Stone Grave, and one Mound Builder's (all of which had large, well-developed jaws, normal in shape) possessed a rope-like projection extending the entire length of the suture. This development appeared unlike the excessive development as noticed in modern skulls. It had the appearance of having been first made and then glued upon the suture as observed in Fig. 135, No. 1.

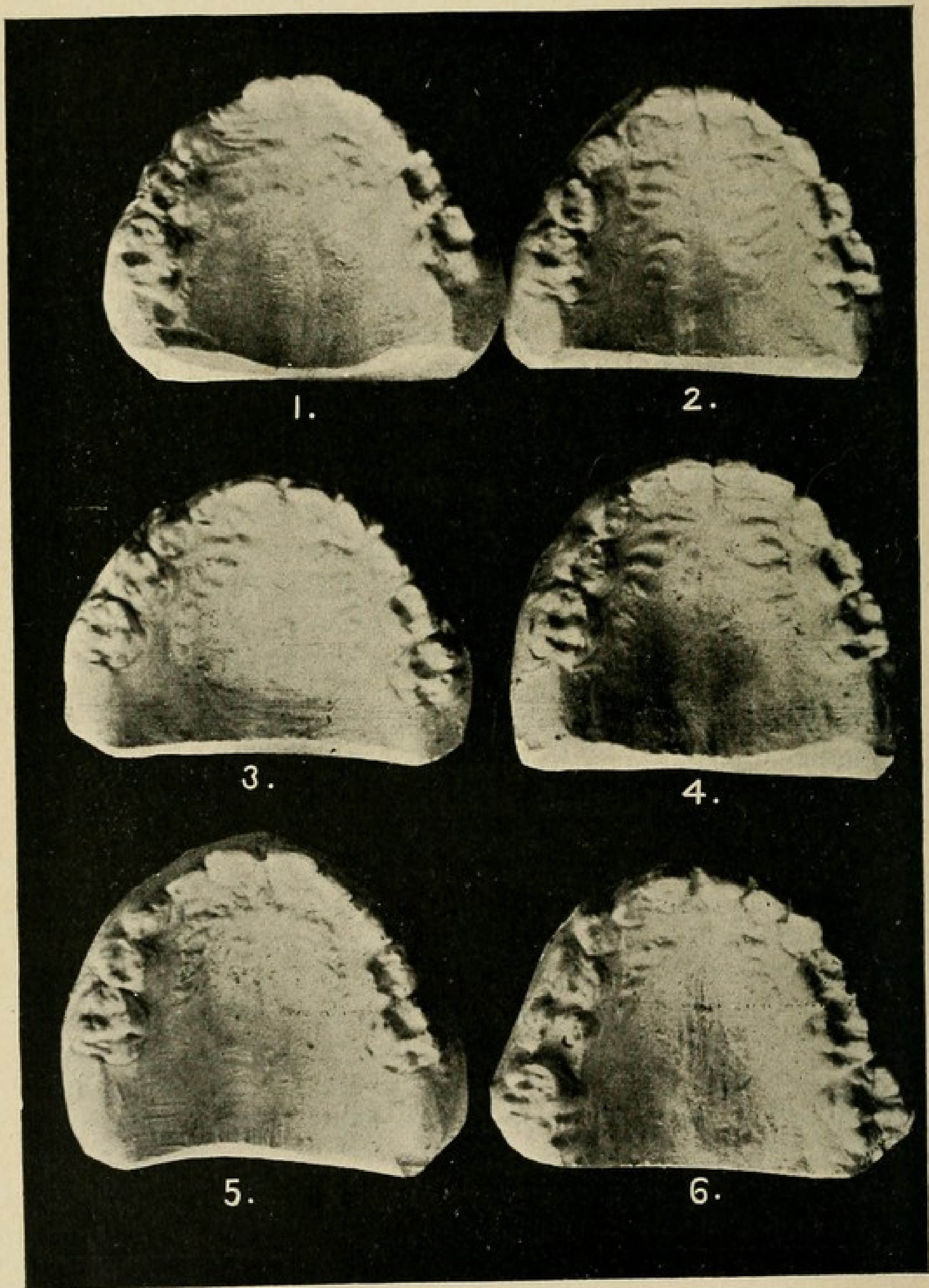
The deformity of the suture in Nos. 2, 3, 4, 5 and 6, varies in proportion to the width of the arch (in the narrow arch the suture is quite low, or thick, while in the normal arch they are quite flat; the grooves of either side of the suture are not uniform, one side being deeper than the other.

It is claimed by scientific men that these grooves are due to ossification of the vomer, which would produce rigidity of the suture, and the bone upon either side is afterward carried up. Thus, Clouston* says:

"Those palates, where the deformity consisted in a ridge down the center antero-posteriorly, seemed to show that in

* *Dental Record*, May, 1891, p. 200.

PLATE A

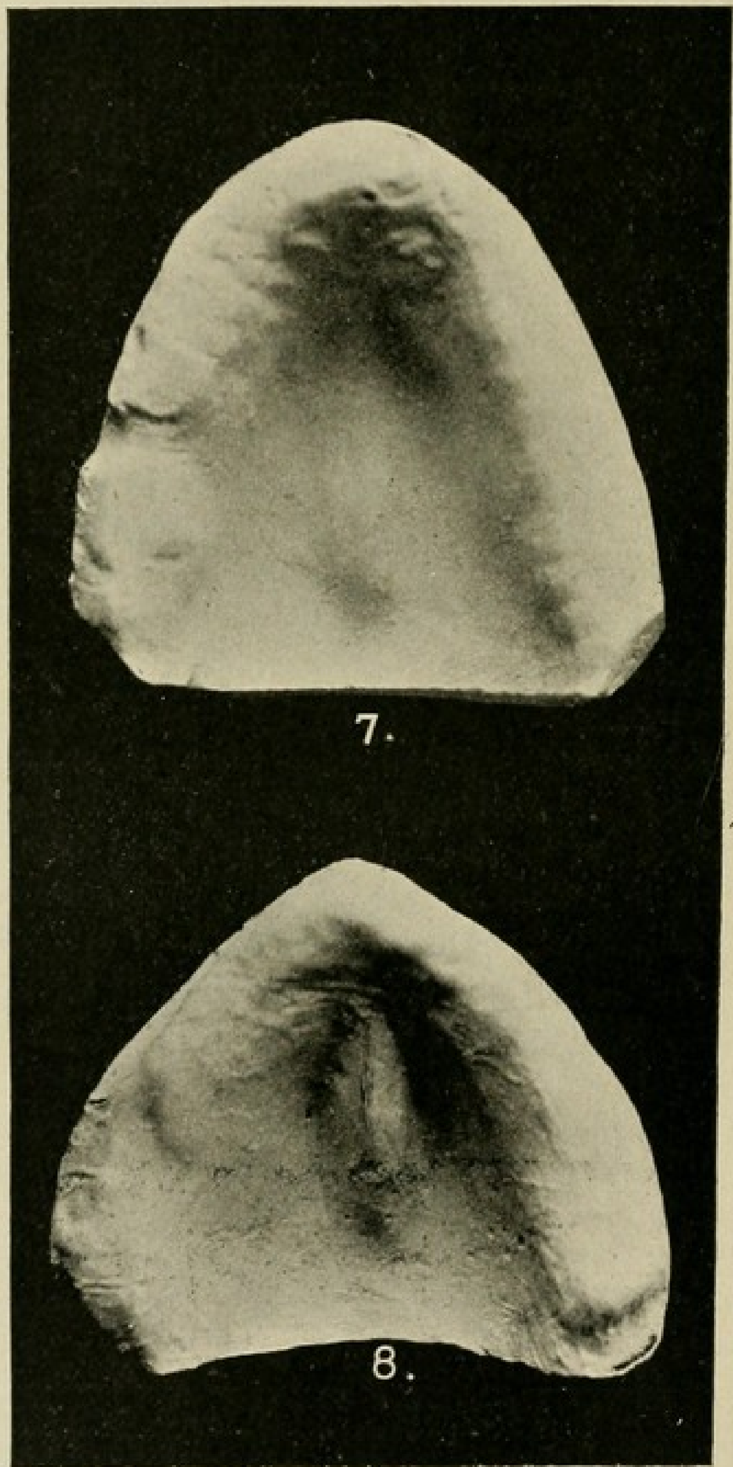


them the deformity took place at a later period than in the other deformed palates. When the nasal septum was getting stronger and kept the center of the palate down, while on each side of it the palate was drawn up, making two vaults side by side, instead of one." Plate A, six models are shown, ranging from two to six years. Fig. 1, at two years, shows a ridge extending from a line drawn across the vault at the cuspids, through the entire length of the jaw. Fig. 2, at two years, shows a similar condition of the ridges, except that it begins in the center of the vault at a line drawn across the first temporary molar.* Fig. 3, at three years of age, shows a slight ridge just back of the incisors, extending only a short distance, when the center of the vault is perfectly flat, and the ridge begins again in the posterior part of the vault. Fig. 4, at four years, shows the ridge starting at a line drawn across the vault at the first molar and extending the entire length of the suture. Fig. 5, at five years, shows a broad ridge extending the entire length of the vault. Fig. 6, at six years, shows a very narrow ridge, also extending the entire length of the vault.

As the vault ossifies as early as the first or second year, and as the ridge is also found as early as the second year, the vomer not ossifying until later in life, the theory will not hold good. The ridge takes so many different shapes that, when a number of models containing it are examined, the theory that the sides of the arch are drawn or pushed up, seems absurd. Thus, models Figs. 7 and 8, Plate B, show vaults similar to No. 2, Fig. 135, except the grooves are deep and sharp. Fig. 7 extends from just back of the incisors to opposite the second molars where the arch becomes perfectly smooth throughout the balance of the hard palate; Fig. 8 commences at same point and stops opposite the first permanent molar. These models alone show the fallacy of this theory because nothing could force the deep grooves in the

*The author has a number of these models showing the ridge at the second year, and he has observed many more in his practice. Since the two halves of the maxillary bones are supposed to ossify at the eighth week of fœtal life, it can be readily seen that in those cases where ossification was not complete these ridges would form when the child begins to masticate its food.

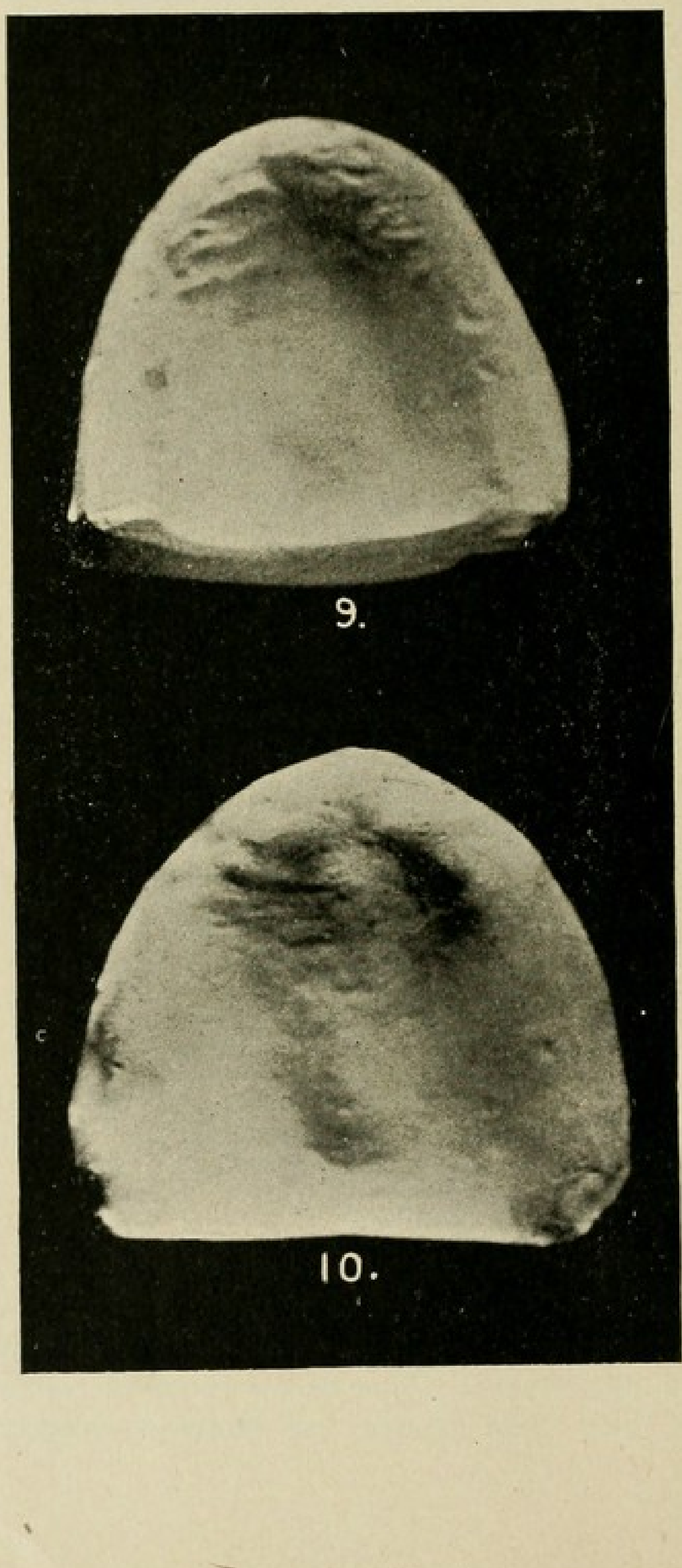
PLATE B



anterior alveolar process, as suggested by many authors, since the vomer extends through and beyond the anterior surface of the anterior alveolar process to form the nasal spine. If such a thing were possible, the posterior part of the vaults, which would easily yield to force, would be affected, which is not the case. The ridge extends to the second molar, or as far as the grooves. One of the jaws is very small and contracted with slight hypertrophy extending all around the inner surface, giving the sharp appearance to the grooves; the other is a little larger, has no hypertrophy, hence the groove upon either side of the suture is not so narrow, although fully as deep. Figs. 9 and 10, Plate C, show well-developed jaws with very broad ridges. In Fig. 9 the ridge commences about opposite the first bicuspid and extends back as far as the second molar tooth; in Fig. 10 the ridge extends from the alveolar process just back of the incisor, to the second molar; both are about the same width. The grooves upon either side are very shallow and about the same depth of ridge. These are similar to Nos. 4, 5 and 6, Fig. 135. Fig. 11, Plate D, is a very small jaw with a marked ridge commencing in the alveolar process, back of the incisors, and extending as far as the second molars; the grooves upon either side are very deep and sharp. This is due to a small jaw and hypertrophy of the alveolar process. We occasionally find a groove in the center of the vault running the entire length of the suture in place of the ridge, as illustrated in Fig. 12, Plate D; this is due to two causes: (1) Arrest of development of the suture, and, (2) hypertrophy of the palate bones and mucous membrane upon either side of the suture. This groove is sometimes shallow, again deeper, sometimes broad, and again narrower—depending upon the extent of the hypertrophy.

The two sides of the contracted arches are not uniform. This is due to the location of the teeth in the alveolar process which are in more upon one side than upon the other, carrying the alveolar process with it. The sides of the palate are not carried up, because there is no force to move them. Sometimes these deep grooves are situated entirely in the

PLATE C

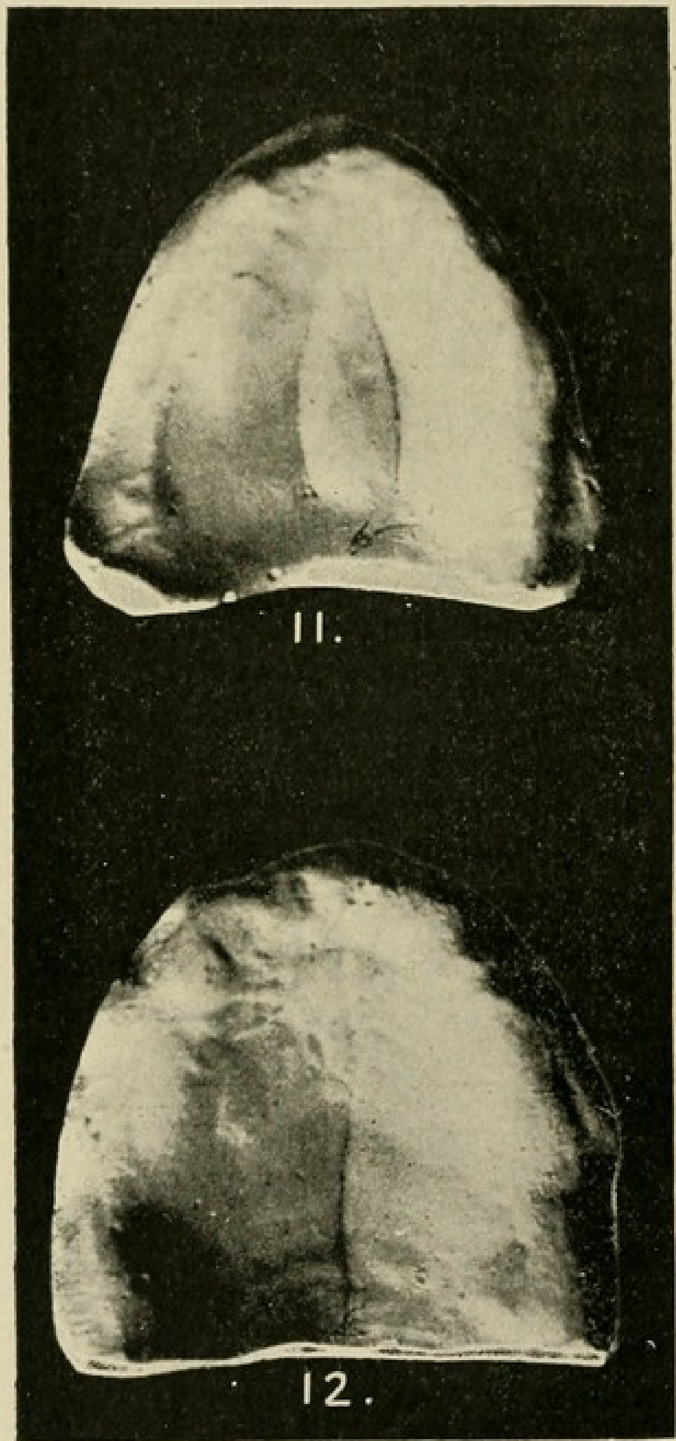


anterior alveolar process; sometimes entirely on one side; sometimes in the center of the vault in the antero-posterior direction, and again in the posterior part of the vault.

The location of these grooves, especially those in the alveolar process, and the fact that sometimes they extend only .25 to .50 of an inch, would preclude such a theory. If the sides were carried up, owing to the very thin bone, a like projection would extend into the floor of the nose. I have examined 1,367 skulls with this deformity, and I have yet to find the first instance. In every case the floor of the nose and commencement of the septum were smooth and evenly developed throughout its entire length. How, then, are these deformities to be accounted for? We have seen that these projections are developed as early as the second year, and as late as the thirty-sixth year. We are safe in the assurance, that they are the result of excessive development of the suture, due to irritation set up at the time of ossification, by mastication—the lower jaw developing laterally faster than the upper, thus crowding the superior maxillary bones apart. I have observed this action in a large number of my patients, one of which I will here describe.

A lady, thirty-six years of age, who has been under my care for the past fifteen years, has a space between the central incisors of .50 of an inch. No space was observed until she arrived at the age of twenty years. The teeth filled the arch and all antagonized. The lower jaw continued to develop, and the act of mastication carried the superior maxillary bone laterally—widening the suture, the space filling in and producing quite a ridge, as noticed in Fig. 135, Nos. 4, 5 and 6. The depth of the ridge depends upon the amount of irritation. The height of the groove upon either side to the depth of the ridge. When there are grooves upon either side the jaw is always contracted—the alveolar process being nearer the center of the vault. This, together with the ridges, produces the groove. If it were not for the excessive development of the median suture and contracted arch the vault would take the shape of the dotted lines and would be normal in its development.

PLATE D



DEFORMED VAULTS.

Deformed vaults are due (1) to an irregularity in the arrangement of the dental arch, (2) hypertrophy of the alveolar process and maxillary bones, and (3) to excessive development of the palatine suture. Irregularities of the dental arch are the result of two causes: (1) Neuroses of development, producing arrest of development of the maxillary bone; (2) local causes, or the result of accident. Those produced by an arrest of development take typical forms, which I have classified by taking 3,000 models of irregularities of the teeth and grouping them under the heads of V, partial V, semi-V, saddle, partial saddle and semi-saddle. The irregularities of the teeth produced by local causes do not take typical forms, but are as numerous as the number of cases.

Hypertrophy of the alveolar process may affect the whole dental arch, or it may attack one particular locality in which only one, two or three teeth may be involved. The shape of the vault in such cases depends entirely upon the extent of the hypertrophy, but does not take the typical form. The position, occupied by the teeth in the dental arch, and the manner of their formation are studied under their respective heads. Having then found the true cause of the deformed vault, let us examine some of them and see how they compare with the normal vault. I secured an entirely new set of models from dental practitioners in Chicago, consisting of six V-shaped (Plates 35 and 36), six semi-V (Plates 37 and 38), six saddle (Plates 39 and 40), and six semi-saddle-shaped (Plates 41 and 42). These were prepared in the same manner as the other models.

The direction of the teeth in a normal jaw are nearly perpendicular, while those in the V-shaped vault are at an angle of 45°. This, of course, is owing to the forward movement of the incisor teeth. Just back of the incisor teeth there is quite a prominent ridge of alveolar process noticed in the drawings of the normal jaw, which is due to the contraction of the vault in the anterior portion, producing a thickening of the alveolar process. In other respects the vault does not differ from the normal palates. The same general rule holds good in the semi-V vault, except the teeth do not stand at such an angle. This is accounted for by the fact that frequently only one incisor protrudes, therefore only one incisor extends; while the other is in a perpendicular position. The position of the normal tooth may have been on the side of the model reproduced in this drawing. In the drawings, showing a cross section of the vault, it will be noticed in a general way that the vaults are much narrower than in the normal; it will also be noticed that the two sides of the vault are not in harmony. These drawings are all very accurately made, so that by placing a rule at the center of the upper and lower arches and drawing a line from one to the other, the two sides of the vault can be easily studied. The more contracted the jaw the higher the vault seems to be, and the sides seem to be more irregular. In the saddle and semi-saddle antero-posterior drawings the teeth stand perpendicularly, therefore do not protrude. The ridge, posterior to the incisors, is not so thick or prominent. The lateral drawings do not show the pinched condition at the upper part of the vault that is noticed in the V-shaped vaults. This is due to the fact that the contracting is not in the anterior part of the mouth, but at the bicuspid region, while the bicuspids are carried in. The top of the vault is rarely ever affected. Occasionally hypertrophy of the alveolar process is so extensive that the teeth are carried laterally toward the median line, the vault is very much narrower, and in some cases it is almost closed. It will also be observed that the figures do not correspond with each class of deformities.

DEFORMED VAULTS DUE TO LOCAL IRREGULARITIES OF THE TEETH.

Such irregularities of the teeth can only affect the margins of the vaults, and not the vault proper, as only a few teeth are involved. The remainder of the dental arch, being as a rule in a normal condition, the vault proper is retained in its natural shape.

CHAPTER XXXI.

CLEFT PALATE.

Cleft palate was much discussed by early writers. Early in the nineteenth century Tiedemann* noticed that in certain cases of cleft palate the olfactory nerve was absent or abnormal. He concluded therefrom that the deformity was resultant upon atrophy of the olfactory organ of nervous origin. This theory, however, failed to meet much acceptance. M. J. Weber, after a careful analysis of all accessible cases, failed to find one in which the olfactory nerve was absent. In all probability the coincidence of cleft palate and olfactory nerve atrophy discovered by Tiedemann resulted from the same central nervous maldevelopment, and they bore no causal relation to each other.

The etiology of cleft palate is necessarily involved in obscurity, since cleft palates are comparatively rare, in proportion to other forms of nutritive degeneracy, and since they occur so early in fœtal life. Palatal embryology, to a certain extent, casts light on the ætiology.† At a very early period of fœtal life a series of clefts appear on each side of the cephalic extremity, separated by rods of tissue called branchial arches. The clefts communicate with the alimentary canal. These various clefts have usually coalesced about the ninth and tenth week of fœtal life, but occasionally this coalescence fails or is incomplete. This leads to various deformities, the chief of which are cleft palate and harelip. After an analysis of these embryological factors, that able teratologist, Bland Sutton,‡ states that "cleft palate has been known to affect several members of the same family and to occur in the offspring of the affected members." He cites instances of the transmission of this deformity from an affected pug-bitch to her offspring. He states further, "if it were

* Zeitschrift f. Phys., Band 1, Heft 1, 1844, p. 71.
† Keen's American System of Surgery, p. 639.
‡ Evolution and Disease, p. 189.

possible to practice selective breeding in man as in dogs, a race of men with harelips and cleft palates could be produced."

Engle refers cleft palate to excessive development of the anterior portion of the brain and skull, such as produces *hernia cerebri*, ventricular atrophy or excessive anterior cerebral lobe development. This mixed patho-teratological theory is not warranted by either embryology or clinical observation. The narrow and broad foreheads are alike affected.

Langdon Down has found a constant relation between brain deformity, cleft palate, and deformed vaults. Down states that: "The cause of the frequent excessive vaulting of the palate is not quite clear. It may possibly arise, as has been suggested, from sphenoid arrest of development or vomer defects in development." It has been plausibly shown that the contracted high vault is not due to these conditions, and that there can be no relation between contracted vaults and cleft palates. The cleft occurs before the tenth week of fœtal life, while the contracted vault does not appear until after the sixth year. The claim is made by Walther* and Langenbuch† that cleft palate was becoming more frequent during the present century. This opinion was supported by Oakley Coles,‡ on the ground that palatal vault deformities were more frequent, and that a relationship existed between these and cleft palate. He further states that "we shall be led to the inevitable conclusion that the relation between a high state of civilization and a high proportion of palatal deformities is something more than a mere matter of coincidence."

In the study of this subject, however, an assumed relationship between palatal deformities and cleft palate may, for reasons elsewhere given, be at once dismissed from consideration.

Early literature on this subject is admittedly meagre. The early teratologists discussed the gross rather than the

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*Graefe and Walther's Zeitschrift, Band 21, Heft 2, 1834, p. 175.

† Neue Bibliothek f. die Chir., Band 4, Heft 3, p. 492.

‡ Coles: Deformities of the Mouth.

minute details, and the registration of cleft palates was neglected in common with brain, renal, hepatic, and cardiac teratology.

Cleft palate may be divided into two classes—congenital and acquired. By congenital is meant existing at birth; acquired cleft palate is the result of disease, inherited or acquired, but affecting the part after birth. It is not intended here to discuss this subject, except to indicate that better acquaintance with etiology of disease, and its effects upon the hard palate, will show causes of congenital lesions and effects of acquired disease upon the tissues to be at least allied.

Congenital cleft palate is divisible into two kinds—complete and partial; complete when the fissure extends the entire length from the uvula to and including the anterior alveolar process, and even the lips; partial when only a small part of the structure is involved. Thus the cleft may extend through the anterior alveolar process, involving only the incisive bones, which is very rare; when present, single or double harelip almost invariably co-exists. I have observed in practice six cases where a small portion of the anterior alveolar process and jaw was involved, with one or two teeth. The hard palate only may be involved to the extent of a small fissure, or the whole palate may be wanting. The soft palate only may contain the cleft or simply the uvula. Cases are on record in which the non-development of the intermaxillary bones produces fissures in the lip. *A priori* cleft palate would seem to be an expression of hereditary defect. This view is that taken by Bland Sutton* from actual observation. Oakley Coles† states that "the antecedent which strikes one *a priori*, as being likely to play the most important part in the production of congenital deformities, is that of hereditary influence. But though it will be evident from the facts which I shall presently adduce that the indirect influence of heredity in the production of cleft palate is marked and undeniable, no sufficient statistics have as yet been brought forward to show that the actual presence of the deformity in the parent

* Evolution and Disease.
† Deformities of the Mouth.

has any direct predisposing influence on its occurrence in the child. In other words, though the defective conditions which precede and accompany the phenomenon of cleft palate are almost certainly to be referred to parental influence, it is extremely doubtful whether cleft palate is in itself transmissible. I am fully aware that such distinguished authorities as Demarquay, Roux, Trelat, Follin and Duplay are inclined to an opposite belief, and their conclusion is supported by the evidence in connection with the analogous deformity of harelip. Still, unless accurate records of ancestry could be obtained for three or four degrees of removal, it would be premature to make any positive assertion on the point. I feel, however, that it may be confidently stated that the deformity cannot be produced from any impression received by the mother during pregnancy. In most of the cases which have come immediately under my notice, where one of the parents had a cleft palate, all the children born have been perfectly developed, even though dread of transmitting the deformity was always present in the mind of the mother.

"In one case, curiously enough, there are three members of one family with cleft palate, one seventeen years of age, the other thirty, and the third thirty-five; the first and last are ladies, the other a gentleman who is married and has a family without any trace of the father's deformity. In these cases no instance of cleft palate could be found either among the ancestors or the collateral branches of the family; but it will be interesting to watch whether in the following generations any traces spring up again, for cases of immediate transmission seem but rarely to have been placed on record.

"In the case of another family, however, I have obtained the following remarkable history:

"G. H. C., born 1853; perfect. L. C., born 1855; single harelip and cleft palate. J. F. C., born 1856; perfect. F. W. C., born 1860; double harelip and cleft palate. H. E. C., born 1863; perfect. The paternal grandmother also had cleft palate."

My own observations, so far as they go, only justify me in taking the tentative position of Coles.

Knecht* found five per cent of 1,200 criminals examined to have cleft palates, and fourteen per cent of the prostitutes examined by Pauline Tarnowsky† had cleft palates. Dr. Langdon Down among congenital idiots found only a half per cent of cleft palates. Grenser only found nine cases in 14,466 children, or one in 1,607. I examined 1,977 feeble-minded children without finding a single case. In 207 blind, but one case was observed. In 1,935 deaf mutes two cases, or about one in 1,000. The percentage among the defective classes is not large, but undoubtedly it is much larger than among normal individuals.

Bland Sutton's experiments with dogs, elsewhere cited, indicate the presence of this deformity among animals, and further, that it is transmitted. The followers of Weissmann, relying upon his dictum‡ that acquired defects are not transmitted, will dispute the validity of these experiments. Weissmann's original position on this subject has been abandoned by him, for he states,§ in his latest work, that "the origin of a variation is equally independent of selection and amphimixis, and is due to the constant occurrence of slight inequalities of nutrition in the germ plasm." The influence of this factor is shown by the statistics of zoological gardens. A keeper of the Zoological Gardens in Philadelphia observed cleft palates in the mouths of lion cubs born in the gardens. Cleft palates were also observed in a number of pups born in Buffalo.

Dr. Ogle found that ninety-nine per cent of the lion cubs born in the London Zoological Gardens had cleft palates. He claims this is due to the artificial diet as the result of enforced captivity. Similar results observed in other gardens in Europe are charged to feeding the mother with meat without bone. Feeding with the whole carcass of small animals greatly diminishes these deformities.

It would seem that if cleft palate could be attributed to this cause, other bony structures should also be involved.

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* Cited by Lombroso, Criminal Man.
† Etudes Anthropometriques.
‡ Essays on Heredity.
§ The Germ Plasm.

Many of the lions born in captivity were rickety. Cleft palate has been observed among dogs, sheep, goats, etc. The question, therefore, whether domesticity does not play in them the alleged part of civilization in man, can be solved only by a knowledge of the frequency of the condition among wild animals of the same genus. It is evident that in dealing with the question of ætiology the influence of shock on the mother's nervous system cannot be excluded in the cases charged to feeding.

It may be here of interest to note the date of the development of the parts chronicled by Beaunis and Bouchard:

"Beginning of third week—first pharyngeal arch; buccal depression. End of third week, coalescence of the inferior maxillary protuberances; formation of the three last pharyngeal arches. Fourth week—olfactory *fossæ*. Fifth week—ossification of lower jaw. Sixth week—the pharyngeal clefts disappear; the tongue, the larynx and germs of teeth. Seventh week—points of ossification of intermaxillary bone; palate and upper jaw (its first four points). Eighth week—the two halves of the bony palate unite. Ninth week—osseous nuclei of vomer and malar bone; the union of the hard palate is completed. Third month—points of ossification for the sphenoid and nasal bones; squamous portion of temporal; orbital center of superior maxillary bone; commencement of formation of maxillary sinus; epiglottis. Fifth month—osseous points of lateral masses of ethmoid; ossification of germs of teeth; appearance of germs of permanent teeth."

CHAPTER XXXII.

NEUROSES OF DEVELOPMENT OF IRREGULARITIES OF THE TEETH.

THE V-SHAPED ARCH.

Irregularities of the teeth and jaws, resulting from excessive development, have been described. It remains now to show how irregularities result from arrested development.

Arrest of development is confined mostly to the upper jaw; hence V and saddle-shaped arches are more numerous than irregularities of the lower jaw. Local conditions, such as premature extraction of the temporary teeth, causing the first permanent molars to move forward, thus diminishing the size of the jaw, are also the cause of these irregularities.

The manner of these formations is as varied as the peculiarities themselves.

It may be well at the outset to state that the only structures involved in the formation of these deformities are the jaws and the alveolar process on the one hand, and the teeth upon the other. The alveolar process is soft and yielding, while the teeth and jaws are composed of hard, unyielding substances. The process adapts itself to the conformation of the teeth. We are taught that the teeth of the superior or inferior maxilla constitute a dental arch, and that the first permanent molars perform the function of keys to the arch. After years of thorough investigation I find that the jaws and teeth, like the lateral halves of the body, develop independently of each other, both possessing their own peculiar characteristics as regards irregularities of the teeth. In order to simplify the classification of irregularities of the teeth I shall call the lateral halves of the jaws which are separated by the median line, the right and left inferior and the right and left superior dental arches. While these terms as applied to the lateral halves of the maxillary bones are not strictly correct from an architectural point of view, yet practically (as will be seen) they answer the purpose for which they are employed.

The manner of the formation of the V-shaped arch and kindred deformities may be compared to the construction of an arch of stone. The changes which take place in the movement of the teeth are very similar to those which may occur in a stone arch of faulty construction. Figs. 136, 137 and 138 represent one normal arch and five varieties of irregularities of the teeth. Each lateral arch is viewed as containing stones corresponding in number and size with the teeth of a normal upper denture. Fig. 136 represents two arches; the left superior arch is perfect. The first stone is marked "posterior base," and corresponds to the first permanent molar. The second stone is the "anterior base"; it correponds to the central incisor. The next stone is located upon the anterior base and corresponds to the lateral incisor. The succeeding stones are laid upon the posterior base, and represent the first and second bicuspids. The stone corresponding to the first bicuspid is usually in position first, but sometimes the stone corresponding to the second bicuspid is placed first. To complete the arch it is necessary to place the "key-stone" in position—the cuspid tooth. If the stones have proper proportions and the measurements are correct, the key-stone will fit into place and the arch will be complete. We shall find on examining the foundations, two more stones, which correspond with the second and third molars; these stones, with the base and the stones above the base, making a strong abutment.

THE NORMAL ARCH.

In order that aberrations from the normal may be better understood, let us first consider the question, what constitutes a normal arch.

There are three characteristics of the normal arch. Independent of temperamental peculiarities, the line extending from one cuspid to another should be an arc of a circle, not an angle or straight line; the lines from the cuspids to the third molar should be straight, curving neither in nor out, the sides not approximating parallel lines. Absolute bilateral uniformity is not implied in this, as the two sides of the human jaw are rarely if ever wholly alike. A uniform arch necessitates a uniformity of development between the arch of the maxilla and the arch of the teeth, and a correct position of the individual teeth in their relation to each other. When there is inharmony of development between the jaw and the teeth, as may happen when one parent has a small maxilla with correspondingly small teeth, and the other a large one with correspondingly large teeth, if the child inherits the jaw of one and the teeth of the other, irregularities must follow. Such difference in diameter between the arch of the maxilla

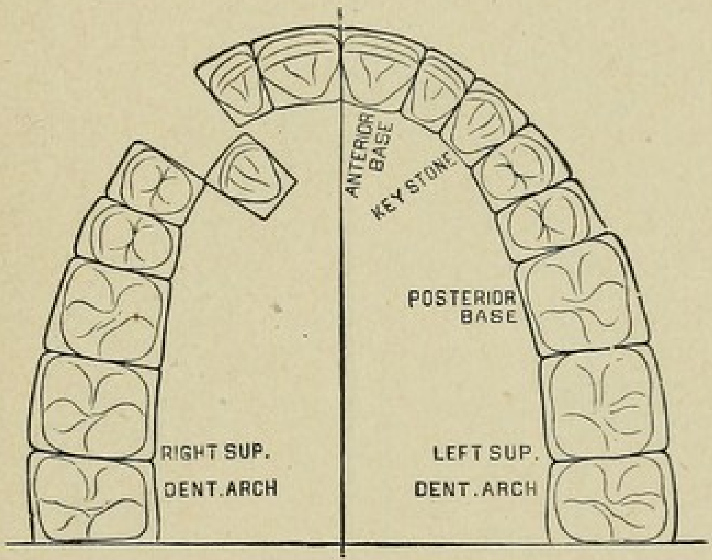

Fig. 136.

and that of the crowns of the teeth is a constitutional cause of irregularity.

Whenever there is a difference between these diameters, the line formed by the teeth must either fall outside or within the arch of the maxilla, and irregularities of arrangement result.

FORMATION OF THE V-SHAPED ARCH.

In Fig. 136 the right superior arch shows the diameter of the stones to be either too small for the curve of the arch, or that the bases were set too far apart for the curve of the arch. This results in a greater space for the key-stone than is required, and not finding support it drops through toward the center line.

In Fig. 137 the right superior arch shows that the posterior base and the foundation stones have been brought forward to such an extent that when the other stones are placed in position, the space intended for the key-stone is entirely closed and the key-stone remains outside the arch. The left superior arch appears as though the key-stone were too heavy for the arch, and its weight has carried the smaller stones with it. The posterior base with its foundation stones, being

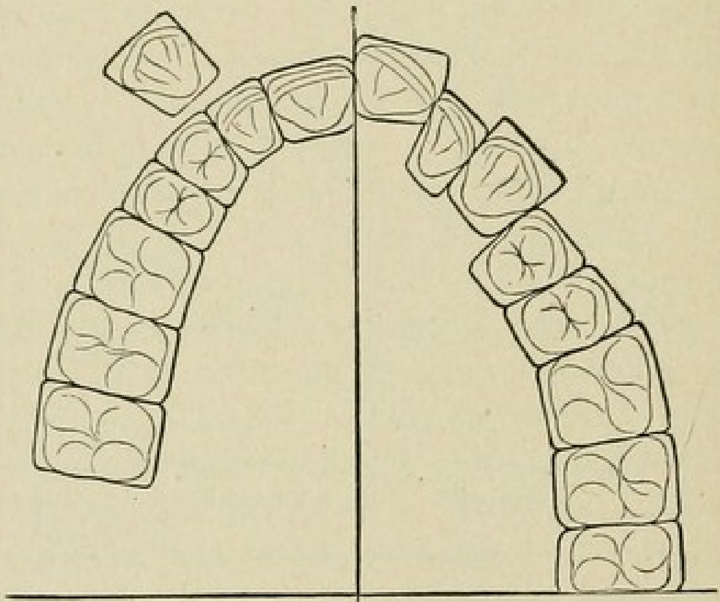

Fig. 137.

the strongest, resists the force; the anterior base being weak and without support, bulges out, and in this way a semi-V-shaped arch is produced.

Fig. 138 illustrates the V-shaped arch. The right superior arch shows that the key-stone has gradually carried the arch inward; the posterior base is in its proper position, the anterior base has been carried forward, and all the stones are in line. The key-stone in the left superior arch has produced the same result as upon the opposite side, excepting that the posterior base and the foundation stones were placed too far forward, leaving insufficient space for the key-stone. The teeth, however, do not bear the same relation to one another upon their approximal surfaces that the stones of the arches do. The stones of an arch have broad, flat surfaces, while the teeth touch merely upon the points of rounded surfaces.

The ten anterior teeth which are involved in the construction of the V-shaped and kindred irregularities, are illustrated in Fig. 139, in which the positions of the roots and crowns, and their mutual relations, are approximately shown. As will be observed, the teeth are all wedge-shaped, the bases being located near the cutting and grinding-edges and the apices at the ends of the roots. These are nearly round and conical, the points of antagonism being near or quite at the cutting or

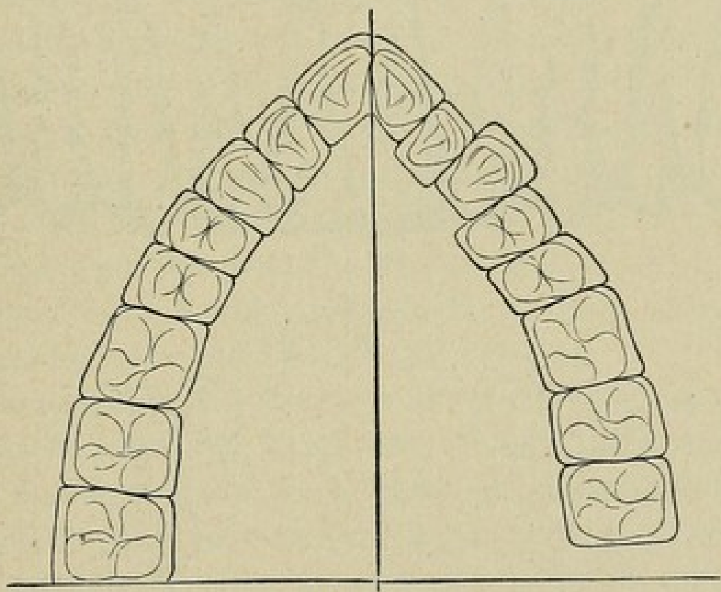

Fig. 138.

grinding edges. Fig. 140 shows a section of the teeth at their points of contact. These points must be kept in mind, as they constitute the fulcra of the levers, which, when force is applied to the teeth, cause them to rotate and move out of position, thus producing a greater variety of deformities than it is possible to demonstrate upon the stone arch.

As has been previously mentioned, these irregularities are not observed until after the eruption of the second set of teeth. We shall therefore first consider the first permanent molars. These teeth are the largest, strongest, and possess the largest roots of any of the teeth. They are located posteriorly to the temporary set. Owing to their position and to the fact that they have long, large roots, their apices are directed backward, and, in a majority of cases, the distance from the apex of one root to that of another is greater than at the neck, which fact indicates that they are firmly fixed in their alveoli. The alveolar process is wide at those points; these teeth therefore would naturally be designated as the posterior basis of the lateral arches.

The next teeth which make their appearance are the central incisors. These are situated in the extreme anterior

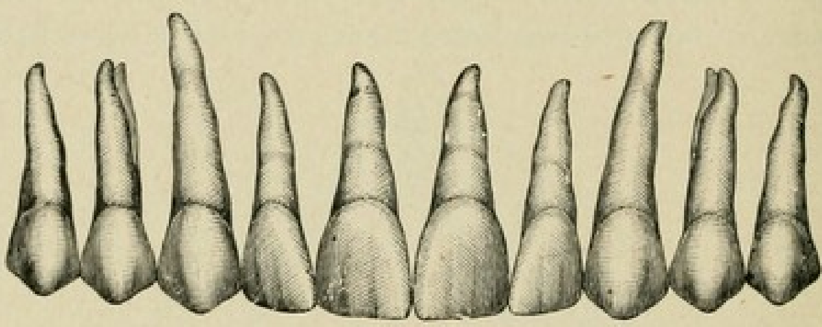

Fig. 139.

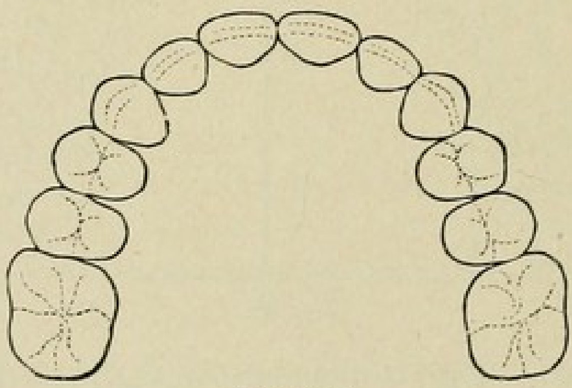

Fig. 140.

alveolar process on either side of the median line, and the process is quite thin at these points. These teeth will be called the anterior bases of the lateral arches. The next to make their appearance are the lateral incisors, which take positions at the distal surfaces of the central incisors. The roots of these teeth are not so large nor so long as the roots of the centrals; therefore they are not as firmly fixed in the alveoli. Each lateral tooth, however, is supported by the central, and represents the second stone upon the anterior base. The teeth which next appear are the first bicuspids.

Immediately following are the second bicuspids, which represent the second and third stones upon the posterior bases. The arches are then complete, except the key-stones—the cuspid teeth. These cannot be omitted, for they bind and hold the teeth together and give beauty and shape to the arches. The follicles of these teeth are originally situated outside of and above the crown and roots of the teeth already in the arch, which results in a larger circle; and because these teeth have long, powerful roots, unusual power and leverage is given them. For this reason they are directed downward and inward, their crowns being so located that the lips assist greatly in aiding the downward movement of these teeth. The downward and inward movement of the cuspids is similar to the lowering of the key-stone in an arch; it continues to move downward until it meets with an obstruction, which may be confined to the upper jaw and include the teeth anterior and posterior to the cuspid. If the teeth in position are in harmony with the jaw, the cuspids will descend into their proper places and, touching the teeth on each side, lock the arches and hold the teeth in proper position.

Let us examine the arches with their bony encasements, and ascertain what the bases are resting upon, the relative strength and support of each base, and the relative strength of the anterior and posterior columns. In the posterior parts of the mouth the alveolar process is very thick, and the base —the first permanent molar—is large, having three roots in the upper jaw and two in the lower, curved and so arranged in the alveolar process as to preclude its going backward. We also find other teeth of nearly equal strength posterior to the first permanent molars. Anterior to the base—the first permanent molar—we find the first and second bicuspids: these teeth are all firmly imbedded and situated in the long axes of the alveolar process, forming together a very firm base. The anterior column of the arch consists of but two teeth, while the posterior column has five. The anterior teeth possess single roots, and are situated crosswise in a very thin alveolar process, thus demonstrating the comparative weakness of the anterior arch. In some instances the space may be too large in the superior arch, and the key-stone or cuspid tooth may continue in its downward course till it engages with the the teeth in the lower jaw.

DESCRIPTION OF THE V-SHAPED ARCH AND ITS MODIFICATIONS.

The V-shaped arch presents a triangular outline (Fig. 141), the apex of the triangle being formed by the central incisors where the process is *usually* bent so that the incisors form an angle instead of being in line. From this apex the lateral halves are in a straight line terminating at the first molars; a line connecting them forms the base of the triangle. The cause of this peculiar outline is a want of correspondence between the size of the jaw and teeth, or the premature

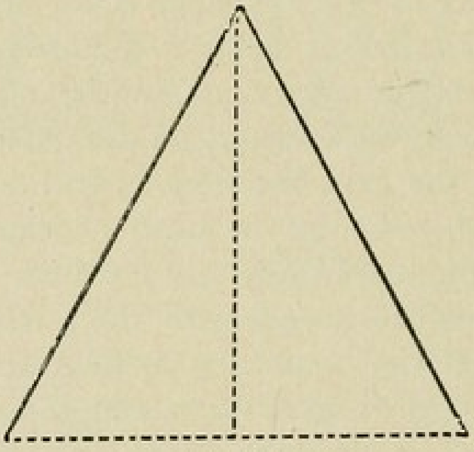

Fig. 141.

extraction of the temporary molar, or both causes combined, thus allowing the first permanent molars to move forward. When the rest of the permanent teeth come in they do not find room and are thus crowded together; the process must give way in order to adapt the greater arch formed by the crowns of the teeth to the lesser arch of the maxilla. The point of fracture is in or near the median line, since the process is thinnest at this point. The illustrations given here show varieties of this type. By comparing each one with the diagram it will be seen that they all are triangular in outline, Fig. 144 being the best representation of this form of irregularities. A line passing from the median line of the central incisors through the cutting edges and crowns is straight.

The study of the cases here given shows the result of the forward movement of the first molar. The subsequent loss of teeth, the peculiarity of articulation, and the thinness of the process at certain points determine the modifications. In Fig. 142 it will be noticed the laterals are gone; for this reason

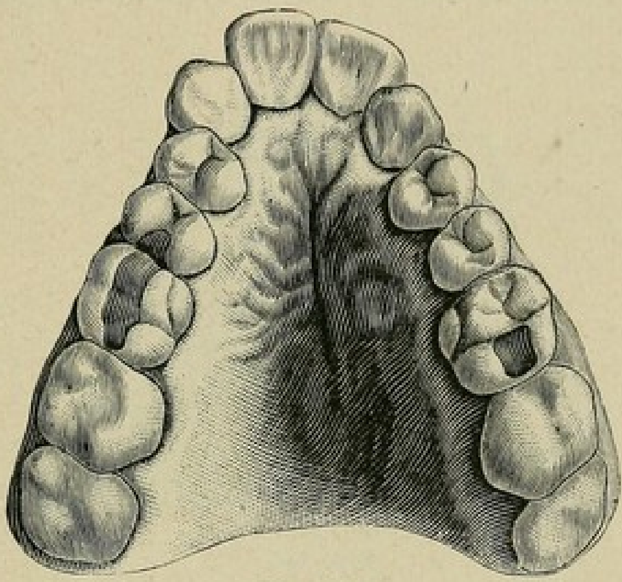

Fig. 142.

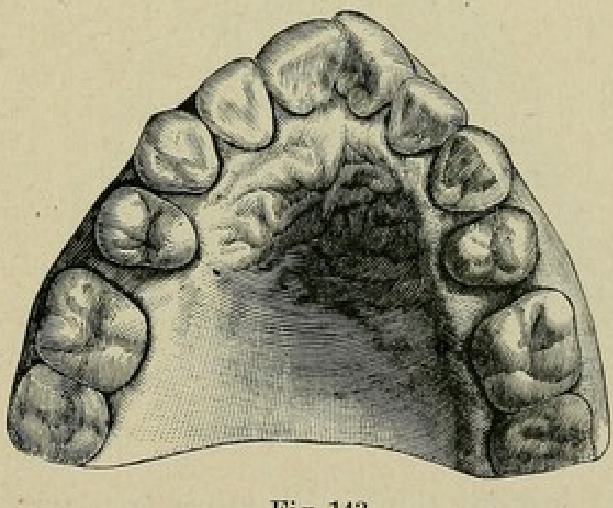

Fig. 143.

the centrals are still in line, space having been made by the absence of the laterals; Fig. 143 shows by its overlapping centrals that there was want of space at the time of their eruption; the loss of the second bicuspids subsequently, together with peculiarities of articulation, have permitted the lateral halves to assume some curvature. Fig. 144 shows an arch too small for the teeth, and is destitute of the right first molar and the left first bicuspid. These were evidently lost after the central incisors were erupted. The rest of the teeth have migrated more or less because not kept in place by close articulation. Thus the cuspids are kept out of place, and by

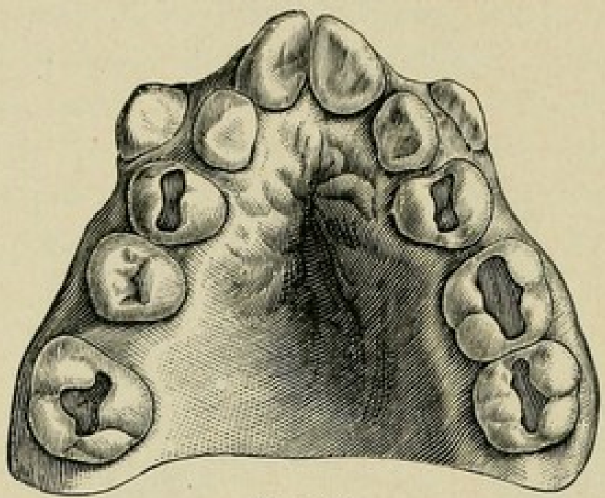

Fig. 144.

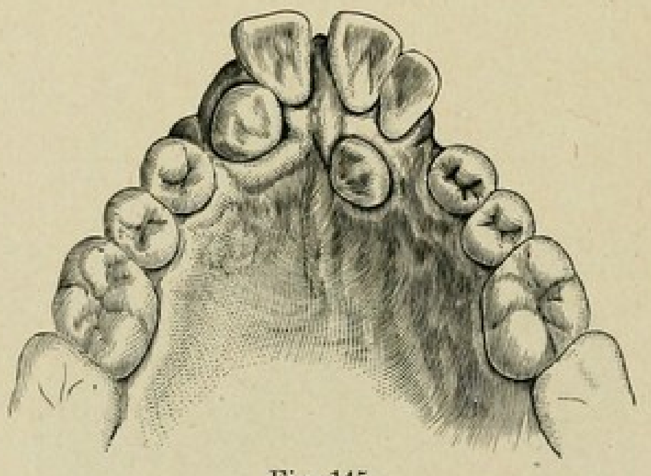

Fig. 145.

their pressure inward tend still more to narrow the arch anteriorly. In Fig. 145 the centrals are spread, though the process is evidently bent. This spreading is accounted for by the absence of the right lateral, which has allowed the central to move backward and the cuspid to move in. On the left side we see the cuspid erupted inside of the arch.

Modifications of the V-shaped arch result from modifications of the above-named conditions. A difference in the time of eruption of the cuspids, everything else being equal, effects a difference in the space left for their accommodation, and thus partial V-shaped arches are found. The key-stone (the cuspid) is not entirely outside or inside of the arch in the partial V-shaped form. but may appear partially crowded out

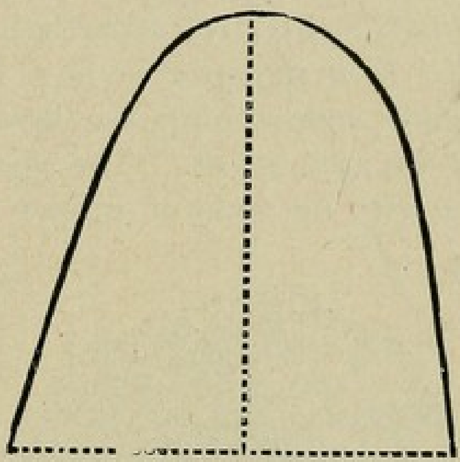

Fig. 146.

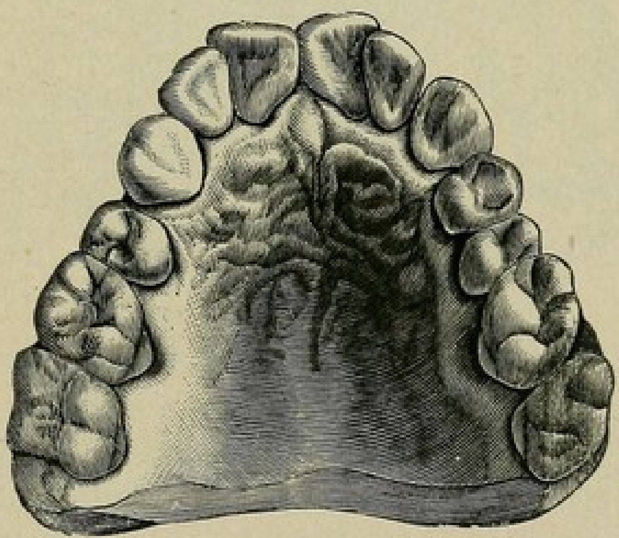

Fig. 147.

of place. Hence the arch is neither a normal curve nor wholly angular, but unites the characteristics of both. Its lateral diameter is less than that of the normal arch, giving it a contracted appearance. (See Fig. 146.) Thus a number of varieties of the fundamental forms of the V-shaped arch are formed, differing in degrees of anterior contraction. All of these result from the comparative thinness of the anterior portion of the process offering but little resistance, an abnormal pressure from behind, and the greater strength of the cuspids, which causes them to seek room irrespective of the space left for them. By drawing a perpendicular line from the median line of the central incisors to the base, and comparing the halves thus obtained with our diagram, we see that the right half in Fig. 147 is partially V-shaped, while the left is normal. Near the apex we have the crowded condition of the incisor, overlapping the lateral; from thence back the curve of the arch is lost. The absence of the first bicuspid, together with the want of proper articulation, has

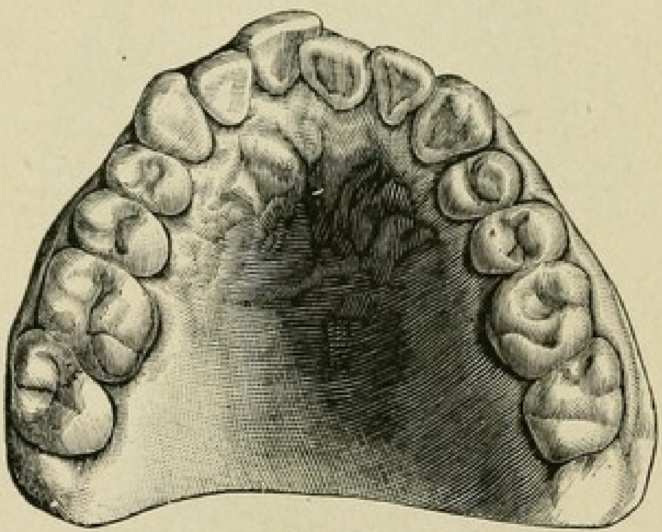

Fig. 148.

allowed the cuspid to press nearer the center of the palate than is normal.

In Fig. 148 the V-shape is not so apparent, but the central incisors are crowded, which shows that there is not perfect harmony between size of teeth and jaw. This contracts the anterior arch.

When one side of the process near the symphysis is the stronger, thus affording greater resistance, or the pressure of the cuspid is less, that side may maintain its normal relations while the other may give way to conditions resulting in a V-shaped contraction. The curve will then be broken, not at the apex of the triangle, but near it; the incisors will overlap and when pressure from the cuspid acts on the weaker column it must give way. This results in the semi-V-shaped form. (Fig. 150.)

Fig. 151 illustrates a semi-V-shaped arch. The teeth in the left dental arch are nearly on a straight line. The teeth in the right dental arch are situated upon a slight curve. In

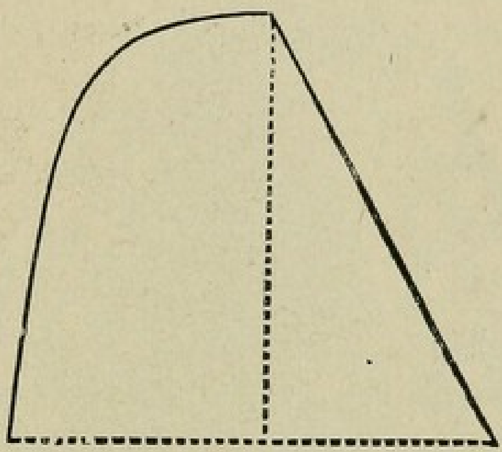

Fig. 150.

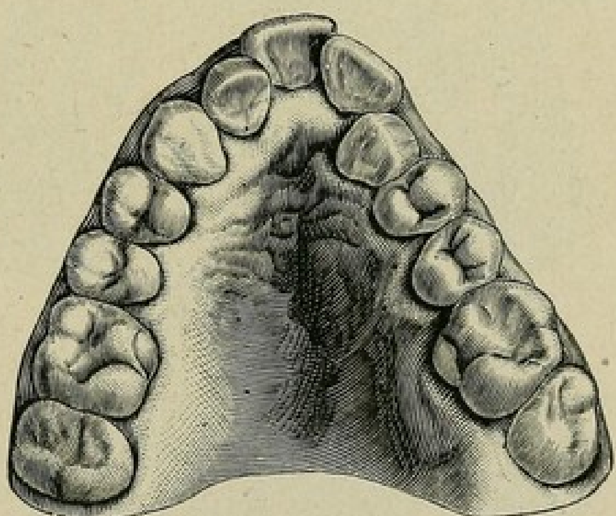

Fig. 151.

this arch the cuspid is in position, while upon the left arch it is missing. The posterior teeth have moved forward and filled the space intended for the cuspid. It is still located in the alveolar process, and the force produced by the inward pressure of the cuspid is so great that the central and lateral incisors have been carried forward and the teeth and alveolar process have produced the straight line. The lateral pressure of the teeth prevents their being carried farther inward. The lack of proper antagonism of the central incisors has allowed the cuspid to force the incisor and alveolar process forward until the basilar ridge of the right central antago-

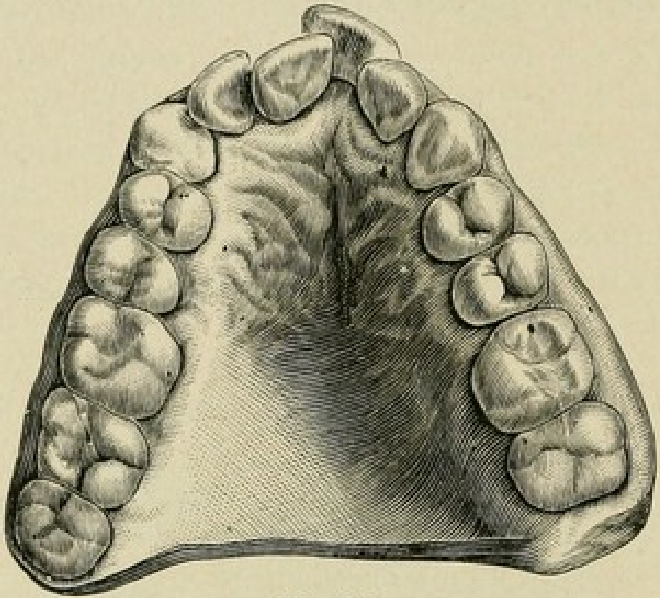

Fig. 152.

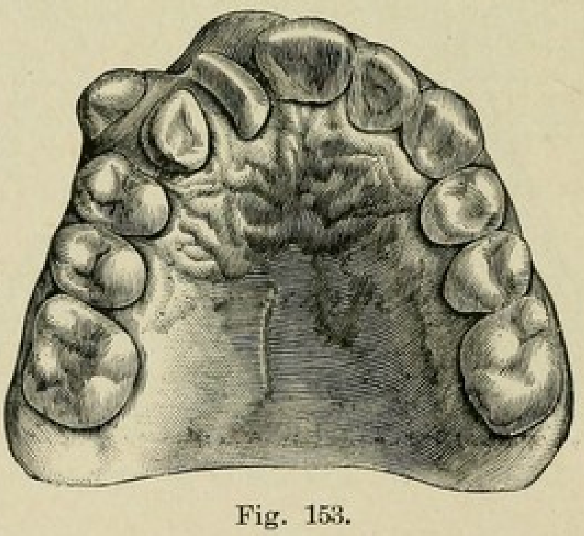

Fig. 153.

nizes with the mesial surface of the left central. This, in a measure, checks the progress of the cuspid inward and holds the arch on a slight curve. A perpendicular line drawn from the mesial surface of the right central incisor (Fig. 152) to the base shows the left side to be V-shaped, while the right is normal. In Fig. 153 the outline does not so clearly point to a V-shaped arch. By comparing the curvature of the two halves and noting the position of the right cuspid, it is more apparent. The bending of the process at the mesial line is evident from the position of the right central. This has turned upon its axis from want of lateral antagonism and proper occlusion. This partial rotation has allowed the lateral to move back, occupying in part the space of the cuspid, which has forced the cuspid out of its normal position, causing it to erupt outside of the arch.

Fig. 154 shows a combination of semi-V and partial V-

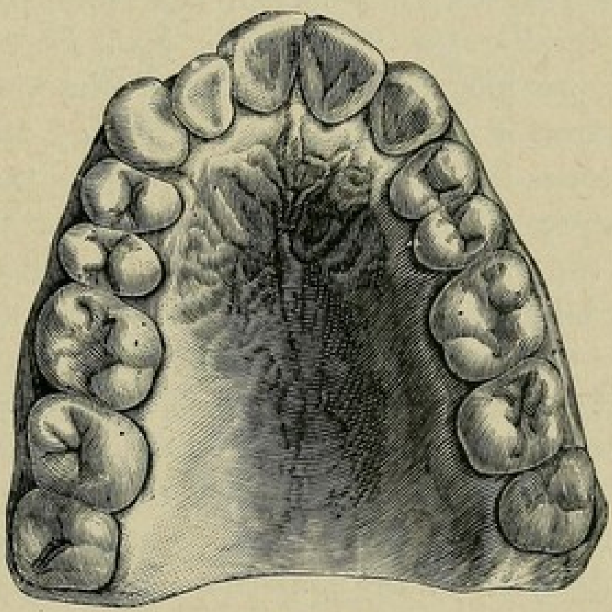

Fig. 154.

shaped arches. The cuspid being outside of the left arch contracts it and gives it the characteristics of the V-shape. On the right side the cuspid is partially crowded out of place, and the arch is somewhat contracted.

IRREGULARITIES OF THE LOWER JAW.

The lower jaw never assumes the V-shape when the teeth articulate normally, because the anterior inferior teeth normally close inside of the upper teeth, and, while the force from improper occlusion of the jaws and the forward movement of the posterior lower teeth is as great or greater than the like force exerted upon the upper jaw, the forward movement of the central incisors is prevented by the striking of their anterior surfaces against the posterior surfaces of the superior incisors. There are many irregularities of the anterior inferior teeth caused by the forward pressure of the posterior teeth. These are quite difficult to regulate, owing to their intimate relations with the superior incisors. The inferior dental arch should be divided into the right and left lateral arches, corresponding to those of the superior arch. The pressure produced by improper articulation and the forward movement of the posterior columns (the bicuspids and molars) is exerted on each lateral half independently, like that in the lateral arches of the upper jaw. Each lateral arch on the lower jaw has its posterior base (the first permanent molar), an anterior base (the central incisor), and the same number of stones in position upon the bases—the same key-stone—all representing the same number of teeth as are contained in the superior lateral arches. The development of each inferior lateral arch is independent of the other, as is the case with the superior lateral arches. The irregularities of the teeth in each lateral arch are independent of the others. When the posterior column moves forward, if the key-stone (the cuspid tooth) is retarded or slow in coming into place, the space is filled by the first bicuspid and the cuspid remains outside, precisely as in the superior lateral arches. If the pressure of the posterior columns and the key-stone is uniform, the force will be exerted against the anterior base and the first stone upon the base (the central and lateral incisor). In this case a different condition exists. The anterior base and first stone of the superior lateral arch, and the anterior inferior column, resist the force. Occasionally, this is so great that the anterior columns of both superior and inferior dental arches are carried forward. When this occurs, the incisors upon the upper jaw protrude. When the forward movement of the posterior column occurs, the incisor (or anterior column) will crowd past one another like the sticks of a fan, provided the pressure be uniform in both lateral arches. The six teeth which are instrumental in the construction of these deformities are illustrated in Fig. 155. These teeth, as will be observed, are wedge-shaped; their points of contact are at their cutting edges; slight oblique pressure will cause these teeth to lap over each other. If the pressure is upon one side only, the irregularity will be located on that side. One of the common irregularities is seen when the key-stone or cuspid tooth is slow in erupting. The posterior column moves forward and the resistance of the anterior column forces the key-stone outside the arch. It sometimes happens that the key-stone moves into place and

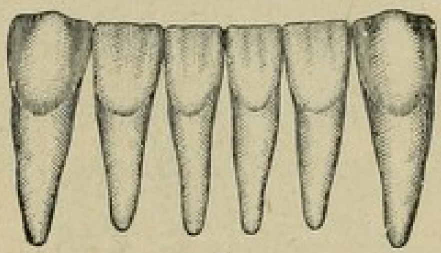

Fig. 155.

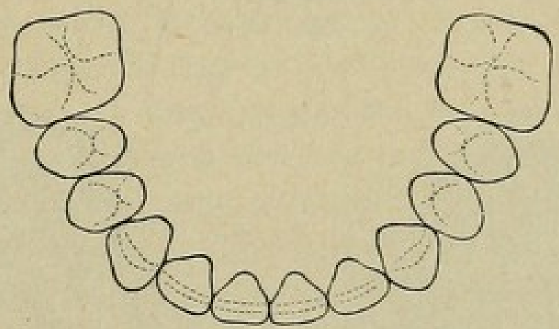

Fig. 156.

is held in position by the anterior column, and the second stone upon the posterior column (the first bicuspid) is carried forward outside the arch. This theory can be better understood by examining cases of this kind which are found in my models of the jaws and teeth, and which will be illustrated later. It may be well first to glance at Fig. 156, which shows in position a section of the teeth made on the line of lateral antagonism. It will be observed that the mesial and distal surfaces are convex, and the points of contact are situated at the extreme lateral surfaces. If the teeth at eruption should not touch at these particular points, or if the force exerted should not be in direct line with these points of contact, the teeth would be situated upon an incline, and the force thus applied would readily carry the teeth one way or the other. Such deformities occur more frequently with the incisor and cuspid than with the posterior teeth. The posterior teeth are

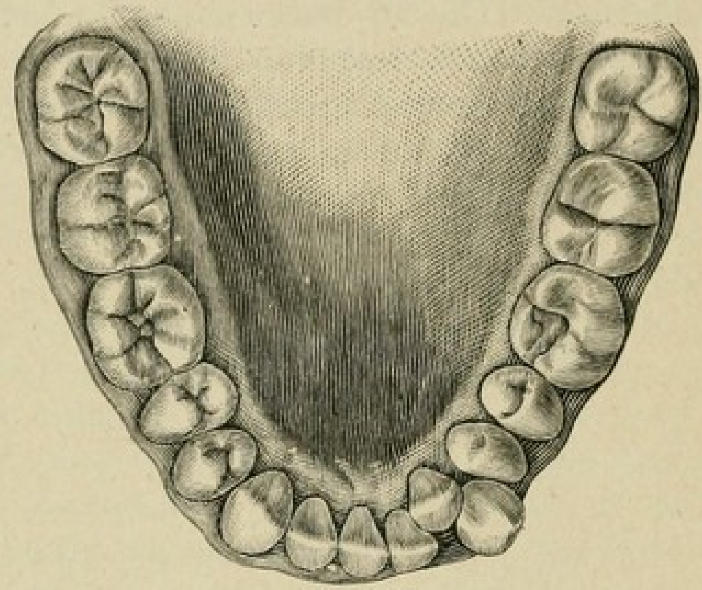

Fig. 157.

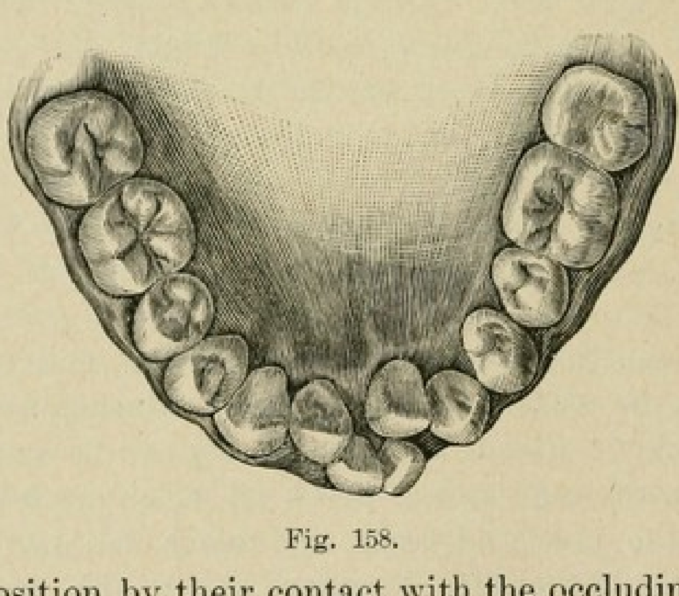

Fig. 158.

held in position by their contact with the occluding teeth of the opposite jaw, while the incisors do not occlude. One marked feature of these irregularities is that in most cases the lateral incisor is carried inward and the centrals outward to remain in position in one or both lateral arches. These conditions are fully illustrated in the chapter on local causes.

Fig. 157 shows the right dental arch as normal. In the left dental arch the anterior column with the cuspid (the key-stone) has moved forward, and the lateral incisor is carried inward. This is explained when the relation between the mesial surface of the cuspid and the distal surface of the lateral is understood. In the forward movement of the cuspid the lateral impinges upon a markedly inclined plane upon the mesial surface of the cuspid, and the forward pressure carries the lateral inward. Fig. 158 shows the same irregularity in both right and left lateral arches, the pressure being uniform upon each arch. The centrals are also slightly rotated in their sockets. This is produced by the flat lateral surfaces of the roots meeting and the pressure of the crowns against the basilar ridges of the superior centrals.

THE SADDLE-SHAPED ARCH.

The saddle-shaped arch is not so common a deformity as the V-shaped. It has many of the peculiarities, however, that are seen in the V-shaped arch. It may include one or both lateral arches. It may be partial on one side and marked upon the other. It may involve the bicuspids and first permanent molars upon one side, or but a single tooth on the other. Each lateral arch produces its own deformity independently of the other. The roof of the mouth may be high or low. The deformity, like the V-shaped arch, is favored by the high arch. The following illustration (Fig. 159) shows the manner of the production of this deformity. We see here a right and left superior lateral arch of stone, each stone corresponding in size and location to the natural teeth. The left lateral stone arch, corresponding to the left superior dental arch, shows the formation of the saddle-shaped arch and the order of laying the stones and changing the base. The first stone laid in the arch corresponds to the first permanent molar, and, like the stone in the V-shaped arch, is denominated the posterior base. The next stone laid corresponds to the central incisor, then the stone which stands for the lateral incisor. The natural order then changes, and the next stone laid corresponds to the key-stone of the

V-shaped arch (the cuspid). It becomes the anterior base, forming a fixed point in the anterior part of the mouth. The next stone laid corresponds to the first bicuspid, followed by those representing the second bicuspid and the second and third molars. The stones being in position, we find that the auterior and posterior columns are nearly equal in strength and resisting power. The anterior column is made up of the anterior base (the cuspid), with its long root, backed up by two foundation-stones, representing the central and lateral incisors. The posterior column is made up of its base, the first permanent molar, backed by two foundation-stones, rep-

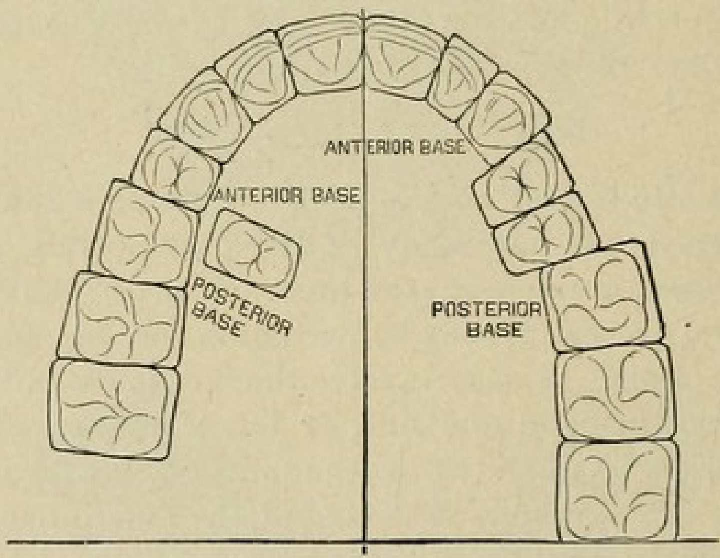

Fig. 159.

resenting the second and third molars. The forward movement of the posterior column takes place in the arch from the same causes which produce the forward movement in the V-shaped arch. The stone representing the cuspid is not the stone involved; it is almost always fixed in its proper place. The weaker stones are those which correspond to the bicuspids, and they are the stones which are always displaced when the forward movement of the posterior column occurs. The change in the order of the laying of the stones—*i. e.*, the stones corresponding to the cuspid instead of the bicuspid (it being irregular)—accounts for there being fewer saddle than V-shaped arches. The change of the anterior base will also explain why the anterior column and alveolar process do not project, as in the case of the V-shaped arch. The right superior lateral arch illustrates another common variety of the saddle-shaped arch. It does not differ materially from the left lateral arch as regards the order of laying the stones. The anterior base is transferred one stone back, the stone corresponding to the first bicuspid. The posterior base remains the same. The posterior column moves forward and carries the stone representing the second bicuspid inward. By comparing the shapes of the natural teeth with the stones in the arch just described, we shall observe that the approximate surfaces are convex instead of flat like those of the stone arch

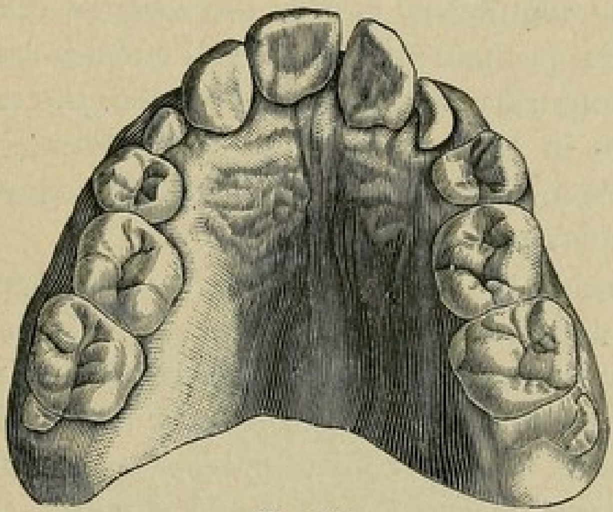

Fig. 160.

just described. The peculiar incline of the anterior surface of the first permanent molar and the posterior surface of the cuspid tooth, together with the oval shapes of the bicuspids, are singularly well adapted to cause these irregularities upon the application of force. The first permanent molars are situated farther outside in the arch than any teeth posterior to them. The cuspids occupying such a prominent position in the arch, in the anterior part of the mouth, the least deviation inward of the bicuspids would give the pinched appearance of the jaw at that locality. In neurotics and degenerates the jaws will in some cases develop in length and not in width. In such cases the jaws at the sixth and seventh year remain permanent. The temporary molars hold the permanent bicuspids in the undeveloped position, and the cuspids erupt outside the arch. In this way a full saddle is formed. This deformity is caused also by the too early extraction of temporary molars, which allows the first permanent molars to work forward and force the bicuspids inward, or by the retention of the temporary molars or their roots, thus deflecting the crowns of the bicuspids. The question arises, why are not the bicuspids forced outward as well as inward? I would reply that they do occur frequently outside the arch; I have several among my collection of models. The inward movement, however, is the natural one, because the crowns when in the jaw are situated between the roots of the temporary molars. The temporary molars are situated upon a smaller circle than the permanent molars and cuspids (see Fig. 160). When the temporary molars are extracted, the crowns of the bicuspids are in the radius of a smaller circle, while their roots have been carried outward by the development of the jaw and alveolar process.

The molars in the saddle and semi-saddle-shaped arches of the upper jaw frequently diverge laterally. If the case shows a semi-saddle-shaped arch, the divergence is on the side of the deformity. If both lateral arches are involved, both sides diverge. Cases having the deformity most prominently have the most marked divergence. When a slight change exists only at the bicuspid region, the divergence in the molar region is slight. This peculiar arrangement of the molar teeth may be due to two causes: First, the teeth upon the lower jaw diverge on account of the shape of the inferior maxilla; the farther removed from the incisors, the greater the distance between the molars of the opposite side. The molars upon the upper jaw usually articulate with those upon the lower jaw. The disparity in the appearance of the normal position of the teeth and those above described is due to the pinched condition in the bicuspid and first molar region rather than to the position of the molars. Second, when the arch is contracted at the bicuspid region the tongue is limited in its movements. In swallowing, the tongue goes to the roof of the mouth and is then forced backward for lack of room, thus shortening and, consequently, broadening its surface. The result of the lateral expansion would naturally be to force the teeth and alveolar process outward.

The position of the temporary molars determines the position of the bicuspids. This position shows the diameter of

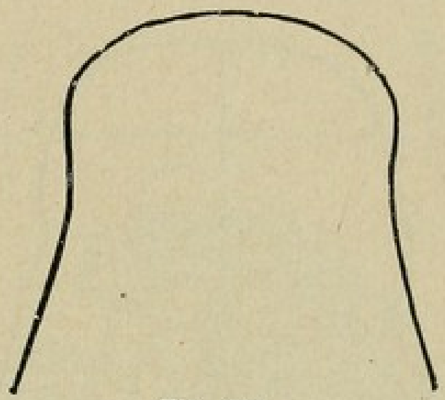

Fig. 161.

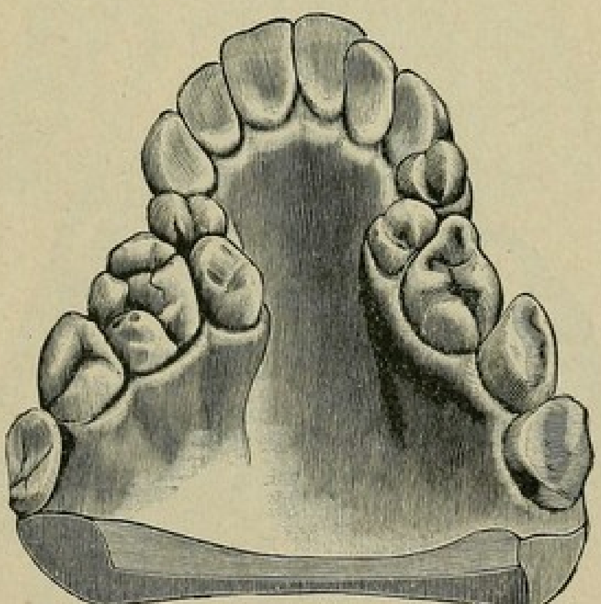

Fig. 162.

the jaw early in life. From that time until the eruption of the third molar, *i. e.*, from the third to the twentieth year— the jaw has an opportunity to develop, which naturally carries the alveolar process and teeth out laterally, causing the crowns of the third molar to face the cheek in some instances,

DESCRIPTION OF THE SADDLE-SHAPED ARCH AND ITS MODIFICATIONS.

When there is harmony between the size of the teeth and that of the arch, and the permanent bicuspids erupt under favorable conditions, so that their greatest diameter is in a line with the greatest diameter of both first cuspid and molar,

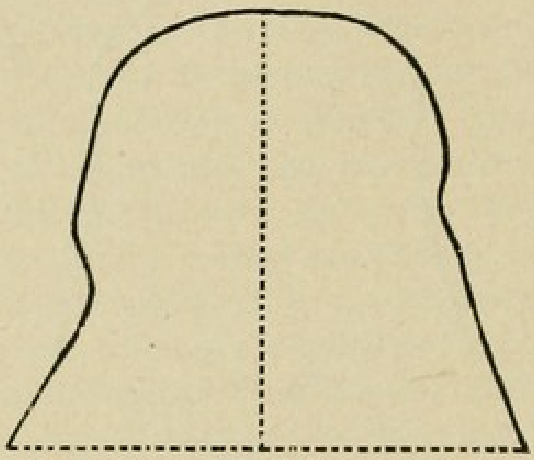

Fig. 163.

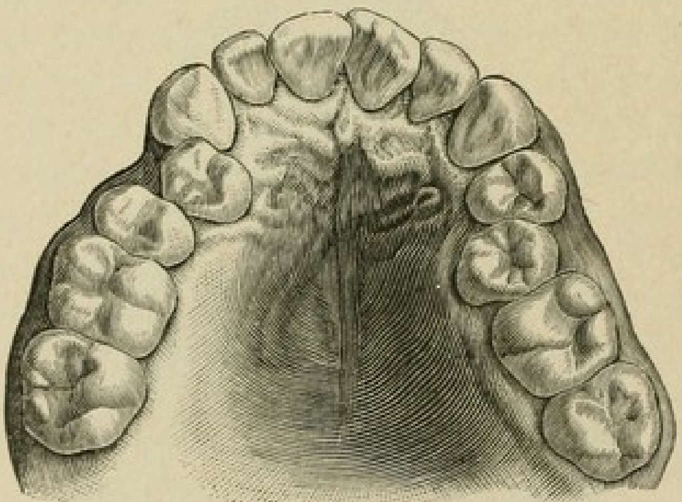

Fig. 164.

they will be held firmly in place, since the greatest pressure is on this very line. On the other hand, when the bicuspids are erupted *after* their proper time, while the cuspids progress duly, the cuspids, meeting with no resistance, fall into their natural position, while the bicuspids erupt inside of the arch, forming an angle. This angle results from two causes

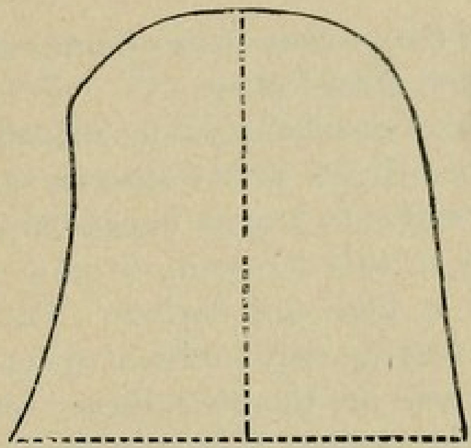

Fig. 165.

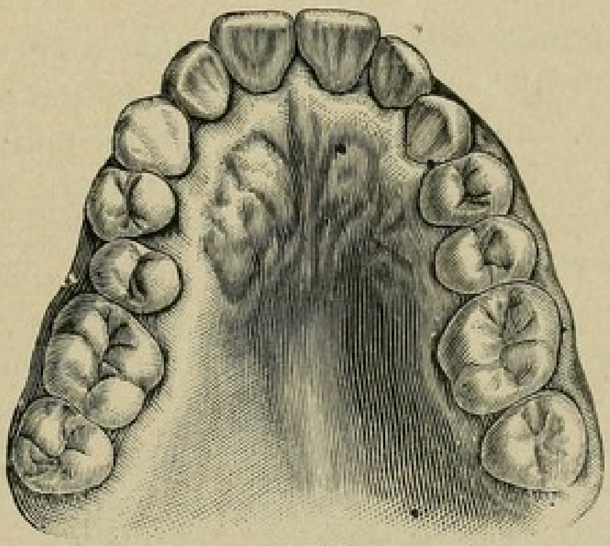

Fig. 166.

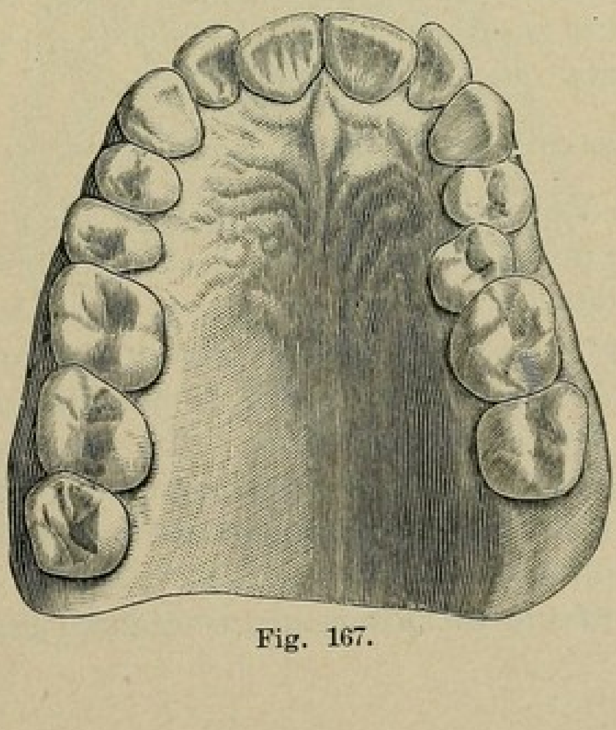

Fig. 167.

—the thinness of the process at this point and the diminution of resistance which must follow.

Fig. 162 shows a decidedly saddle-shaped arch. The maxillary bone is too narrow at its anterior extremity for the teeth, which are suited to a more expanded jaw. The constitutional tendency to this deformity is quite apparent in this case. The vault is high and narrow. The first molars are pushed forward, leaving only sufficient space on each side for one bicuspid. These are therefore turned inward toward the palate, making the vault at this point still narrower than it naturally is.

When the unfavorable conditions that result in the saddle-shaped arch are not so pronounced, we have the partial saddle-shaped arch. Thus, because of the greater uniformity of the maxilla and of the arch of the crowns there may be more space, and the bicuspids may be forced but little out of place, or the molar may move forward but slightly, interfering less with the bicuspids. Sometimes it happens that in trying to adjust themselves to the limited space one bicuspid may be crowded outward and another inward. Sometimes the first bicuspid is in, more frequently the second. (Fig. 164.)

Figs. 165 and 166 show a normal arch on the left side, and a saddle-shaped arch on the right. The vault is normal in this case; hence there is more room for the erupting bicuspids, and less curvature results than is found in Fig. 164. Fig. 167 shows a similar condition of the left side.

COMBINATION OF V AND SADDLE-SHAPED ARCHES.

How the V-shaped and saddle-shaped arch on one side only may be produced has already been described. How they may be combined on one side remains to be explained. Given thinness of process in the anterior part of the mouth, premature or tardy extraction of the first molar, and there will be a forward movement of the incisors. The development of the cuspid will press the alveolar process inward, thereby contracting the arch, and the tardily erupted bicuspids will adjust themselves to the limited curve as before stated. In this way the features of the two forms are combined; that is, a contracted or angular anterior arch, and a posterior arch that is more or less concave. The opposite side may be V-shaped, saddle-shaped or normal. (Figs. 168 and 170.)

Fig. 169 shows a combination of V and saddle-shaped arch on the left side and V-shaped on the right. Figs. 170

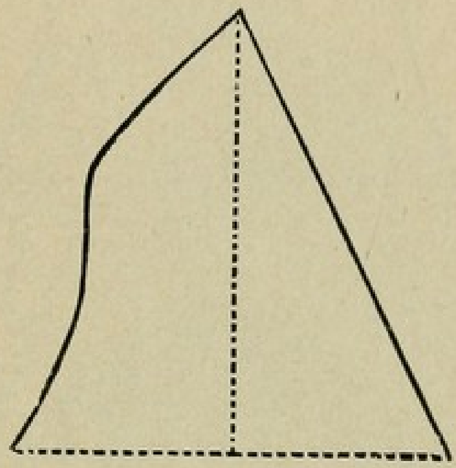

Fig. 168.

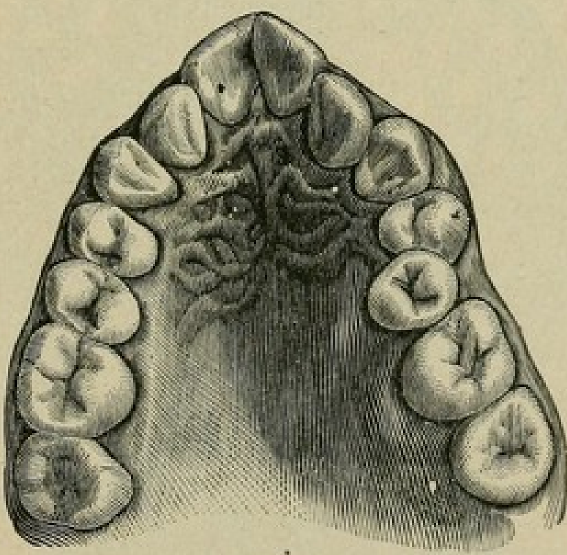

Fig. 169.

and 171 is a case of semi-V and semi-saddle-shaped arches combined.

Fig. 172 shows a semi-saddle shape in the right lateral arch; the second bicuspid has been forced inside the arch. The opposite side shows a condition exactly reversed. The points of lateral antagonism of the second bicuspid are outside the

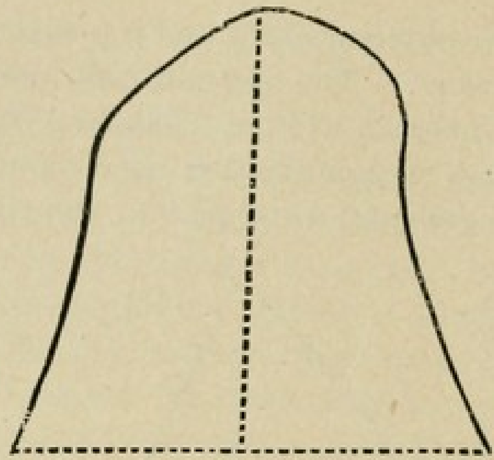

Fig. 170.

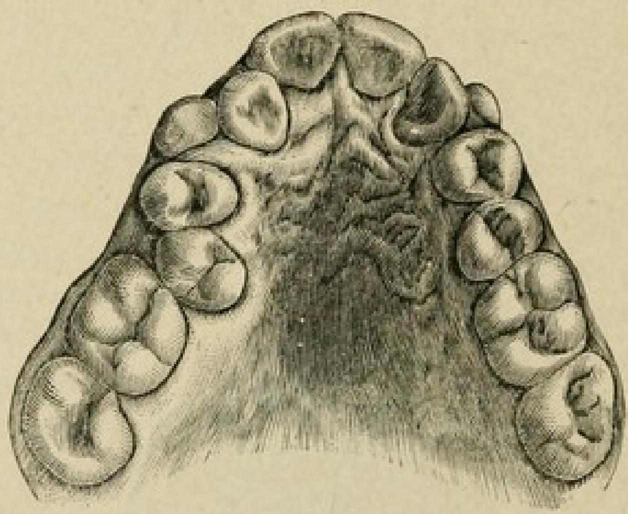

Fig. 171.

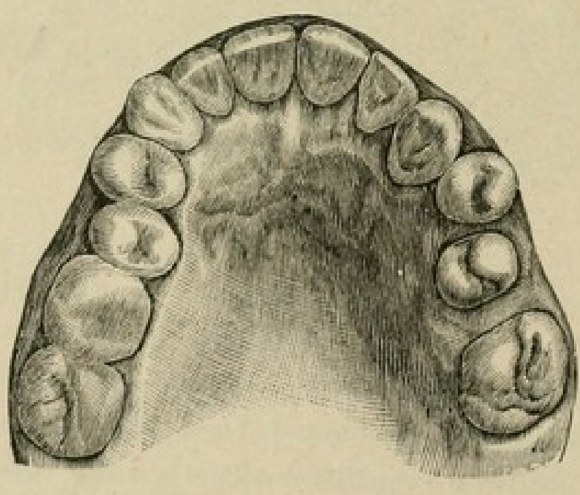

Fig. 172.

long diameter of the dental arch. The anterior movement of the posterior base forced the tooth outward. The tendency of this irregularity was to form the V-shaped variety. The irregularity of the left lateral arch (Fig. 173) is a common one.

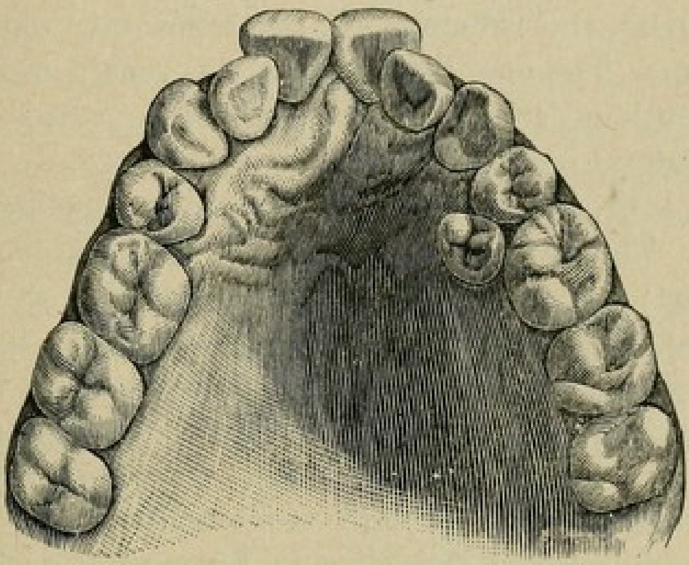

Fig. 173.

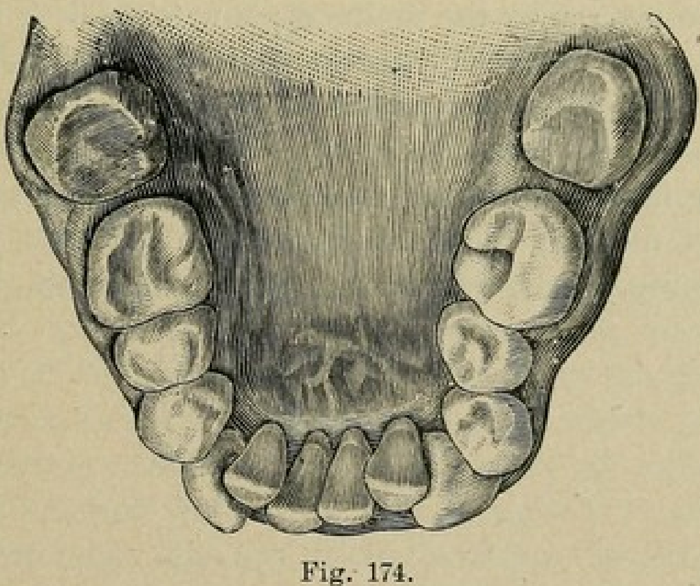

Fig. 174.

The teeth develop normally, but the second bicuspid is either retarded in its development or it is deflected inward by some local cause. The anterior base is, in this case transferred to the first bicuspid. The posterior and anterior bases come together, and the second bicuspid is crowded inward. The irregularity corresponds to the right lateral stone arch of Fig. 159.

THE SADDLE-SHAPED ARCH OF THE LOWER TEETH.

The saddle-shaped arch on the lower jaw is generally due to local causes, the retention of the temporary molars being one of them. The one illustrated is the result of both local and constitutional causes. This deformity is also due to an arrest of lateral development of the lower jaw.

Fig. 174 illustrates a saddle-shaped irregularity upon the lower jaw. The impression is from the jaw of a man fifty-six years of age; the second molars were extracted at the age of twenty-two. The irregularity was produced at the time of the development of the teeth. The teeth are large and firmly set in the powerful jaws. Asymmetry of the jaws exists. If they had developed in unison, this deformity would have been prevented. The forward movements of the posterior columns have carried the cuspids forward and the lateral incisors inward, so that the cuspids and centrals stand on a line. The second bicuspids and first permanent molars have been forced inward by the inclined plane formed by the posterior surfaces of the first bicuspids, and also by the articulation of the superior teeth, which form a smaller arch than the lower teeth. As will be seen, the third molars have moved forward and nearly filled the spaces made vacant by the extraction of the second molars. This forward movement was no doubt due to improper articulation with the upper teeth.

CHAPTER XXXIII.

LOCAL CAUSES OF IRREGULARITIES OF THE TEETH—UPPER JAW.

A local cause resulting in an irregularity is found in malposition and malocclusion of individual teeth as a result of an accident, such as premature or tardy extraction of temporary teeth, or malposition and malocclusion growing out of constitutional causes.

Before taking up each form of the irregularity to which an individual tooth is subject, a few words should be said about the relative influence and force of teeth, for on this these irregularities in a great measure depend.

RELATIVE IMPORTANCE OF INDIVIDUAL TEETH IN EFFECTING IRREGULARITIES.

Foremost in influence on the relative position of permanent teeth is the first molar. If the temporary molar is extracted prematurely the forward movement of the posterior column follows it, the expanse of the anterior column producing more or less vicious position, relation and occlusion. I have frequently observed the anterior movement of the temporary molars and cuspids as well as the permanent bicuspids and cuspids, from the great force exerted by the first permanent molar, and have a number of models showing same. To this even the cuspid must yield, though most influential in the anterior column. Next to the first permanent molar in importance is the cuspid. It asserts itself above the rest because of its vital force, length of root, peculiar shape and location in the jaw. The length of its root allows it to deviate more than any other tooth from its original position, because, with the same degree of pressure brought to bear on or near the apex of its root, a tooth may diverge in proportion to the length of its root; though the angle is the same, the divergence grows greater the farther the cusp is from the apex.

The central incisor comes next in importance, and then the lateral. The central incisor finds a support in its fellow on the opposite side, while the lateral is the most passive of teeth. It, however, plays the part of a co-ordinating force, since without this wedge the teeth are not retained in their position, and occlusion is disturbed. Because of its weakness and short root it is very easily displaced.

THE CENTRAL INCISOR—IRREGULARITIES PRODUCED BY THE MALPOSITION OF CENTRAL INCISORS RESULTING FROM FLEXION OF THE ALVEOLAR PROCESS.

In the chapter on general classes of irregularities the fact was emphasized that the forward movement of the posterior column—*i. e.*, the bicuspids and molars due to premature or tardy extraction—will force the weaker anterior column and alveolar process forward. The pressure brought to bear upon it from both sides makes the arch of the upper maxilla greater than that of the lower. As a consequence occlusion will be wanting or defective and flexion must take place according to the position assumed in the eruption of each individual tooth. This condition is greatly promoted by the pressure of the cuspids, which, in coming down, assert themselves at the expense of the weaker incisors. But this is not all. Much depends on the size and the development of the germs of the permanent incisors. When there is strong vitality their size may be out of proportion to that of the alveolar process. Owing to healthy nutrition or the nature of the food that is taken into the system during the time of their development, the centrals may become very vigorous. This more than ordinary development shows itself not so much in the relative position of the axes, but in the irregularities of the cutting edges, owing to the excessive diameters of these, which causes them to overlap slightly. When a temporary incisor persists too long in its socket, the germ of the permanent tooth is embarrassed in its eruption. The germ seeks its way out as best it can, and as projecting in a straight line is out of the question, it slips around the temporary teeth and is forced partially out of position. The process in this case is not unlike that of the germ of a plant that forces its way out from under a stone.

Having considered the cause of the irregularities of this division, we will now proceed to consider its varieties. A form frequently met with is found in V-shaped arches. The central incisors are crowded together so that their cutting edges are not in a line, but form an angle that points for-

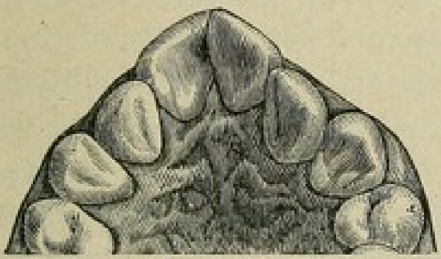

Fig. 175.

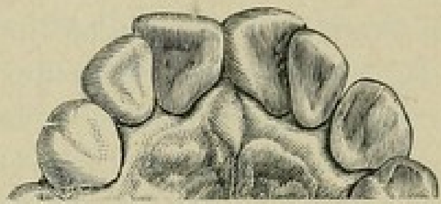

Fig. 176.

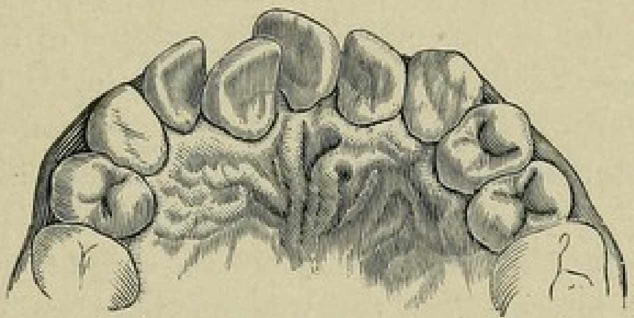

Fig. 177.

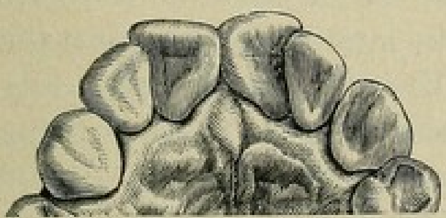

Fig. 178.

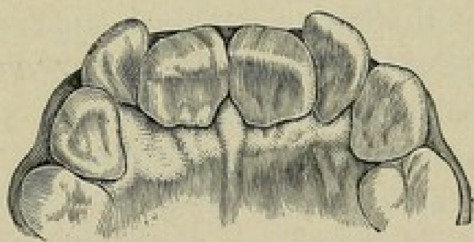

Fig. 179.

ward. (Fig. 175.) This is the most natural form for the flexion to assume. The arch is simply broken in front, following the general direction of the pressure. The mesial surfaces are parallel; the anterior angle points forward, following the general law of incisors. The force is uniform. Had the anterior column not been forced forward by the posterior one, these teeth would be normal in every respect. Sometimes we find them overlapping each other slightly, and occasionally the anomaly is met with that the general axes of the teeth do not converge, but diverge. This divergence is found to be due to a faulty occlusion, the lower incisors acting as a wedge, driving the upper incisors apart, or else, from a want of occlusion, they follow their course without guidance and support.

In the second class, where the cutting edges form an angle which is directed backward (Fig. 176), the pressure from behind by the posterior column has met with an obstruction in front. This obstruction exists in the center of the alveolar process, and is strong enough to resist in a measure the pressure from behind. Hence the force spreads itself on the lateral divisions of the anterior process. The result is that the mesial line is formed behind the distal line, and an angle is formed. Here, as in the former case, occlusion is an important factor in determining the position of the axis. A want of proper occlusion may force the anterior teeth apart. The laterals also in seeking their natural position may help to force the distal surfaces of the central incisors still more out of line. Being wedged in between centrals and the cuspid teeth, the latter, by their greater force, cause the centrals to yield to the laterals that are wedged between them. The mesial angle of the laterals infringes upon the inner surface of the distal angle of the centrals. These continue to rotate until the entire mesial surface of the laterals rests against the palatine surface of the centrals. Then the rotation naturally ceases, the laterals forming an abutment. Pressure being exerted on both centrals, in this way an angle is formed, and the pressure on both sides being equal, they are not thrown out any farther. The direction of the cutting edges depends on the shape of the teeth.

If the diameters of the cutting edges exceed much those of the necks, they necessarily overlap to a greater extent.

When the two central incisors do not erupt harmoniously, one overlaps the other. (Fig. 177.) If, in addition to this condition, the force that is brought to bear on the anterior alveolar arch is very unequal, certain modifications occur. An unequal pressure exerted by the cuspids in their eruption will force one side of the arch farther forward than the other. When the first molar on one side has been extracted, while that on the other side remains, the forward movement is necessarily one-sided, and a corresponding irregularity follows. The tardy extraction of temporory teeth goes far in forcing the germs of the permanent teeth out of place. Irregularity in the lower incisors through faulty occlusion modifies greatly the direction of the upper teeth.

Sometimes centrals projecting in a line in front of the laterals are met with. (Fig. 178.) In this case the centrals erupted properly; but the arch being undeveloped, there is not room for the laterals. These are carried forward by the posterior column and in by the cuspids, and are possibly driven in by the lower incisors, which, instead of striking

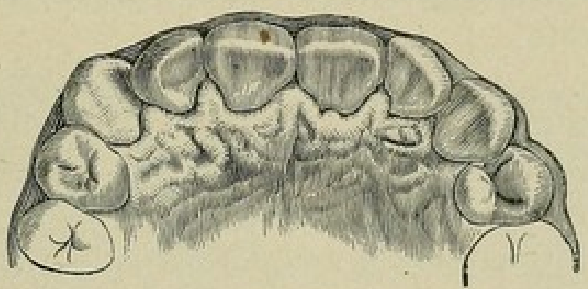

Fig. 180.

within them, strike without, exaggerating the difficulty. When this is not the case, and the laterals strike outside of the lower teeth, the upper arch is too large for the lower, and the upper centrals, not finding the proper support below, are forced out in a similar manner.

A similar condition is that in which the central incisors strike within the laterals. (Fig. 179.) The cause is the same; but the laterals in erupting fail to find the proper support and project outward, while the centrals occlude properly. In this case the upper maxillary arch is not necessarily too large for the lower; but the teeth are crowded.

One form of irregularity that is occasionally met with is that which gives rise to a right angle in the region of the cuspids, the incisors being in a straight line. (Fig. 180.) There are, of course, cases of this kind where the upper and lower arches resemble each other, and where the occlusion is fair, which, for these reasons, cannot be classed under irregularities. When this rectangular appearance is found in the upper jaw only, it is evidently due to a flexion in the region of the cuspids caused by the forward movement of the posterior column. The anterior alveolar column will be found thick, and is therefore capable of resisting the pressure of the posterior column, and the pressure is spent on the weakest point—*i. e.*, the region of the cuspid. Hence the flexion at this point. There is always an excessive development of the upper jaw and alveolar process. This causes the teeth to erupt too far forward for occlusion with the lower arch, and the lip draws them in until they strike the lower arch, and the long axes of the teeth point inward instead of outward. Thus the vault is brought forward, leaving the lower incisors without support.

IRREGULARITIES PRODUCED BY THE MALPOSITION OF CENTRAL INCISORS DUE TO VICIOUS ERUPTION.

The laws that govern the eruption of the teeth and harmonize their development are occasionally interfered with. The germs that should be directly over the temporary incisors may be displaced. These should be situated above and anterior to the temporary teeth; but occasionally the germ is situated above and deflected posteriorly, and thus it is liable to be erupted on the palatine surface. A displacement of the germs generally results in vicious eruption; for, however slight it may be, as the tooth progresses, the line of its axis must diverge more and more from that of its normal position. The central incisors spring from a point farther back than it should be. If the elevation of the gum is followed, it will be seen that these two diverge more and more toward their cutting edges. Thus the relation of their axes is changed entirely, and a partial rotation is produced. (Fig. 181.)

Again, if the roots of the temporary teeth persist instead of being absorbed as the permanent teeth advance, they materially interfere with the eruption of these, and are apt to turn them out of their course. When one of the conical roots of the incisors infringes upon another not in the same line, as the teeth develop, a tendency to rotation is established on the principle of the screw. This partial rotation upon its axis is more apparent the greater the diameter of the tooth; for the cutting edge, usually in line with the other teeth, now partakes of the revolution of the axis, and so forms an angle with the arch.

In these three cases, when the tooth is fully erupted it finds a proper resting-place on the opposing tooth; its malposition may be corrected by the exercise of its proper function; but it often fails to find this, and projects out, being without support.

Adventitious germs appear occasionally in the alveolar process. When these are found in the arch, they necessarily disarrange the occlusion and throw the teeth out of their

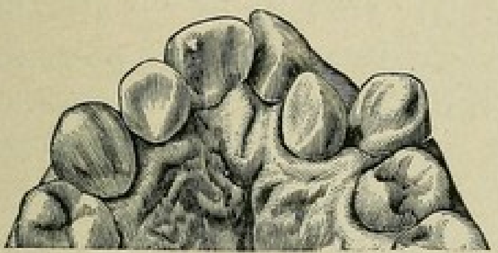

Fig. 181.

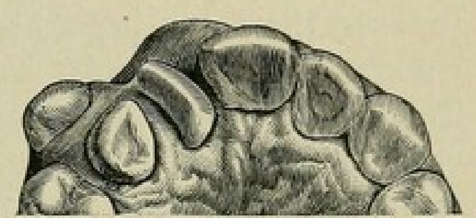

Fig. 182.

proper position. Supernumerary teeth usually appear at the median line, and then necessarily crowd all the teeth laterally. Frequently one supernumerary tooth is found exactly in the median line, and centrals coming down to the right and left in the arch.

Occasionally two are found in the position where the centrals should be. In such cases the central incisors are generally located outside and anterior to the lateral incisors. When a supernumerary is found outside of the arch in the median line, one central may be in position; the other may be thrown out or in, and may be rotated 45° upon its axis. (See Fig. 182.)

IRREGULARITIES PRODUCED BY THE MALPOSITION OF LATERALS.

1. Mesial surface of lateral overlapping distal surface of central, while distal surface is in a line with cuspid.

2. Mesial surface of lateral overlapping distal surface of central, while distal surface is behind the cuspid.

3. Mesial surface of lateral behind the distal surface of the central, while the distal surface is in a line with the cuspid.

4. Lateral in a line anterior to that of central and cuspid.

5. Lateral in a line posterior to central and cuspid.

6. Lateral at right angles with the line of the incisor and cuspid.

7. Lateral wholly inside the arch.

The lateral is found more frequently out of position than any other tooth because it is the weakest tooth in the arch and has the shortest root, and is therefore more easily displaced.

We have seen that the position of the central incisor is the combined result of the relative strength of the alveolar process, the force brought to bear upon it by the posterior column and the cuspid, and the peculiarities of occlusion. The lateral, on the other hand, depends for its position on the combined force of central and cuspid. Like other teeth, each lateral depends upon the environments of its own side of the arch, independent of the other. Besides its weakness, two other conditions are productive of its change of position—(1) the shortness and conical shape of its root; (2) its wedge-shaped crown. The shortness of its root, together with its conical outline, cause it to be more easily impinged upon by the root of the incisor, which will produce partial rotation. The wedge-shape of its crown facilitates rotation. The greater the diameter of the cutting-edge in proportion to that of the root, the greater the degree of rotation must be before the lateral finds a resting-place. If the diameter were equal to the space left, and there were no impinging on the root, there would be no displacements. But when the space is not sufficient for the lateral and a pressure is brought to bear on one side of either cutting-edge or root, there must be a partial rotation, which is proportioned to the diameter of the cutting-edge. The wedge-shaped character of the crown assists in rotation, as the rounded angle of the anterior cusp offers less resistance than a line or surface. This gives rise to the commonest form of irregularity (Nos. 1 and 2; Figs. 183 and 184), in which the mesial surface of the lateral overlaps the distal surface of the central, while the distal surface of the lateral is either in a line with the cuspid or just back of it.

3. In those cases where the lateral is in a line with the cuspid (Fig. 185), but its mesial surface is behind the central,

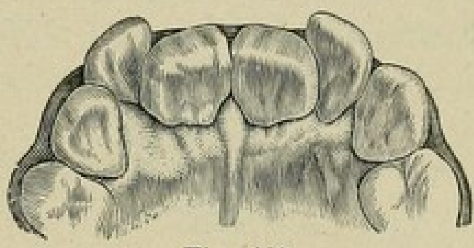

Fig. 183.

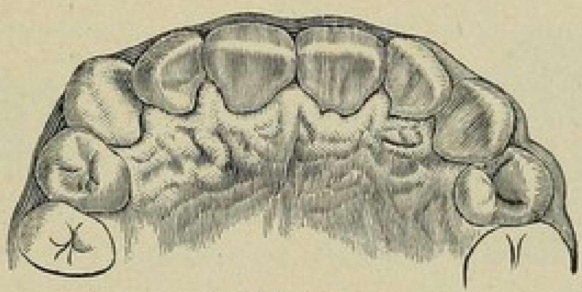

Fig. 184.

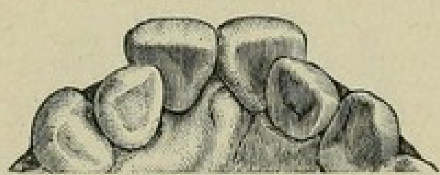

Fig. 185.

the cuspid, having a much broader mesial surface, affords a firm abutment to the movement of the lateral, while the mesial surface of the latter easily glides over the narrow, rounded distal surface of the central incisor. In this case the relative diameter of the upper and lower maxillæ determines the occlusion and position in a measure. If the lower maxilla and the upper are properly proportioned the lower incisor may strike in front of the upper.

4 and 5. Laterals not finding room in the anterior column are met with in a line in front of that formed by the central and cuspid (Fig. 186), or behind it (Fig. 187). In both cases there is no rotation produced by a one-sided pressure either upon the root or cutting-edge. Whether the lateral is found without or within the line depends upon the relative diameter of the upper and lower maxillæ and occlusion. If the proper relation exists and the lower incisors strike within the upper, the upper laterals will be found outside the arch.

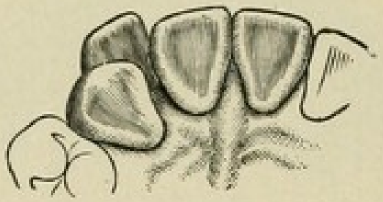

Fig. 186.

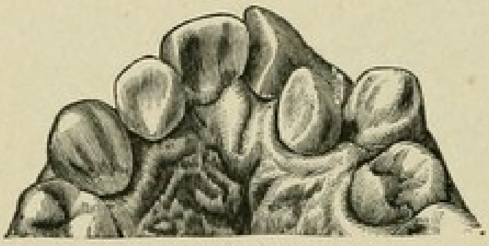

Fig. 187.

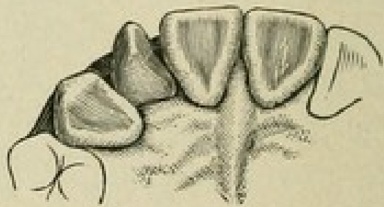

Fig. 188.

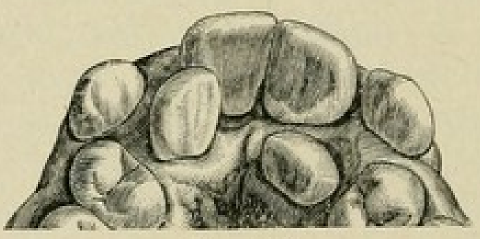

Fig. 189.

When the diameter of the upper arch is greater than that of the lower, its laterals may be found within the line of the centrals and cuspids. In this case the lower incisors must either strike over the upper, which occurs when there is a proper relation of diameters of upper and lower maxillæ, or else they may strike behind the upper laterals, which can occur only when the upper arch has a greater diameter than the lower.

6. A rotation of 90°, so that the lateral is at right angles with a line passing through centrals and cuspids, can occur only when there is no obstruction to the movement of either root or cutting-edge and where there is no proper occlusion. (Fig. 188.)

7. Occasionally a lateral is found wholly inside of the arch. The cause is twofold. Sometimes the lateral is erupted so tardily that the cuspid pushes it out of its place. Then, again, even though it is erupted, in due time the greater relative (Fig. 189) size and strength of the cuspid may crowd it toward the palate.

IRREGULARITIES PRODUCED BY THE MALPOSITION OF THE CUSPIDS.

The cuspid is the most important tooth in the anterior part of the mouth in regard to durability and influence on expression. It owes its durability to the hardness of its tissue, slowness of its development and simplicity of shape. The absence of sulci lays it less open to the inroads of caries. The pyramidal shape of its cusp gives it great power of resistance. Its strength depends on these conditions and the length of its root, which exceeds that of any other tooth. Owing to the length of its root its cusp may move farther from its normal axis without really forming a greater angle with it. It is placed at the angle between the anterior and posterior columns forming the key-stone; hence it is of the greatest importance in affecting expression. The shape of the crown may vary from the agreeable rounded outline of beauty to the prominence of the tusk of a wild beast. The limits of variation of form and position thus being greater than those of any other tooth, it attracts more attention and does more to help make or mar beauty. The deviations from its normal position may be due to malposition of the germ or crowding out of place. It is difficult at times to determine which of these causes produces the irregularity, though generally it is clear.

When no source of pressure upon the erupting tooth can be recognized, such as is the case when the cuspid erupts in the vault, it is safe to assume the former.

In both the deciduous and permanent set, as compared with other teeth, the cuspids are late in erupting. In both it must seek its way between two teeth already erupted; hence its liability to be forced out of place.

The permanent cuspid rarely erupts before the twelfth year after the centrals, laterals and bicuspids are in position. It is crowded, and therefore meets with obstacles in its descent. Its crypt is placed above and in front of those of the lateral and bicuspid. As at the age of nine the roots of the incisors and bicuspids are pretty well calcified, the cuspid may be materially hindered in its eruption by these when there is a lack of space. Its conical root makes it yield easily to pressure, and its cusp glides readily over the roots of the adjoining teeth. If the relation between the calcification and decalcification of the temporary teeth does not take place simultaneously a new factor of disturbance arises, for by the pressure of an additional obstacle, in the shape of a remaining portion of the root of a deciduous tooth, the cuspid may be thrown out of its course, while a too rapid absorption of a deciduous root leaves the column of resistance broken, thus opening a new channel for the erupting tooth.

The position of its crypt above and in front of those of the lateral and bicuspid accounts for the most common form of irregularity, *i. e.*, being outside of the arch and above the other teeth. The tendency of the cusp is necessarily forward, because the combined force of the bicuspids and the first permanent molar from behind is greater than that of the lateral in front; hence the lateral is easily pushed out of place. Besides, the roots of all teeth naturally pointing backward would give it this tendency.

When in its normal position the cuspid pushes its way between the roots of the lateral and bicuspid, and thereby spreads the arch, giving it a parabolic outline and forming a key-stone; but when it remains outside of the arch, the expanded contour is lost and a pinched condition results in the shape of a V-shaped arch. The additional pressure of the cuspid upon the region of the lateral only increases this tendency. The cuspid when out of place is usually found above and outside of the lateral and bicuspid, this tendency being given by the position of its germ and its calcification being late as compared with other teeth. (Fig. 190.)

One or two cuspids may be found erupted in the palatal vault when there is a malposition of the germs. (Fig. 191.)

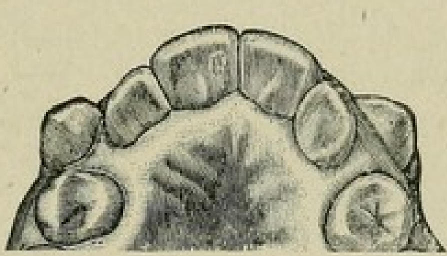

Fig. 190.

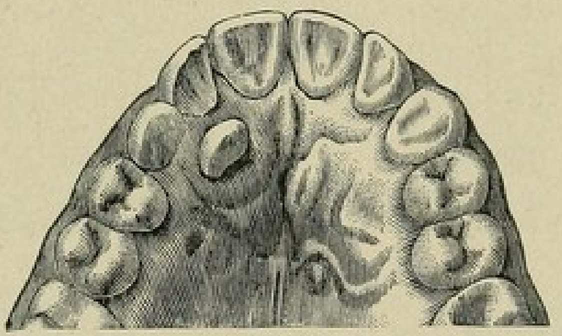

Fig. 191.

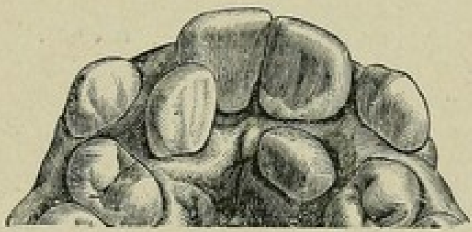

Fig. 192.

Occasionally it is found outside of the first bicuspid or between the first and second bicuspid, sometimes in front or anterior to the lateral. (Figs. 192 and 193.) Frequently it takes the place of the lateral. (Fig. 194.) Sometimes one cuspid is found in the palate while the other is on a line pointing inward. (Fig. 195.) When it comes through in this position the deciduous cuspid may still be in position, the first bicuspid having crowded forward to the lateral. (Fig. 196.) Occasionally when the cuspid is missing, the lateral will drop backward. (Fig. 197.) Its usual position when in the palate is inside the lateral incisor, but sometimes it is embedded in the hard pal-

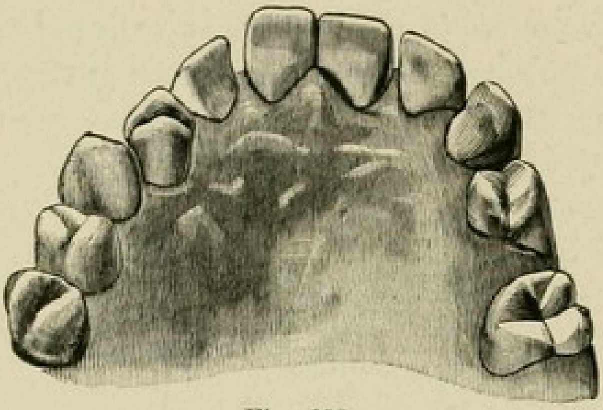

Fig. 193.

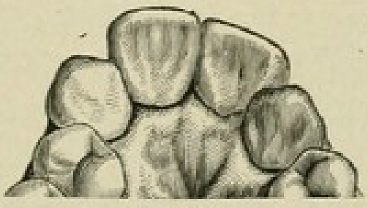

Fig. 194.

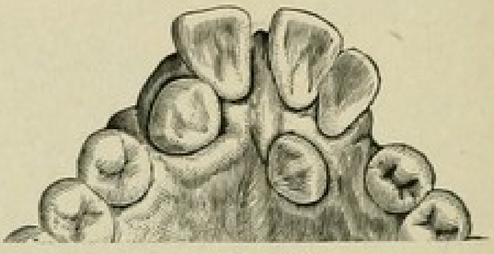

Fig. 195.

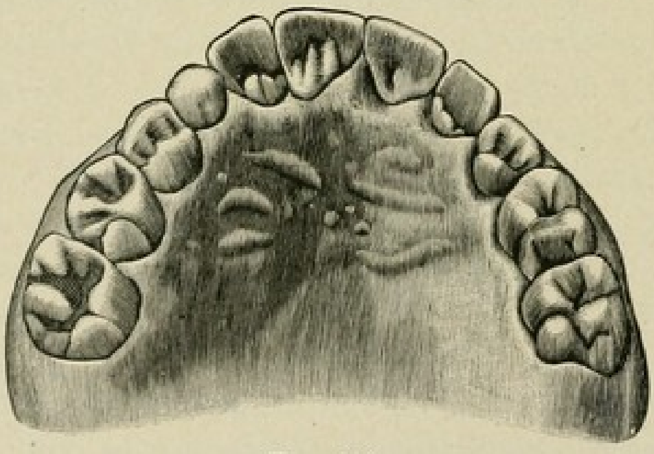

Fig. 196.

ate. A pinched condition in the bicuspid region necessarily results from such malposition, owing in part to the want of prominence of this tooth when in its normal position and in part to the inward pressure of the cuspid upon the bone-cells.

(Figs. 198 and 199.) When the cuspid moves out of position it does so at the expense of the first bicuspid and lateral incisor. The force may be so great as to push the lateral forward and through the alveolar process. When the cuspid is found in the roof of the mouth, or out of its normal position, the posterior column moves forward, filling the space usually occupied by the cuspid (Fig. 194), and the half of the arch of which this tooth is a member remains undeveloped. (Fig.

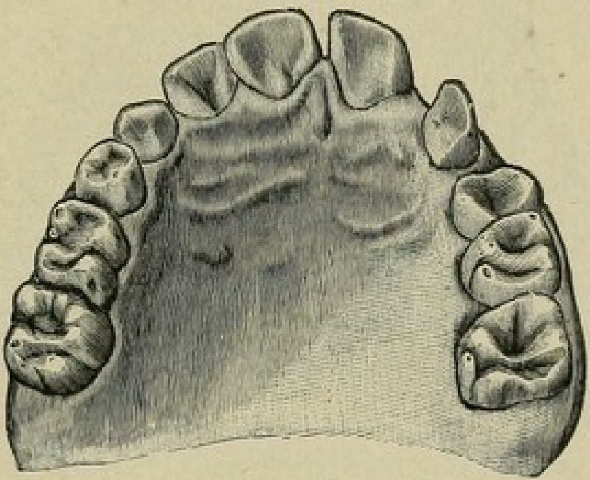

Fig. 197.

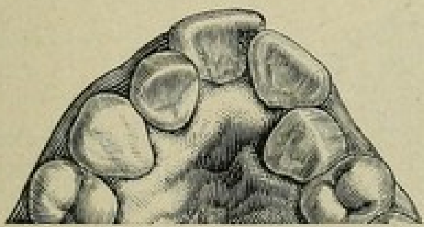

Fig. 198.

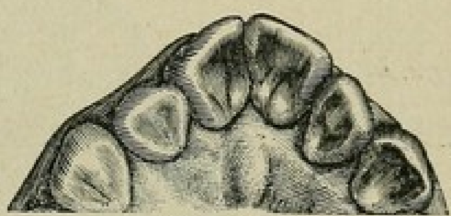

Fig. 199.

198.) If the cuspids erupt simultaneously the pressure exerted is uniform, and there is less liability to irregularity. One may erupt normally while the other may be abnormal in position.

IRREGULARITIES PRODUCED BY THE MALPOSITION OF BICUSPIDS.

The shape of the crown of the bicuspid particularly endangers it to irregularities of position. The antero-posterior diameter of its outer cusp is greater in proportion than that of the inner, having a wedge-shaped space on the palatal side.

This causes it to touch at one point the tooth in front and back of it, and makes rotation upon its axis easy. Irregularities are chiefly limited to the second bicuspid for reasons that become apparent when we consider their causes.

Like irregularities of other teeth, irregularities of bicus-

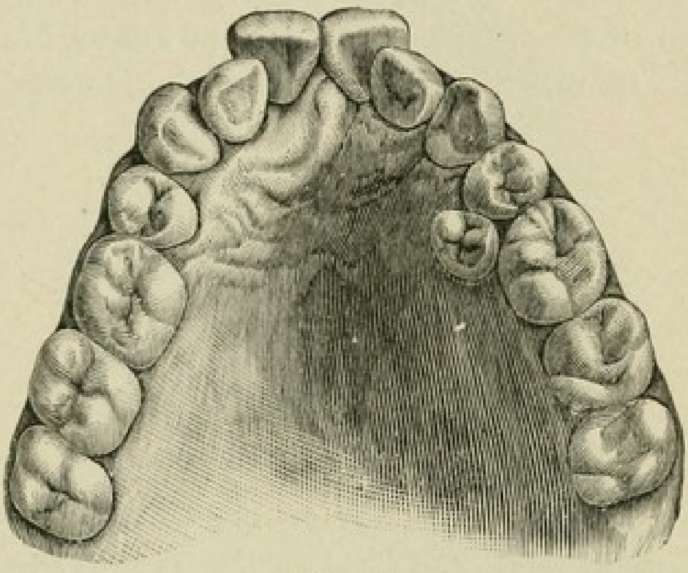

Fig. 200.

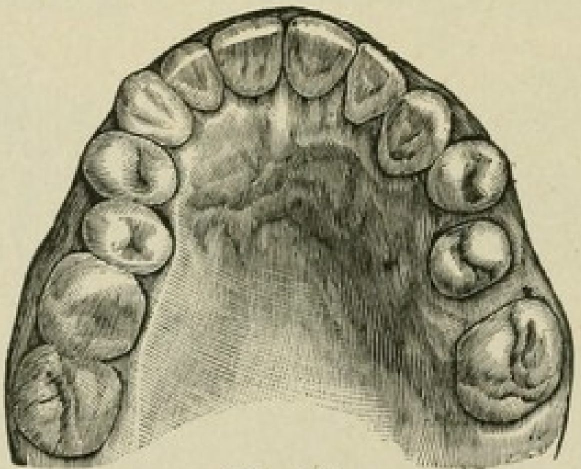

Fig. 201.

pids may arise from constitutional causes, *i. e.*, from a lack of accord between the size of the jaw and that of the teeth, or from local causes. The latter are frequent and come under the following heads: (1) Tardy eruption; (2) deflection due to the retention of temporary roots; (3) forward movement of the molars and (4) rotation from want of occlusion.

1. *Tardy eruption.*—The natural order of eruption is: first bicuspid; second bicuspid; cuspid. But this is disturbed occasionally, so that the first bicuspid is followed by the cuspid, thus pushing it backward. When there is a lack of space the second bicuspid must seek its way between the first bicuspid and the first permanent molar, and if there is a lack of room it is crowded outside or within the arch. (Fig. 200.)

2. *Deflection.*—When a temporary molar is retained too long, or its root is not absorbed as fast as the bicuspid is erupted, this obstacle may deflect the bicuspid or cause it to rotate more or less upon its axis, being favored by the spongy character of the alveolar process. (Fig. 201.)

3. The forward movement of the molars necessarily diminishes the space left for bicuspids and cuspids, and when the first bicuspid and cuspid erupt before the second bicuspid, this may be crowded out of its proper place.

4. A rotation of a bicuspid from a want of proper occlusion is not rare. An examination of the grinding surface of the bicuspid shows that it is designed to articulate with an opposing tooth. When its two cusps fail to find an opposing cusp to keep them in place its function is lost and its fixedness of position endangered.

Frequently more than one of these causes are at work, or one implies another. Thus, if there is accord between the size of the jaw and that of the teeth, some of the local causes cannot arise; the cuspid may erupt before the second bicuspid without disarranging the arch, and a bicuspid may be deflected by a deciduous root and ultimately move into place unless crowded upon by a six-year molar. Rotation may be the result of a crowded condition, throwing the tooth out of the arch when proper occlusion is out of the question.

As the first bicuspid erupts before the second, it has all the advantage of such space as there is. It may be crowded out of place by the forward movement of the six-year molar together with the premature eruption of the cuspid. Permanent deflection due to the retention of a deciduous root is out of the question when there is sufficient space, but rotation upon its axis from want of proper occlusion may occur here as elsewhere.

The posterior surface of the bicuspid touches the first cuspid only at one point, being an angle and not a surface, and this is a fruitful source of irregularity.

IRREGULARITIES OF THE TEETH PRODUCED BY THE EXTRACTION OF THE FIRST PERMANENT MOLAR.

Irregularities first attracted attention by the deformity they produced, not by their interference with function. Overcrowded anterior portions of the arch and displacement of individual teeth were noticed. A long time elapsed before the results of injudicious extraction were observed. Therefore the first permanent molar was ruthlessly destroyed until comparatively recent times, producing a large proportion of irregularities in the form of malocclusion. This loss of function is produced so gradually that the patient is not aware of it; he may notice inconvenience in mastication, but does not attribute it to the cause, as even persons of great intelligence know little about the occlusion of their teeth.

This tooth has been hitherto sacrificed for two reasons: (1) Its early decay, brought about by the tax upon the system of the growing child and the neglect from which the teeth suffer, particularly during the period of its development. The parent usually does not know of its existence until the child complains of toothache. (2) The tooth has been extracted to correct an overcrowded arch.

When removed to stop pain, the pain is indeed relieved by extraction, but has in its train many evils hereafter pointed out. When removed to correct a crowded arch, twice as much space is gained as desirable, and the crowded arch is not relieved, as the cuspid, because of the length and strength of its root, remains stationary, while the bicuspids move back singly or in pairs, leaving the position of the incisors unchanged. The disastrous effects of extracting the first molar become apparent when its function is understood. We cannot do better than give its fourfold function, as stated by

Dr. J. E. Cravens, of Indianapolis, in the annual of *Universal Medical Science* of 1888:

"The first permanent molar has four distinct functions: (1) To supply additional surface for mastication when development has progressed so that the deciduous molars, unaided, are no longer competent to meet the requirements of nature. (2) To support the crowns of the deciduous molars when they have become unstable, because of absorption of their roots to accommodate the advance of their immediate successors—the bicuspids—which are usually erupted between the ninth and the eleventh years. The deciduous molars begin to loosen six to twelve months before their final displacement. Should a permanent first molar be extracted early—say between the seventh and eighth years—the deciduous molars supported by it would loosen prematurely so as to be unserviceable for mastication, and perhaps be lost six to twelve months before the eruption of the succeeding bicuspids. (3) To guide the second bicuspid into position in event of a loss of this molar previous to eruption of the second bicuspid, the latter is liable to erupt back of its true position, or after erupting nominally to float backward along the ridge of the gum, inclining posteriorly, in such a manner as seriously to impair its effectiveness as a masticating organ. This is particularly the case in the inferior maxilla. (4) To induce additional development of the horizontal portion of the lower jaw, immediately anterior to the ramus, in order to make easier the eruption of the permanent second molar, and to prevent the well-known tendency of the latter to tip forward, thus weakening the support of its roots and impairing its value as a grinder.

"The first permanent molar is supposed by many observers to exercise an important influence in establishing a proper angle to the inferior maxilla. If such idea is correct (and several conditions indicate that it is), it adds possibly another to the already long and important list of the functions pertaining to this tooth."

The wholesale extraction of the first permanent molar in the past has, no doubt, caused arrest of development of the alveolar process as well as of the maxillary bones, for the process and jaws depend for their development largely on the function of the teeth, their articulation and their motion stimulating nutrition and enlarging the arch.

Some of the older dentists, whose skill is the result of routine rather than knowledge, are still to be found extracting four sound molars without the least thought of the consequences. Such a one, who was practicing in a southern parish not many years ago, was in the habit of taking out the first permanent molar in *every instance.* He said the result was "that all the people in that part of the country possessed good, regular teeth, and that an irregularity was the exception." The author has observed in many cases the want of development of the alveolar process, and sometimes the jaws, from the extraction of those teeth. This assertion is verified in those cases where the germ has not developed and the tooth is missing. More marked instances are those where three or four germs are wanting. The loss of a tooth performing such a work as the first permanent molar impairs mastication and produces vicious occlusion, and is detrimental to the contour of the face. When extracted before the second molar is erupted, one-half or more of the grinding surface of the teeth is lost.

The nutrition of the patient suffers in proportion, and health may be seriously impaired because of inability to masticate food properly.

The horizontal portion of the lower jaw will be but imperfectly developed, because function, one of the most important means of development, is lost and insufficient room is left for the second and third molars.

When a jaw with deciduous teeth is compared with one having permanent teeth, we notice a difference in the length of the rami and bodies, and a still greater difference in the angles. This difference results from the gradual separation near the angle, and is due to the growth of the molars. The arches of the permanent set are separated posteriorly by the eruption of the first permanent molar. When these molars are lost before the second molars are in place, the characteristic angle of the jaw becomes less marked. The loss of this molar on one side only will produce asymmetry of the two sides of the face, noticeable perhaps only to the trained eye, the parallelism of the two arches having been disturbed. If the two are lost early, the jaws approach each other more than normally near the angle, throwing the force of mastication forward. As the first and second bicuspids do not erupt until the tenth or eleventh year, and the deciduous molars loosen six to twelve months before they are displaced, the child is forced to masticate its food for several years on a portion of the arch designed for other purposes, compelling these teeth to perform the unnatural function of grinding. This confusion of functions produces but imperfect results and changes the outline of the face.

As the first permanent molar erupts it acts as a fixed point, separating and holding the jaws somewhat throughout their entire extent, in front as well, so as to make room for the growing incisors. The deciduous incisors, being very much shorter than the permanent ones, necessarily have a shorter bite. When the first permanent molar is lost the natural bite is shortened, for this molar acts as a force which lengthens the arches backward and also separates them vertically.

When this tooth is lost the lower permanent incisors as they develop strike with greater force against the upper and are carried forward. The change at first is imperceptible, but in the course of time these teeth will be found spreading more or less like a fan. Though the organic relation of the upper and lower jaw is not so apparent at first as that of other organs, and the two jaws seem to enjoy greater independence, proper occlusion is indispensable to their health, and the teeth in the lower arch are forced out of their sockets by a deposit of osseous material not consumed through proper function.

Naturally bicuspids tend to move forward because of the inclination of the root and the angle formed by the two jaws, which makes the teeth strike at an angle as well. This tendency usually prevents them from moving back, even if the

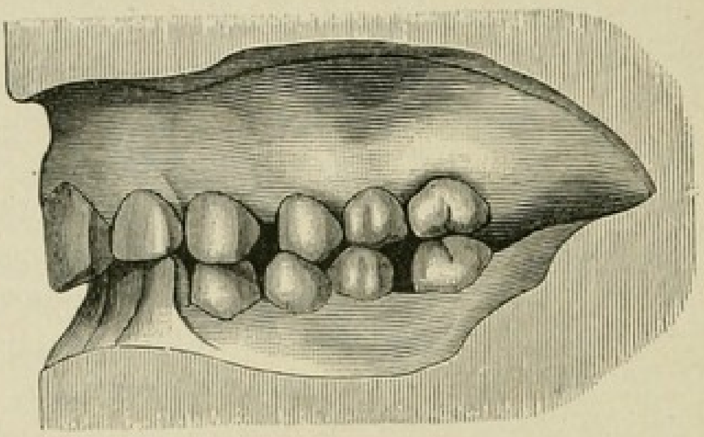

Fig. 202.

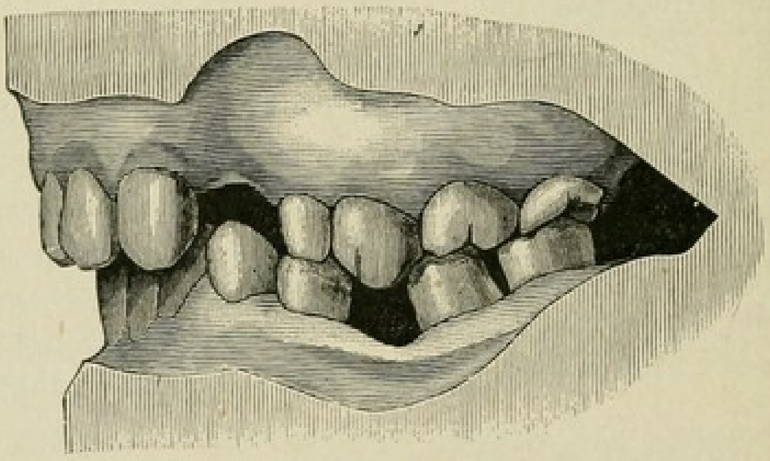

Fig. 203.

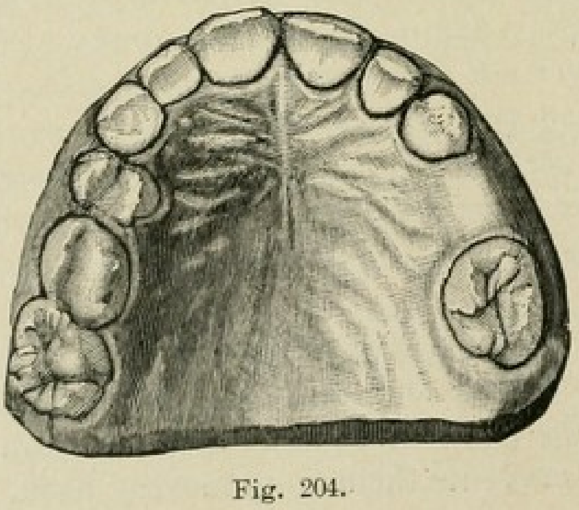

Fig. 204.

first molar is extracted. When the cusps are long they usually retain their natural articulation, but sometimes, as has been pointed out, they move backward. They may move back separately or may drop back together. (Fig. 202.) This dropping back destroys the articulation, causing the opposing teeth to strike only at certain points instead of bringing surfaces in contact, and frequently partial rotation upon their axes results.

The most ordinary result of the extraction of this tooth is the forward movement of the second and third molars (Fig. 203), causing these to tip forward and resulting in vicious articulation, as shown by Dr. Davenport in the *Dental Cosmos* of July, 1887. Externally the articulation may appear not to have suffered, but when it is examined inside of the arch, it is found that the opposing teeth meet only at certain points, becoming thereby partially useless. Fig. 204 shows the forward movement of the first permanent molar. The temporary molars on right side are in place, thus holding the first permanent molar in place; while on the left side the temporary molars have been extracted and the first molar has moved forward one-fourth inch. The force of mastication and the direction of the roots, together with the eruption of the second molar, increases this tendency.

Length of the rami, body, depth of sulci of the masticating surface and local peculiarities of the teeth in front, may so modify the occlusion as to result in bilateral asymmetry, and the degree of tipping forward may be quite unlike.

CHAPTER XXXIV.

LOCAL CAUSES OF IRREGULARITIES OF THE TEETH—LOWER JAW.

The upper and the lower jaw are quite distinct in character, function and course of development, however similar they may appear to be.

The upper when normal describes a portion of a larger circle, the teeth overlapping those of the lower. It is fixed, and depends for its function entirely on the activity of the lower. Owing to this immobility, when irregularities exist they are of a more marked constitutional type. Thus we have the various abnormal arches not seen in the lower; the high and narrow vault and the inward curvature of alveolar processes. It has a greater sweep of development, and consequently greater possibility of irregularity in its anterior columns, because these are unrestricted; while the lower is restrained by the overlapping of the upper teeth. The lower jaw is hung loosely, but firmly by its condyles, permitting motion in three directions—antero-posterior, vertical, and lateral.

In Fig. 205 the six anterior inferior incisors are shown. Observe that the points of contact are at their cutting edges, the mesial and distal surfaces being rounded, which enables them to crowd easily past each other when force is applied; the roots are flattened at their sides, so that when pressure is brought to bear upon them they move with readiness over a considerable distance. That the pressure cannot well be exerted in a straight line through the posterior column, and from thence extend in a curve through the anterior teeth, appears from the law of simple forces, which act in straight lines only. The cuspid, finding no resistance in front, but being resisted by the incisors slightly at the side, must necessarily pass forward. The lateral is too weak to afford resistance. Even if the centrals could be acted upon by the pressure from behind, they could be prevented from assuming a V-shape by the overlapping incisors above; for the more the upper arch is compressed laterally, and the mesial angle of the central is turned outward, the more will the distal angle be turned inward, and thus confine the lower incisors.

The lower incisors being narrower than the upper only favors this tendency. These conditions are necessarily modified by the local peculiarities of the upper arch, the relative strength of the teeth and the nature of the occlusion being all-important factors in determining final results.

Fig. 206 is a diagram of a normal lower maxilla. The line *a b* passes through the cuspids, bicuspids and molars, and shows the direction of the force exerted by the posterior col-

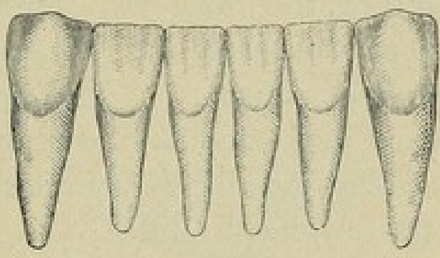

Fig. 205.

umn upon the anterior. For its growth it depends far more upon function than the upper. The growth of the lower jaw is limited to the posterior column, as has been mentioned, this being accomplished by the absorption of the anterior border of the rami, while bone-cells are deposited along its posterior border. Its freedom of motion is, however, retarded by the arch of the upper maxilla, for which reason irregularities are much rarer in the lower than the upper jaw, as the overlapping of the upper teeth tends to correct any predisposition to malarrangement.

Irregularities of this jaw result more from local causes than those of the upper maxilla, except those found in the underhung jaw. Its development depends largely on mastication. Owing to its movements there are fewer irregularities in this maxilla and the jaw is more apt to be normal. Irregularities back of the cuspid are very rare. Occasional contractions of the lower arch occur, such as dipping in, which is due to peculiarities of occlusion. When cases of irregularity exist they are generally found in mouths the lower arch of which exceeds the upper in diameter, thus permitting less firm interlocking and greater freedom of individual teeth.

When the diameter of the circle of the teeth of the lower jaw exceeds that of the upper, its lateral movement causes an enlargement of the upper circle by opening the median suture, this condition being indicated by the spreading of the superior central incisors. As has been shown in the chapter on migration of teeth, twisted bicuspids often result from entire want of occlusion or the touching of two opposing teeth at only one point. The most frequent form of irregularity is a crowding of the incisors. This is generally the case where the size of the teeth and the jaw are not in harmony, and is due to two causes: (1) The teeth of the lower jaw are forced inward by occlusion, the diameter of the circle of the upper teeth being usually the smaller; (2) The forward movement of the posterior column.

The two halves of the lower arch, like those of the upper, for obvious reasons do not present the same forms of irregularity. Like the upper jaw, the lower is subject to forward movement of the posterior column. A want of harmony in the development of upper and lower maxillæ produces a crowded condition of the lower arch, resulting in pressure upon the anterior column.

The direction of the roots of the lower molars greatly increases this tendency. When the crowns of the second and third molars are erupted the first molar is pushed forward. The pressure is exerted principally through the posterior column upon the cuspid, and is in a straight line. This tooth, by virtue of its rounded cusp, slips by the lateral and is projected forward often beyond the central incisors, leaving the lateral behind.

Like the upper maxillæ the two halves of the alveolar arch are separate, and are modified independently. An irregularity on one side by no means indicates a similar irregularity on the other, owing to the difference of pressure that may be exerted.

Fig. 207 shows the left dental arch normal, but the forward movement of the posterior column has caused the right

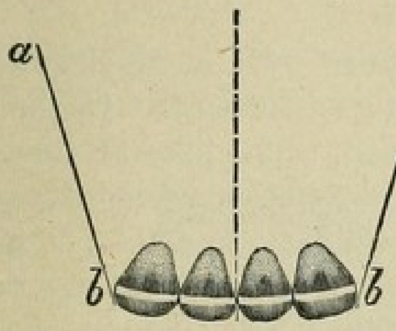

Fig. 206.

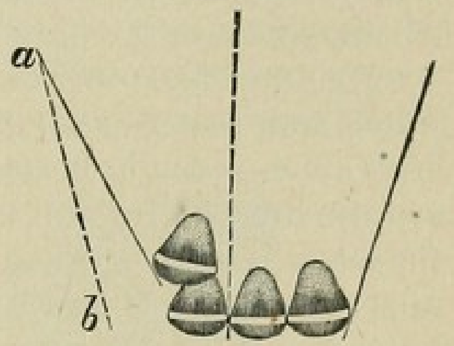

Fig. 207.

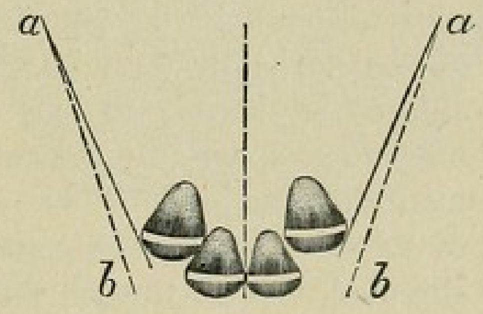

Fig. 208.

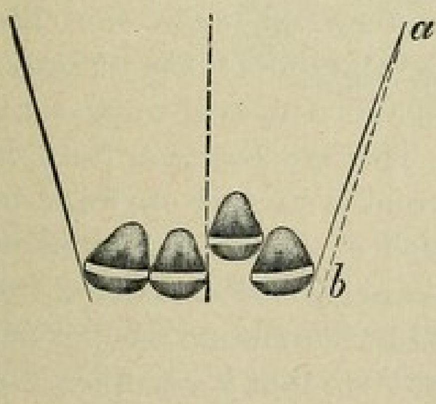

Fig. 209.

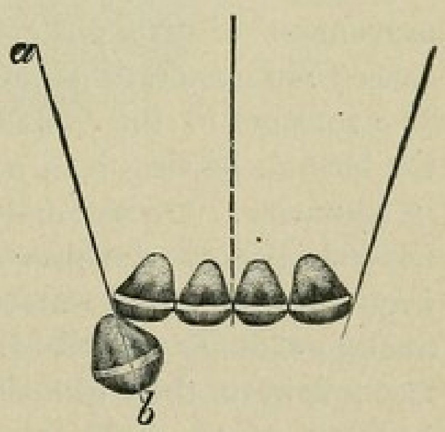

Fig. 210.

lateral to fall behind. As the two columns converge anteriorly they exert their pressure in this direction, in consequence of which we find irregularities of the lower jaw confined for the most part to the region of the incisors.

Though, as stated before, the laterals are generally pressed within, while the centrals occupy their usual position, these teeth may stand at various angles, which are determined by the local peculiarities of the teeth of the upper maxilla. Thus it may happen that a cuspid or a lateral may strike outside of its antagonist of the opposite jaw.

Fig. 208 illustrates a common form of irregularity, in which both posterior columns have moved forward. The laterals are crowded backward and inward. The lines of force are also directed inward, but a V-shaped arch is prevented by the lower centrals striking against the palatal surfaces of the upper centrals. If the cause of this form of irregularity is borne in mind it will be understood why the extraction of a lower lateral or central makes this form of irregularity still worse, inasmuch as it disarranges the occlusion of the cuspids.

In Fig. 209 we see the right dental arch normal. The left posterior column has pushed against the lateral, and meeting with sufficient resistance, the central is carried backward. While erupting, the central was carried inward, owing to a want of harmony of development. Two centrals have been found directed inward, though this form of irregularity is rare.

Fig. 210 shows the left dental arch normal. The forward movement of the posterior column on the right side has caused the cuspid to advance beyond the line of the incisors. The rotation of the cuspid upon its axis caused it to pass by the lateral, leaving it in position. This is a common form of irregularity. Occasionally the cuspid is carried forward in the direction of the pressure. Such a case is illustrated in Fig. 211. The left lateral has been carried inward in the manner already described. The posterior column has pushed the cuspid on the right side laterally so that it occupies the position of the right lateral, and the bicuspid is carried forward and outside of the arch.

THE INFERIOR CUSPID.

The cuspid erupts in line with the other anterior teeth unlike the upper, the crypt of which is above and outside of the lateral incisor and bicuspids. For this reason and the fact that the upper cuspid tends to keep it in position by occlusion, irregularities of the cuspid of the lower jaw are not so common as those of the upper. When the tooth is found out of line, it is anterior of its normal position,—rarely, if ever, posterior. Its eruption may be tardy, giving the advantage of time to the upper cuspid and directing the lower cuspid outward. In a crowded jaw a disarrangement of the

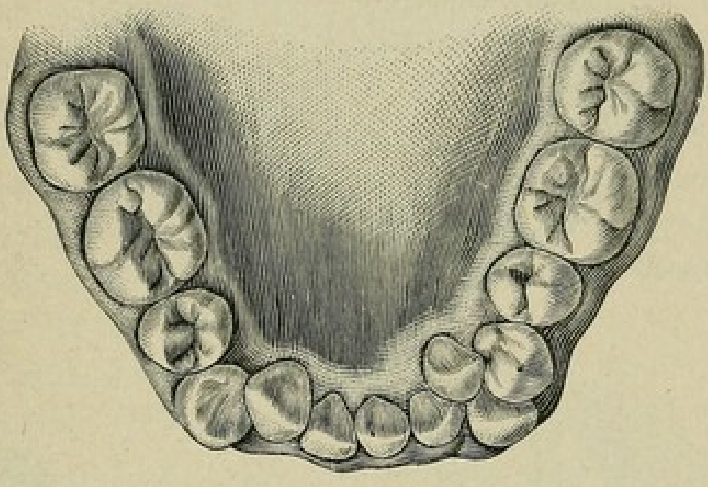

Fig. 211.

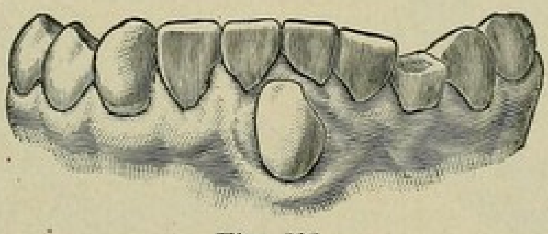

Fig. 212.

incisors may follow, leaving the lateral almost directly behind the cuspid, as in Fig. 211. When there is a malposition of the cuspid on one side of the maxilla, the cuspid of the opposite is usually pushed forward, as seen in the same illustration.

Owing to a malposition of the germ, the cuspid may be found outside of the incisors in the median line (Fig. 212), or even inside of the arch (Fig. 213). Rarely it is found on the median line between the incisors, as shown in this illustration.

LOWER BICUSPIDS.

Like the cuspid; the position of the bicuspid is most frequently affected by the forward movement of the posterior columns. An irregularity in a lateral direction is rare, since the density of the lower maxilla is unfavorable to this.

Whenever a bicuspid is found without or within the arch, it is due to the undue retention of the temporary teeth.

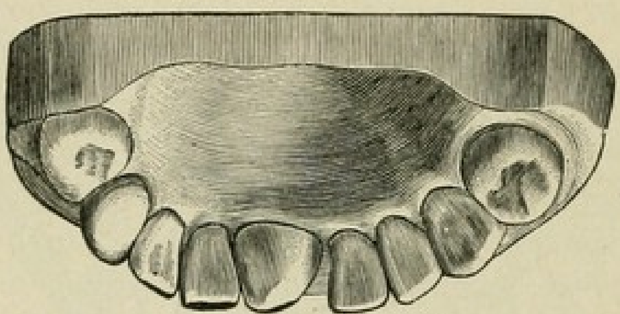

Fig. 213.

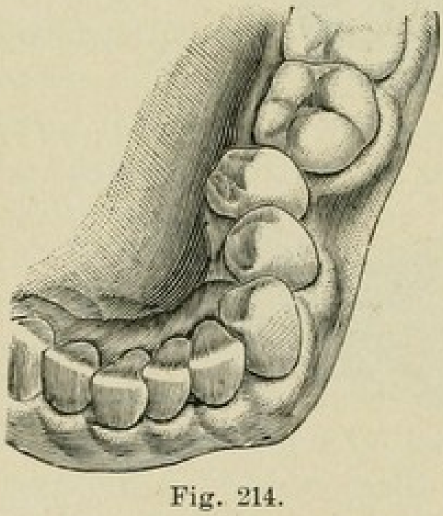

Fig. 214.

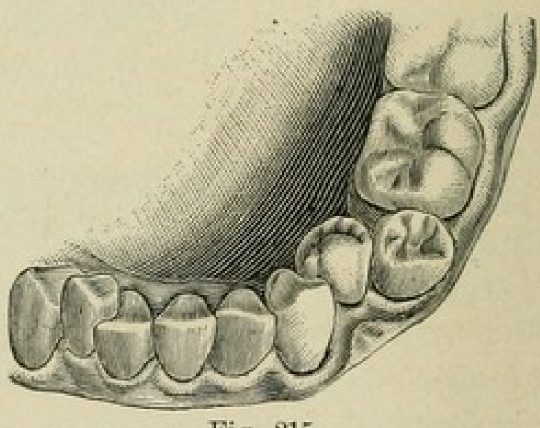

Fig. 215.

Fig. 214 shows the second bicuspid situated inside the arch, while Fig. 215 shows the first bicuspid inside and the second bicuspid outside of the arch. Twisted bicuspids occur frequently from a want of proper occlusion, when the space yielded by the lower jaw is larger than that of the upper, or when the first molar is extracted.

When the second temporary molar is retained too long, the first permanent molar may be pushed forward, thus confining the bicuspid and preventing it from erupting.

MIGRATION OF TEETH.

That teeth move when acted upon by some external force is known to every practitioner, and is utilized in his operations by producing temporary separations, in regulating and the like. Why they should move from their normal position without any apparent cause is not so easy to explain, and theories have been recently advanced to account for this. It is obvious that when the arch of the alveolar process is greater than that of the combined diameters of the teeth, there must be a space or spaces somewhere. This space is usually equally distributed among the anterior teeth. Sometimes, however, spaces are found that disfigure the mouth, and besides these we find occasionally one or more teeth that appear to have rotated upon their axes. An inquiry into these forms of motion is the province of this chapter.

This subject is best considered under two heads: (A) Perfect occlusion; (B) proper relation between waste and repairs.

(A) If the occlusion of the teeth is perfect, so that each tooth is kept in place by its adjoining neighbors and the opposing tooth, dislodgment is impossible. All teeth should touch those adjoining them at the extremities of their greatest diameter. This allows a slight lateral motion.

Good occlusion differs according to the function of different teeth. Their shapes indicate this. The upper and lower incisors overlap each other, producing what is termed the *overbite*. In the normal relation they strike in a straight line, which passes through their roots. The curved lingual surface of the upper incisors allows for their sliding into this position. The force being thus exerted in straight lines, there is a constant tendency to keep them in position, and as the pressure upward and downward is vertical, spreading of the upper incisors is impossible. The relation of cuspids is similar. Quite otherwise with bicuspids and molars. Beginning with the bicuspids, we find the cusps of the first superior bicuspid striking not over that of the first lower bicuspid alone, but over the angles formed by the distal side of the first lower and mesial side of the second. Each tooth beginning at this point is not only in relation to one below, but to two, and when one of these teeth is extracted the order of the mouth is disturbed, and a rearrangement of some kind usually follows. What this will be depends on a variety of circumstances.

A typical example is furnished by the extraction of the first molar. Every practitioner has observed the forward movement of the second molar as a consequence. A tilting forward of this tooth results. The reason for this is obvious when we remember that the posterior cusp of the first upper molar strikes the anterior cusp of the second lower and exerts

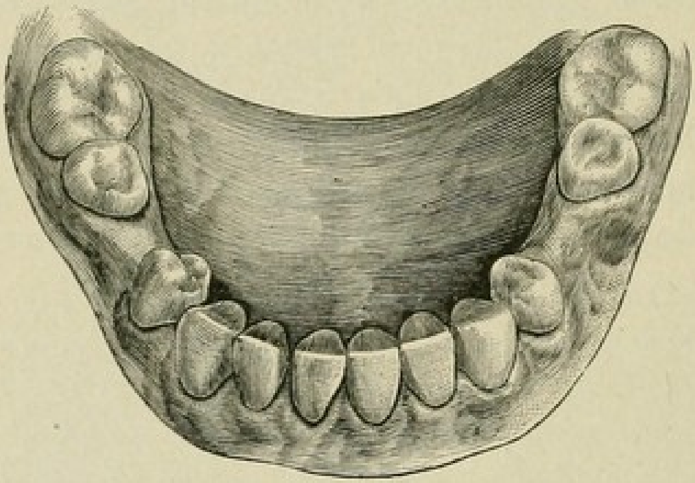

Fig. 465.

its whole force, which was meant to be distributed on both cusps, on it.

(B) The position of the teethis not determined alone by the relative size of the maxillæ and the occlusion of the teeth. Nutrition and absorption, waste and repair, play an important part. On the perfect harmony of these the beauty and health of the teeth depend. Changes in the position and removal of bone-cells go on constantly and vary with the age and other physical conditions of the patient. This disposition and removal of bone-cells is seen in the changes that the lower maxillæ undergo during different periods of life. When the deciduous teeth are replaced by the permanent ones, the arch of the jaw becomes more pronounced, and there is a lengthening of the alveolar ridge backward to accommodate the molars. When the senile changes take place the angle of the jaw becomes more obtuse. That there is a similar adjustment to circumstances going on constantly is proven by circumstances. Correction of irregularities depends on this. The position of the teeth in the alveoli is determined solely by the tissues around it. By producing a pressure in a given direction, bone-cells may be removed on one side and others deposited on the other and the position of the tooth changed. The change in the deposit and removal of osseous matter is not unlike that of the deposit of particles of earth in the bed of a river where stakes have been placed for the purpose of locating the bed of the river. By the successive deposit and removal of these particles the position of these may be changed and even the current of the river. This illustration may help to make clear changes in the contour and density of the alveolar processes depending on the changes of blood-supply and absorption. Irritation may thus stimulate the activity of the capillaries to a more than ordinary degree of repair.

Every tooth exerts a pressure of its own in different directions. Were this not so it would be difficult to account for the elongation of a tooth when its opponent is extracted. This pressure is healthy and implies the antagonism of opposing teeth. If this occlusion is wanting, the relation of waste and repair is disturbed. An excess of bone-cells is often deposited as a result.

When these two fundamental laws of good occlusion and balanced waste and repair are violated one of the three following conditions may follow:

1. The movement of individual teeth in straight lines.

2. The rotation of individual teeth upon their axes.

3. The forward movement of groups of teeth and the alveolar processes supporting them.

THE MOVEMENT OF INDIVIDUAL TEETH IN STRAIGHT LINES.

It was stated above that when the alveolar processes and teeth correspond in size and the occlusion is good, that spaces between the teeth are out of the question. Sometimes a space is found between the central incisors. If the occlusion is good otherwise, this space is due to a continuance of growth at the margin of the suture—*i. e.*, there is a greater deposit of osseous material than is needed, producing a larger diameter of the jaw than the teeth. This begins usually at an early period in life, and continues till the growth of the osseous system has ceased. As the jaw develops in the child while the temporary teeth remain, it is but natural that spaces should be formed in time until the permanent teeth take their place.

Spaces may be artificially created in time by forcible separation by means of wedges. In former years, when more force was applied by dentists, irritation was created, and absorption on one side induced. In this way several teeth were sometimes crowded in one direction. When the anterior incisors do not strike on a line, but at an angle, so that the cutting-edges of the lower incisors strike against the inclined plane of the lingual surface of the upper incisors, an outward pressure is exerted and the incisors separate. The spaces that are so frequently seen in the permanent incisors in children are in many cases produced by the tardy eruption of the cuspids. When the cuspids come down into place these spaces disappear. Spaces are rarely if ever observed between molars.

Again, the lower jaw, if too large for the upper jaw, may act as a wedge, and by striking against it may spread the central suture. The spaces between these teeth are usually found to be healthy. It is not reasonable to suppose that either salivary or germinal calculus or inflamed gums could produce this motion. Were the pressure exerted on one side only there might appear to be some ground for this supposition, providing calculus exerted a pressure too great for the rest of the teeth to resist. But when calculus is deposited on both sides the pressure exerted would be counterbalanced and lateral motion could not take place. Those who hold this opinion are probably misled by the fact that a tooth may be dislodged by calculus from its socket vertically. But this is in accordance with mechanical principles. In this case the calculus diminishes the diameter of the socket, and the wedge-shaped root is forced out.

ROTATION OF INDIVIDUAL TEETH UPON THEIR AXES.

When a tooth touches its opposites only at one point, or the opposing tooth was extracted, as it frequently happens with bicuspids, instead of articulating with surfaces, rotation may result. In this case bone-cells are deposited on one side, while those at an angle with these are removed. This produces a slight rotation which twists the tooth. That this process is physiological, is proven by the healthy state of the gums and alveolus which is found in most of these cases. Fig. 216 not only shows the rotary motion to the bicuspids, but also spontaneous motion in direct lines—a condition frequently observed by the author.

THE FORWARD MOVEMENT OF GROUPS OF TEETH AND THE ALVEOLAR PROCESS SUPPORTING THEM.

In young persons, when the blood supply is rich with nutritious material, and when waste and repair go on rapidly, the four and sometimes six anterior teeth and alveolar processes are carried forward. This proper occlusion with the inferior incisors becomes impossible, and these become elongated, and, failing to find a support in the upper incisors, strike against the roof of the mouth. Irritation is produced and an excessive flow of blood to the parts follows. Thus we have:

ANTERIOR PROTRUSIONS FROM CONSTITUTIONAL AND LOCAL CAUSES.

One of the most interesting forms of irregularity is that in which the inferior incisors impinge upon the mucous membrane of the roof of the mouth and the superior centrals, laterals, cuspids and bicuspids, having moved forward, project to such an extent that the upper lip cannot close over them. It should be observed:

1. That these cases are not confined to normal individu-

als, but are found among idiots, deaf and dumb, blind, demented and insane.

2. The deformity is not seen in temporary teeth, but is confined to the permanent set, beginning at the seventh or eight year and increasing with age. When not corrected the teeth will finally project at an obtuse angle, as is illustrated by a case of a woman fifty-five or sixty years of age that came to our notice, whose teeth projected almost horizontally.

3. The vault connected with this irregularity is usually low, though sometimes high, in which case it is more pronounced; just as V and saddle-shaped arches are more pronounced when associated with a high vault.

4. The irregularity begins at the central incisors, extending backward.

5. Generally later in life tartar collects around the roots, and Riggs' disease sets in, exaggerating the condition.

6. In the majority of cases the superior maxilla is arrested, and the teeth project at an angle of 20°, carrying the alveolar process with them, in order that they may strike over the lower incisors.

Dr. Kingsley, who first described this form of irregularity, is right in his statement that this condition is neither inherited nor the result of thumb-sucking. The conditions under which this irregularity is brought about are both constitutional and local. It should be noticed that the excessive proliferation of bone-cells does not begin before the sixth or seventh year, hence not until the permanent teeth are erupted. A want of balance of nervous function, resulting from neurotic conditions or a transmitted tendency to disease, may interfere with the centers of ossification, which interference, as has been shown, frequently finds expression in the anterior part of the mouth, sometimes producing a high vault, contracted arches, excessive or deficient deposition of bone-cells. The conditions are mostly confined to neurotics and degenerates. An excessive proliferation of bone-cells near the median line of the superior alveolar process tilts the axes of the erupting centrals slightly outward. This direction once being given to them, when the lower incisors strike against them they do not find the resistance of correct occlusion, but act upon them as upon an inclined plane, throwing them out more and more during the process of eruption. This must necessarily terminate in striking the process itself; increased activity of nutrition which irritation sets up, resulting in excessive development, which also shows stigmata of degeneracy. The tilting forward of the upper incisors increases the distance between them, and the lower incisors do not find the resistance belonging to natural function. The consequence is the

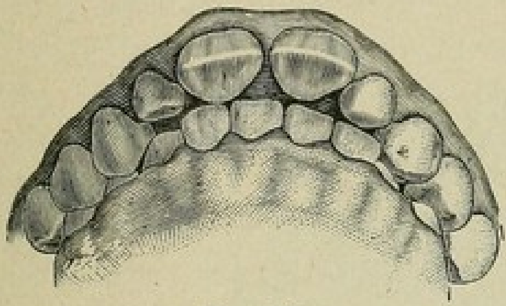

Fig. 217.

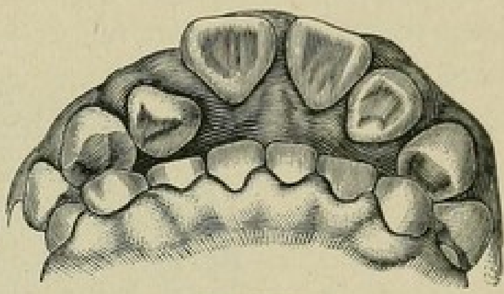

Fig. 218.

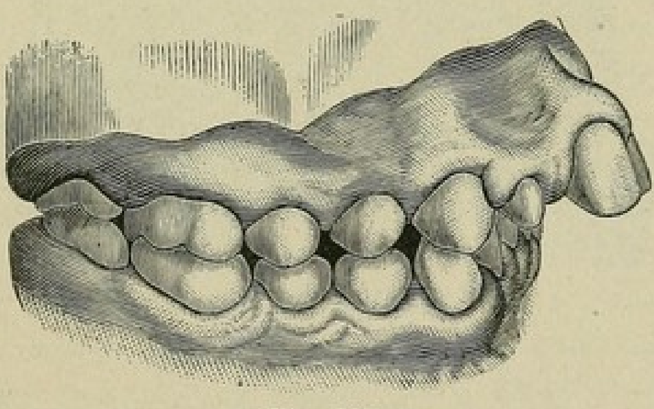

Fig. 219.

elongation of the lower anterior alveolar arch, a circumstance to be noted in these cases. The eruption of the first permanent molars determines the relation of the jaws to each other; occasionally they do not develop their full length. In either case the lower incisors strike against the mucous membrane of the roof of the mouth, which constant irritation stimulates the deposition of the bone-cells in the process, as if nature would defend it against the abnormal pressure of the lower teeth. Were the occlusion correct, the constant pressure on the roots of the teeth would doubtless, in part, counterbalance the excessive deposit by waste. As it is, the roots of the upper incisors form an angle with the cutting-edge of the lower teeth, and as the mouth opens and closes, the force of the lower incisors is not only spent on the superior process, but also through it on the roots of the upper teeth, forcing them out more and more. Fig. 217 shows the starting-point. The central incisors have just commenced to move forward. The model is from the mouth of a girl eleven years of age. The trouble is extended to the neighboring teeth from the

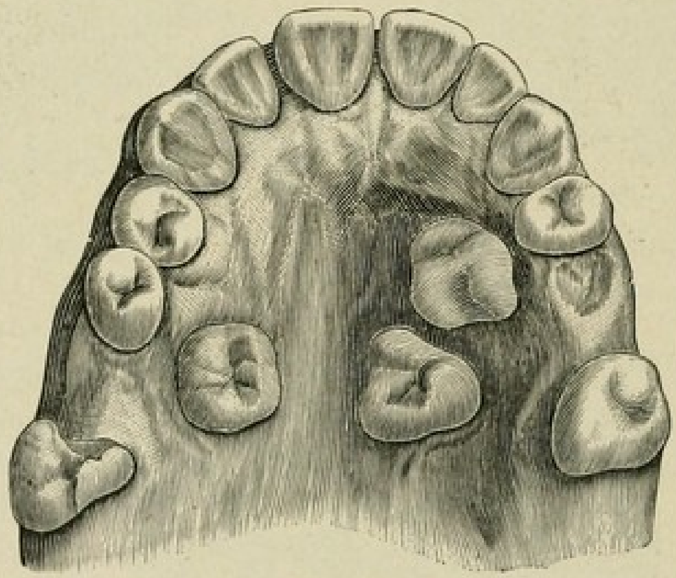

Fig. 220.

nature of the occlusion. Fig. 218 shows the incisors and alveolar process carried forward by the excessive deposition of bone-cells. By the action of the lower lip, which cannot close over the cutting-edges of the upper teeth, but soon gets between the superior and inferior incisors, the former are pressed out still more. Fig. 219 shows a side view of this form of irregularities. Fig. 220 illustrates a remarkable case of migration of the molars.

Want of function encourages a deposit of tartar around the roots of the teeth, inducing Riggs' disease later in life and loosening the teeth.

CHAPTER XXXV.

SUPERNUMERARY TEETH.

Supernumerary teeth are a freak of nature, for which no cause has, as yet, been assigned. It may, of course, be stated that additional germs were formed during fœtal life, but this is no true explanation, for the question still arises, "What caused these?"

Plants put forth adventitious buds and show monstrosities in all their organs; animals are not always developed according to the law of their species; the human race shows monstrosities in every organ. It is therefore not to be wondered at that we see additional teeth. They were noticed by the earliest writers on dentistry, even before Christ. There is no doubt that what the public calls a double row of teeth is often merely malposition of the regular number, and that many a supernumerary tooth, when well formed, escapes notice. It is best, before making a statement in doubtful cases as to the class to which the supernumerary tooth belongs to take an impression; then it can be studied and compared with the rest at leisure.

Deviation from the normal number is more marked in the permanent than in the temporary set. Little mention has been made of deviations in number in the deciduous set, because more rare, and because the deciduous teeth have less individuality than the permanent ones, which would cause an additional tooth to escape notice. The author has come across four cases in his practice of supernumerary laterals in deciduous teeth. Three of these cases presented a supplemental lateral on the right side (Fig. 221); the fourth had them on both sides. It is interesting to notice that the excess was found mostly on the right side, for the reason that greater development of organs on the right side, including the jaw, have hitherto been ascribed to more frequent use. As the germs of the temporary teeth are formed before birth, this theory cannot stand in this instance at least.

When we come to the permanent teeth we find a distinction between cases presenting merely a variation in number and those showing malformed supernumerary teeth. These may be considered under the heads of supplemental teeth and monstrosities. The former are like normal teeth, and it is difficult to distinguish them from these. The contour of the latter, like that of all monstrosities, is governed apparently by no law, excepting a want of definiteness. However, the

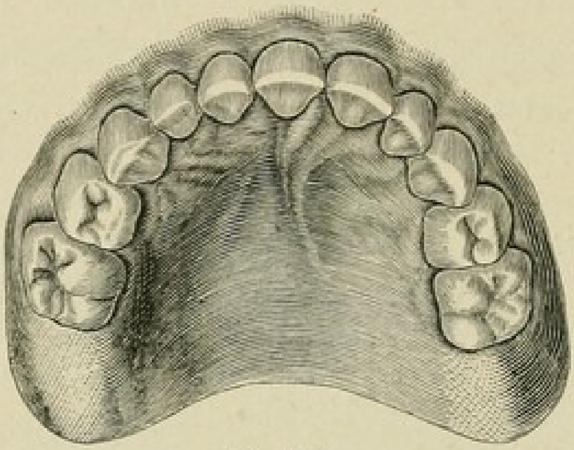

Fig. 221.

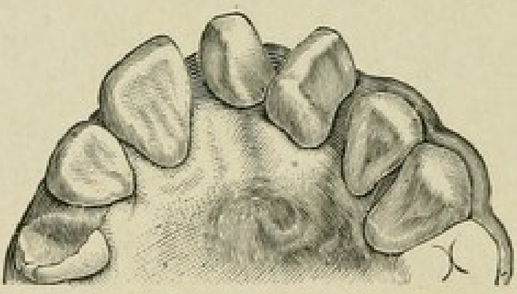

Fig. 222.

root is conical and the crown may be lobed or have the appearance of having been partially folded or poorly formed.

Adventitious teeth are more frequently found in the upper jaw than in the lower. It is a rare thing to find a well-formed supernumerary central incisor. The author has a cast showing five equally well-formed incisors in the lower jaw. Whether the supernumerary tooth is a central or lateral cannot be determined by the form. Coleman records a case having four well-formed central incisors in the upper jaw.

Partially developed additional incisors are not rare. These teeth are found at different angles. They are seen erupting behind the arch, in front of it, or between two other teeth. Fig. 222 shows a conical tooth between two ill-shaped centrals, one of which stands almost at right angles with the

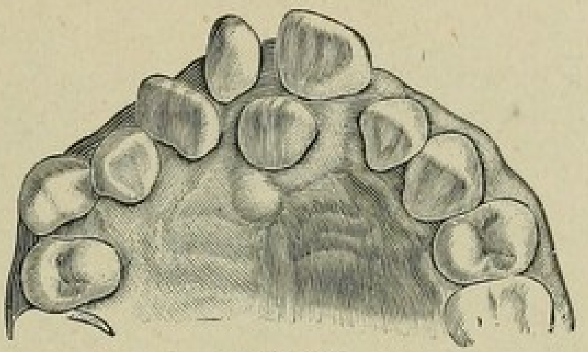

Fig. 223.

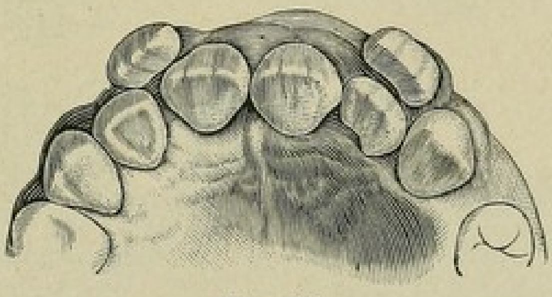

Fig. 224.

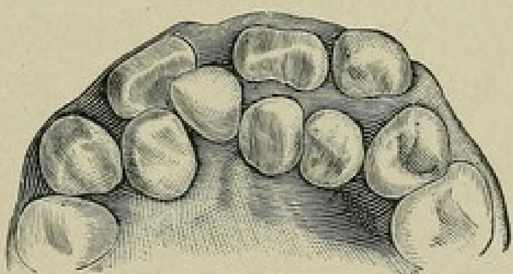

Fig. 225.

arch. Another case still more interesting (Fig. 223) has two central monstrosities separating the legitimate centrals. Fig. 224 shows two supernumerary centrals, having the appearance of being convoluted, between the usual centrals. In Fig. 225 we see two supernumerary central teeth between the laterals, all of which are placed inside the regular arch.

Laterals in excess are not so common as centrals. These are usually more like the normal teeth. Sometimes they are found on both sides. Fig. 226 shows a lateral behind the arch and between the central and the lateral. In the lower jaw they are rare.

In Fig. 227 one of the supernumerary laterals is placed back

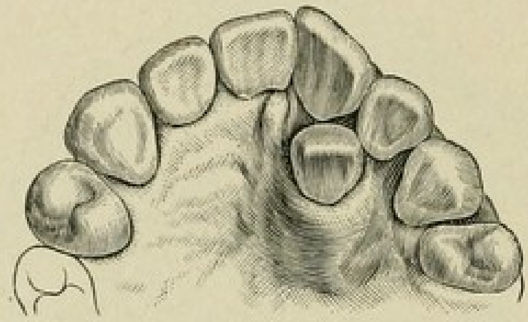

Fig. 226.

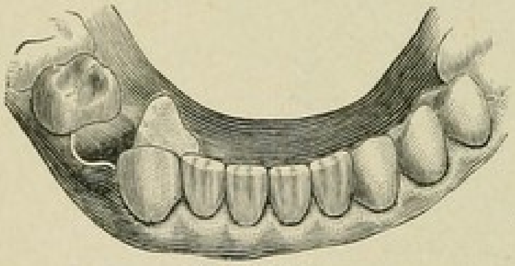

Fig. 227.

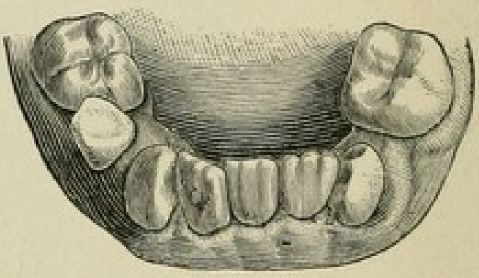

Fig. 228.

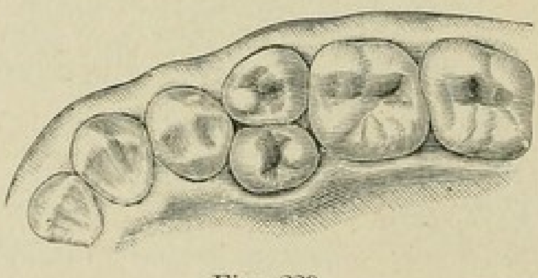

Fig. 229.

of the right cuspid and at right angles with it. The author has two models similar to this in his collection. Cuspids, bicuspids and molars are not often found in excess.

Fig. 228 shows a supernumerary cuspid, twisted upon its axis on the right side of inferior maxilla. The right lateral is missing and the cuspid is, no doubt, a malformed lateral, although it has the appearance of a perfect cuspid. In Fig. 229 we see a dental anomaly to which attention is directed by Dr. Rickey, of San Francisco. In this case it is difficult to say which is the supernumerary tooth. Fig. 230 shows four well-formed molars in each side.

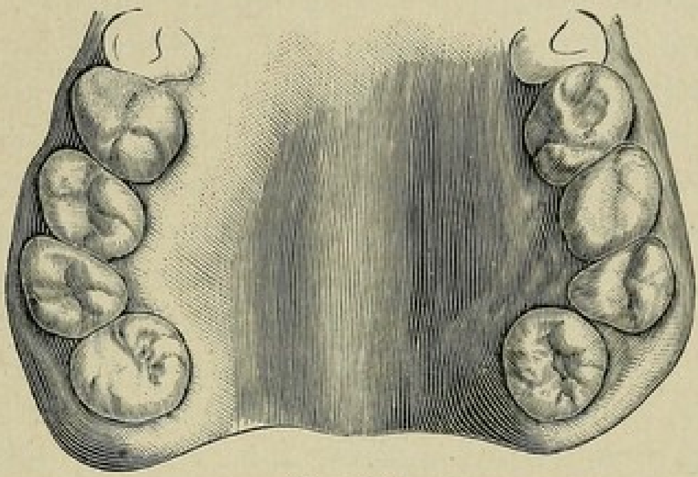

Fig. 230.

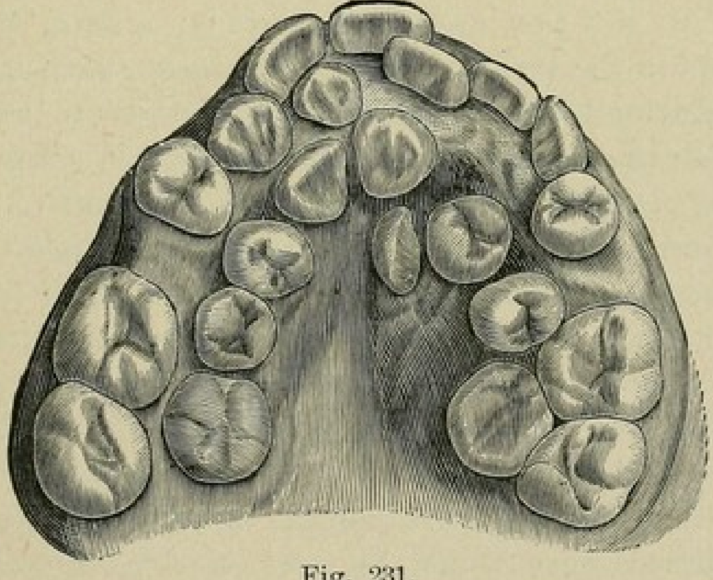

Fig. 231.

Fig. 231 illustrates a very rare case of supernumerary teeth, eight in all. They do not seem to be confined to any one class—incisors, cuspids and bicuspids seem to be duplicated. This cut certainly illustrates a double set of teeth. The model is in the Pennsylvania College of Dental Surgery.

CHAPTER XXXVI.

MISSING TEETH.

That teeth are frequently missing is observed by every practitioner of dentistry. It is often difficult to decide whether the germ ever formed or the tooth is simply imbedded in the alveolar process. Because the crown of the tooth is not in position is no sign that it did not develop. The order in which the teeth are more liable to develop and become imbedded in the jaws, as observed by the author, are *first*, cuspids; *second*, third molars, and *third*, bicuspids. There are good reasons for this—the fact that the order and manner of development of all the teeth, and the development of the jaws, reduce the space for the advancement of the cuspid, bicuspid, and third molars, thus causing difficulty for their eruption.

The teeth which most frequently develop and become imbedded in the jaw are *first*, cuspids; *second*, bicuspids. This is due to the fact that owing to the forward movement of the posterior teeth or other causes, the germs become dislodged from the natural position and point in another direction, thus becoming entangled between the roots of the teeth anterior and posterior, and in this way are unable to erupt into the mouth. The teeth whose germs are most frequently undeveloped are *first*, third molars, and *second*, lateral incisors. The author cannot account for this want of development in any other way than that it is the result of stigmata of degeneracy. Some time ago, out of 670 examinations forty-six per cent of missing third molars, and fourteen per cent of missing laterals were found. In most cases the missing molars were upon the upper jaw and upon both sides, while the missing laterals were always upon the upper jaw, and in most cases only upon one side.

At the time of the examinations, it occurred to the author that it was a very large percentage, but since that time and while making further observations, he is confident that they are always found in neurotics and degenerates, and that the reason of such a large percentage is due to the fact that my practice is made up largely of people who require special treatment. It would be impossible to say that all of these germs did not develop, or that they did and the teeth became imbedded in the jaw for reasons already stated. For our purpose, it makes no difference in either case, the cause is arrest of development, the one of the germs, the other of the jaw, and both are due to the same cause--neurosis or degeneracy.

CHAPTER XXXVII.

THUMB AND FINGER-SUCKING.

In the chapter on refutation of old theories regarding the etiology of irregularities of the jaws and teeth, the author has stated his reasons why the high vault and the V and saddle-shaped arches cannot be ascribed indiscriminately to thumb-sucking, as has been the custom.

Hitherto the greatest confusion of ideas has been current among practitioners as to the etiological differentiation of these cases. It behooves the author to describe the conditions that are due to thumb-sucking in such a way that the student may be aided in making a diagnosis. In cases of irregularities due to thumb-sucking we find several teeth and the alveolar process brought forward. Frequently spaces are found between them, so that they stand out more and more fan-shaped. The vault may be high, but is usually low like that seen in Fig. 234. The teeth are frequently affected only on one side, the shape and extent depending upon the direction of the force and the hand employed in sucking. In the V-shaped arch the teeth are crowded and point toward the center, owing to a force applied by the posterior column and spent on both halves toward the median line. The vault may or may not be arched. In the saddle-shaped arch the teeth are crowded, except in cases due to hypertrophy, and they stand perpendicular. The vault may be high or low. In cases of thumb-sucking, the teeth of the inferior maxilla do not articulate properly with the upper, and are often turned inward, which is caused by the pressure of the thumb upon the cutting-edges. We see from this that the distinguishing feature of a case of thumb-sucking is the spreading of all or a part of the anterior teeth, and that the lower teeth are usually turned inward.

When the vault is high, it is quite marked in the anterior portion of the roof of the mouth; but this is by no means a characteristic feature. As the habit of thumb-sucking usually terminates before the eruption of the permanent teeth, cases of irregularities resulting from thumb-sucking in children over ten years of age are rare. (It will be of interest to the student to note a number of cases that have come under the observation of the author.)

Babies usually commence to suck their fingers within a few hours after birth,—in the majority of cases not later than the first week. The habit is therefore well fixed before the temporary teeth begin to erupt. This being the case, the teeth and the alveolar process are naturally affected in their development if the pressure is continuous. The extent, shape and location of the irregularity depends upon the hand employed and the position of the thumb and finger used. The right or left side are affected according to the hand used, though occasionally we find it in the median line.

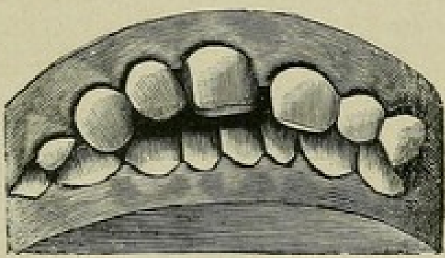

Fig. 232.

As the child usually discontinues the habit before the time of the eruption of the permanent teeth, deformities produced by thumb-sucking are usually confined to the temporary set.

Fig. 232 shows the forward movement of the right central and lateral incisor. The model was taken from an impression of the teeth of a little girl two and a half years of age. While in the act of sucking, the right arm rested upon the breast, and the ball of the thumb was directed against the palatine surfaces of the incisors, which were carried forward. The child discontinued the habit at four. It will be observed that while the cutting-edges of the teeth have been slightly pressed forward, and a very slight impression has been made on the alveolar process, none was made on the roots of the teeth, and consequently no deformity exists where the germs of the permanent teeth are located. After the child discontinued the habit, the teeth soon returned to their natural position, aided by the pressure from the lip. At this age the absorption and deposition of bone-cells is so active that very marked deformities are frequently corrected before the temporary teeth are lost, providing that the habit ceases in infancy.

Fig. 233 shows quite a different deformity. Here we see the teeth fully developed, but a marked deformity existing at the median line. This case is that of a child six years of age. The thumb was held in the mouth so that the teeth came in contact with the thumb at right angles, preventing the development of the alveolar process. The teeth of the

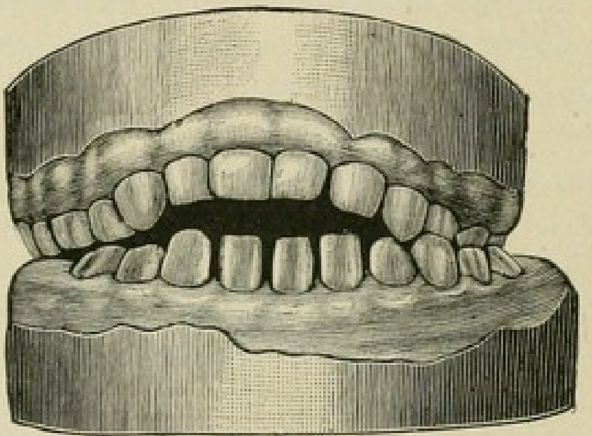

Fig. 233.

inferior maxilla do not articulate properly with those of the superior, which is caused by the thumb having rotated upon the lower teeth after the upper had closed upon them. The hard palate was flat and normal, showing that the pressure was direct upon the teeth, and that the thumb did not come in contact with the tissues of the mouth. When the habit is continued during the development of the permanent set, the deformity is more marked, because there is more leverage, as is shown in Fig. 234. This is a case in which the palate is flat and normal, showing that the pressure was direct upon the teeth, and that the thumb did not come in contact with the tissues of the mouth. The superior jaw and teeth are brought forward by absorption and deposition of bone-cells, and the lower teeth and jaw are carried inward.

These cases are so unlike those of any other form of irregularity of the permanent set that it would seem impossible to overlook the cause. The alveolar process and teeth assume the shape of the object or thing sucked.

Fig. 235 shows the front view of a case of thumb-sucking. The teeth have developed their normal length; but arrest of

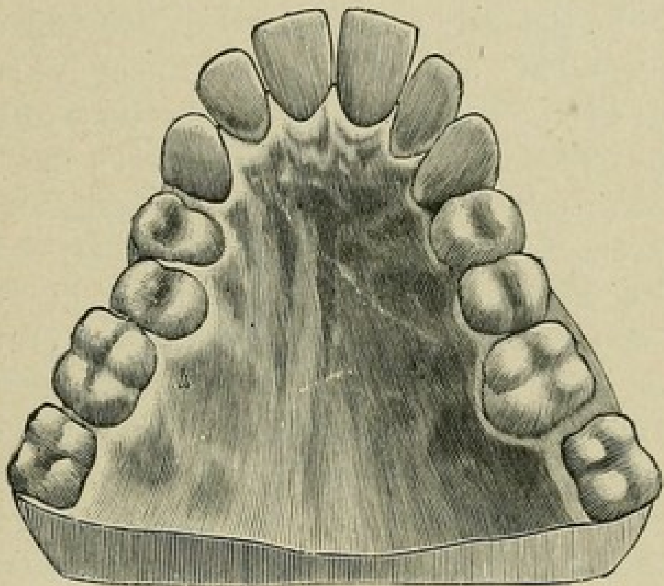

Fig. 234.

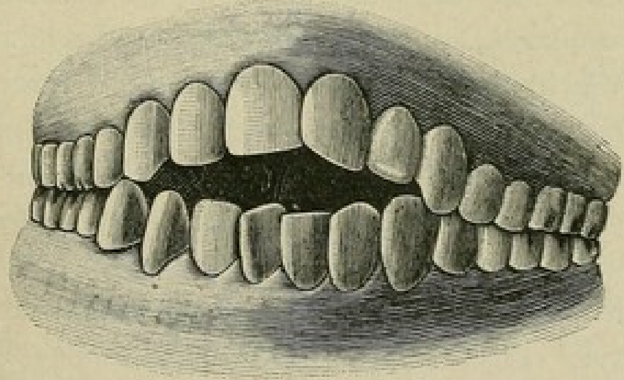

Fig. 235.

development of the superior alveolar process has taken place similar to Fig. 233. In Fig. 235 there has been quite a protrusion and forward movement of superior incisors and alveolar process, the teeth standing fan-shaped. The lower incisors are pressed inward and crowded together. The space is greater on the right side than on the left, showing that the right hand was used.

CHAPTER XXXVIII.

CONCLUSIONS.

The various influences which are brought to bear upon the present races of the earth which result in neuroses of degeneracy, in excessive and arrested development of the osseous system, have been discussed. Excessive and arrested development of the osseous system may be a direct inheritance. The children will possess structures similar to those of one or both parents, as when a child inherits an upper jaw from one parent and a lower jaw from the other, or inherits the jaws from one parent and the teeth from the other. Again, in a family of five children, four may inherit the jaws and teeth of the father, and the fifth the jaws and teeth of the mother. A neurotic brain may be transmitted which presides over the development of the osseous system, and thus occurs excessive or arrested development in the natural growth of the osseous system. It is a singular fact, there seems to be a tendency for neurotic individuals to seek each other's society. Hence the large number of literary societies which are being formed throughout the country, entertainments and social gatherings at which brilliant men and women are to be found. These individuals not only seek each other's society, but marriages are the rule among them. As a result children are born, who, if they live, in many cases become geniuses or possess unbounded egotism. They may become idiotic, deaf and dumb, blind, or late in life, insane, criminals or drunkards. Dr. Bannister,* after citing several instances in which the degenerate intermarried, expresses the opinion that such marriages constitute a potent factor in the perpetuation of neuroses. Similar opinions are expressed by Dr. J. G. Kiernan † from observations of similar cases. He refers the degeneracy of genius to this factor. Genius attracts abnormal females as lighthouses do birds. Dr. Manning ‡ has found

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* *American Lancet*, Vol. VII.
† *Neurological Review*, Vol. I.; *Alienist and Neurologist*, Vol. XIII.
‡ *Australian Medical Gazette*, 1885.

that the peculiar sympathy which the neurotics have for each other often results in marriage. The peculiarities of persons who visit their wives and husbands in insane hospitals are most remarkable, and it sometimes happens that the apparently least insane member of the family is under care, while the seemingly most pronounced lunatic is at large. Nesbit,* from his studies on genius, forms the conclusion that neuropaths seem to be drawn to each other. The most remarkable illustration of this fondness of neurotics for each other is demonstrated in the Keeley hospital at Dwight, Illinois. Here are seen men of all professions, trades and occupations, mingling together in the most social manner. It will also account for the large number of "gold clubs" which are being organized in different parts of the country. This sociability and affection are carried to the extent that, in most cases, cards are exchanged as tokens of remembrance and for the purpose of correspondence.

Such marriages as are here mentioned are great factors in the production of a class of people whom we might expect to be not only deficient in mental stability, but also in their osseous system. Reasoning from this standpoint we would naturally expect to find an increase in abnormalities in older countries, where heredity is more concentrated. Thus, we would expect to find more deformities in people living in New England than in the West; a still larger percentage in England and Europe than in New England. Extending our investigations still further we would expect to find more neuroses and degeneracy among the nobility of Europe than among the middle and lower classes. Mr. Cartwright recognized the fact when he said that "Irregularity is common in most highly civilized communities, and especially so among the upper and middle classes." In accounting for the condition, he says that it is the result of high and selective breeding, and supports his position by illustration of the results of high breeding among animals.

The comparison of uniting families, whether of nobility

* Insanity of Genius, p. 325.

or otherwise, to the selective breeding of animals is not fully justified. In the one case, especially that of royal families, physical and mental conditions are rarely taken into consideration. The main point is the retention of position and rank socially and financially. The physical conditions are almost entirely ignored; the result is that neuroses and degeneracy have penetrated every household, stamping themselves not only upon the osseous, but all the different systems of the human body. This, then, is selective breeding involving position and wealth. On the other hand, selective breeding of animals applies to their physical condition; "low breeding" instead of "high breeding" would be a preferable term.

In families where neuroses and stigmata of degeneracy have been handed down for a number of generations, the deformities seem to be more markedly defined, and a large number result in one individual. This accounts for the larger number of criminals and paupers in Europe than in this country, and the more marked deformities of the head, face, and jaws, as illustrated by Tarnowsky and Lombroso in their books, and in the magnificent exhibit of criminal anthropology by M. Bertillon at the World's Fair. When such cases are found they are usually of foreign birth. Deformities of the jaws seem to be more easily recognized than deformities of other bones, because the least deviation in the one or the other is observed, owing to their close proximity and the occlusion of the teeth. Deformities of the teeth are also very readily noticed. Adenoid growths, polypi, hypertrophy and atrophy of the bones and mucous membrane of the nose are more common among neurotics and degenerates, and the conclusion must be that they are the result, first, of an unbalanced nerve function, producing unstable blood-supply, and second, of an unbalanced bony framework. Tarnowsky and other scientists make quite a point of the atavistic characters of one or two teeth. We must not lose sight of the fact, however, that many teeth deformities are due to local causes, and, therefore, are not stigmata of degeneracy. Elsewhere irregularities of the teeth have been classified into constitutional and local. There is quite a difference between the two varieties. The constitutional variety always involves the jaw bone, develops with the osseous system, and are stigmata of degeneracy. The local irregularities (one, two or three teeth involved) are due to local causes, such as improper eruption, early or later extraction of the temporary teeth. They should not be considered in a diagnosis in connection with neuroses or degeneracy. The author agrees *in toto* with Dr. Alice Sollier, that "dental anomalies are very common in degenerates," and would go still further and include neurotics.

The loss of the third molar and lateral incisor and deformities of the teeth are certainly signs of degeneracy, and are always noticed in arrest of development of the bones of the face and jaws. Many cases occur in which degeneracy is stamped upon the face, while the teeth and alveolar process are normal. The teeth of both jaws erupt and crowd their way into a normal position, thus showing that the jaws and teeth are regular, but the depression from the alæ of the nose upward is quite deformed. In the eruption of the teeth nature asserts her rights and comes to the rescue. With all these conditions grouped under the two heads—neuroses and degeneracy—it is not strange that they should crop out in some form in nearly every family. Hence, inherited conditions will destroy many families in the fourth to the sixth generation.

From the study and comparison of the face, as illustrated in the chapter on "Deformities of the Face" (with the pictures and descriptions in chapter upon "Development of the Face"), it is evident in every instance there is arrest of development at some period in the evolution to the sixth year.

Fig. 54 shows arrest at the bridge of the nose, while all other bones developed their normal size. This is the earliest arrest that could take place. Fig. 55 shows arrest still later in life, and so on until we reach Fig. 60. Arrest of the lower jaw may also take place at any period in its development. All these conditions not only show arrest at some period in the early life of the child, but also show atavism, since these faces are found in many of the different races, such as the negro, Javanese, Bedouins, Esquimaux, and some tribes of Indians, as illustrated in Fig. 6.

The fact has also been demonstrated that a person with a constitutional disease producing arrest of development of the jaws and facial bones may transmit them to his offspring, who inherit qualities which are acquired in the parent.

Nothing has been said in regard to hereditary taint, such as disease, deformities, etc., becoming aborted in the offspring as a result of marriage. Such is frequently the case, but as this condition in no way enters into the subject under discussion, it will be dismissed with this brief mention.

Great stress has been laid upon the excessive development of the lower jaw by some physiognomists, in that it denotes strength and firmness of character, while my experience is that very little can be determined by it alone. Other signs must be taken into consideration before one can decide upon character by the size and shape of the lower jaw. The lower jaw is formed independent of the other bones of the head, and movable; it develops normally or is arrested. If excessively developed or arrested, it is just as liable to denote mental weakness as strength of character. This leads to the discussion of the reason why criminals, prostitutes, drunkards, and in fact, all degenerates, possess stigmata. It should be remembered that degeneracy may lightly touch an organism or deeply affect it. The fact that stigmata of degeneracy in a light degree are often found among otherwise apparently normal persons, indicates that environment has much to do with the progress of development of degeneracy. Whether stigmata, as has been shown in children, are inherited or are the result of constitutional disease, they should equally receive constant attention of their parents, and should be surrounded with all the healthy comforts and influences of home life. Their associates should be carefully selected until they have attained maturity, or until their character is fixed. With this early careful attention from parents there would be fewer criminals, fewer drunkards, prostitutes and paupers in our charitable and correctional institutions.

CHAPTER XXXIX.

EXPLANATION OF PLATES.

Plates 1 to 6 are lithographic illustrations of the upper jaws of boys from an orphan asylum, ranging from six to twelve years of age. They are drawn from casts of the mouths taken as they were sent into the office of the institution by the superintendent, regardless of condition, the only point taken into consideration being the age. The object of these illustrations is to show the progress of the development of the second teeth, their relations to the temporary ones and also to the jaw. Notice the date, manner and formation of the normal V and saddle-shaped arches and their modifications.

Plates 7 to 17 show the shape of the teeth, alveolar process, and vault at the median line of the above cases.

Plates 8 to 18 show the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of the above cases.

Plates 19 and 21 illustrate the shape of the teeth, alveolar process and vault at the median line, of twelve brachycephalic white adults. (For measurements of these cases see pages 344 to 347.)

Plates 20 and 22 illustrate the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar, of twelve brachycephalic white adults.

Plates 23 and 25 show the shape of the teeth, alveolar process and vault at the median line, of twelve mesocephalic white adults.

Plates 24 and 26 show the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molars of twelve mesocephalic white adults.

Plate 27 shows the shape of the teeth, alveolar process and vault at a median line of six dolichocephalic white adults.

Plate 28 shows the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of six dolichocephalic white adults.

Plate 29 shows the shape of the teeth, alveolar process and the vault at the median line of six brachycephalic colored adults.

Plate 30 shows the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of six brachycephalic colored adults.

Plate 31 shows the shape of the teeth, alveolar process and vault at the median line of six mesocephalic colored adults.

Plate 32 shows the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of six mesocephalic colored adults.

Plate 33 shows the shape of the teeth, alveolar process and vault at the median line of six dolichocephalic colored adults.

Plate 34 shows the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of six dolichocephalic colored adults.

Plate 35 illustrates the shape of the teeth, alveolar process and vault at the median line of six V-shaped vaults of white adults.

Plate 36 illustrates the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molars of six V-shaped vaults of white adults.

Plate 37 illustrates the shape of the teeth, alveolar process and vault at the median line of six semi-V-shaped vaults of white adults.

Plate 38 illustrates the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molars of six semi-V-shaped vaults of white adults.

Plate 39 illustrates the shape of the teeth, alveolar process and vault at the median line of six saddle-shaped vaults of white adults.

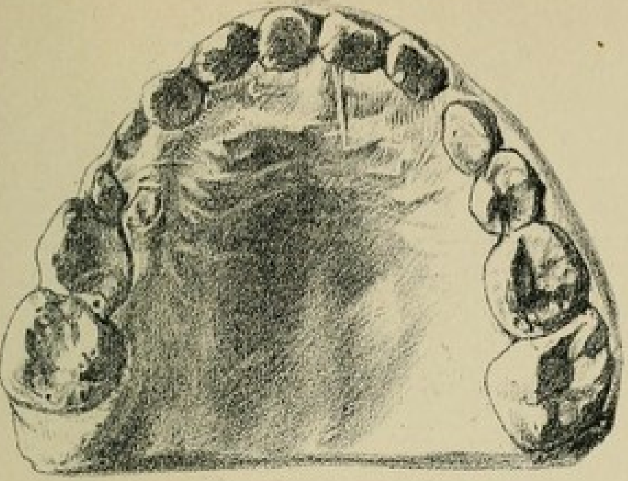
Plate 40 illustrates the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molars of six saddle-shaped vaults of white adults.

Plate 41 illustrates the shape of the teeth, alveolar process and vault at the median line of six semi-saddle shaped vaults of white adults.

Plate 42 illustrates the shape of the teeth, alveolar process and vault at a line drawn laterally anterior to the first permanent molar of six semi-saddle vaults of white adults.

PLATE 1

6 YEARS.



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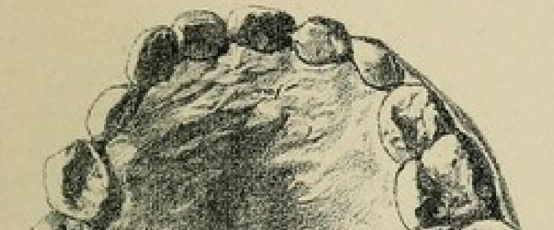

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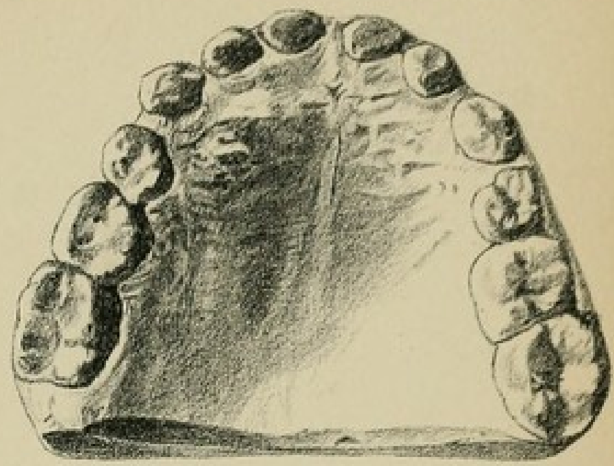
3

7 YEARS.



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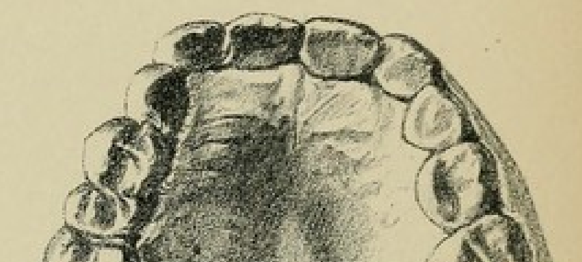

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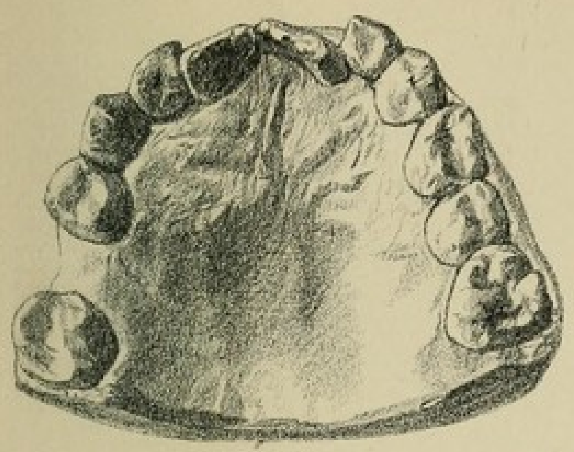
PLATE 2

8 YEARS.



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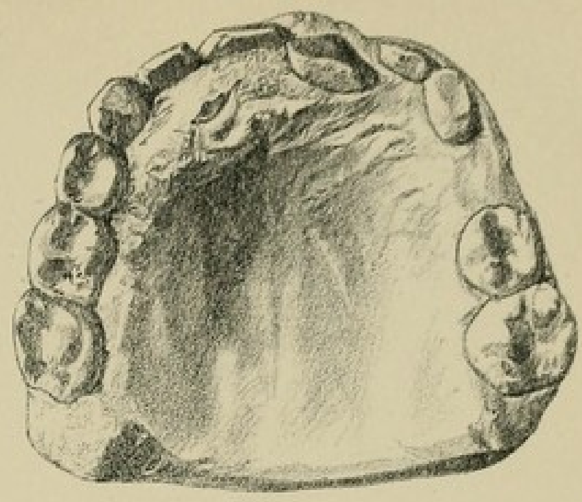

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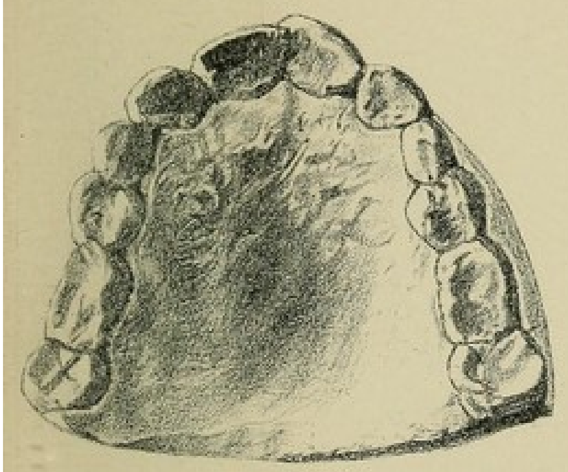

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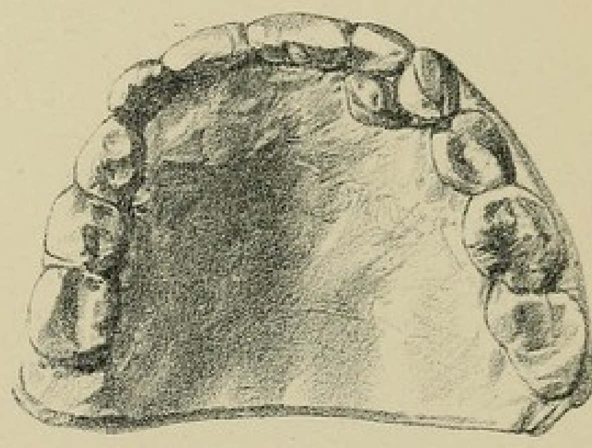

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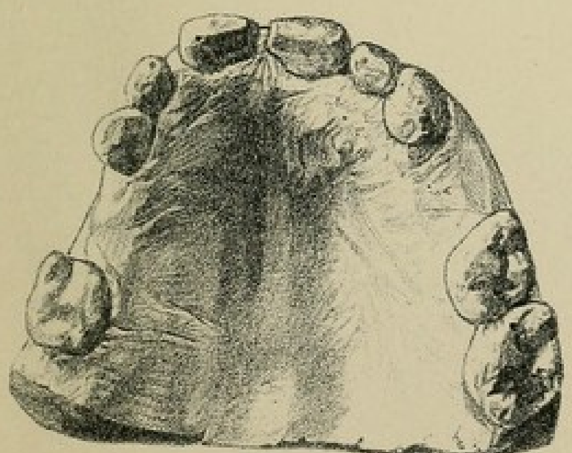

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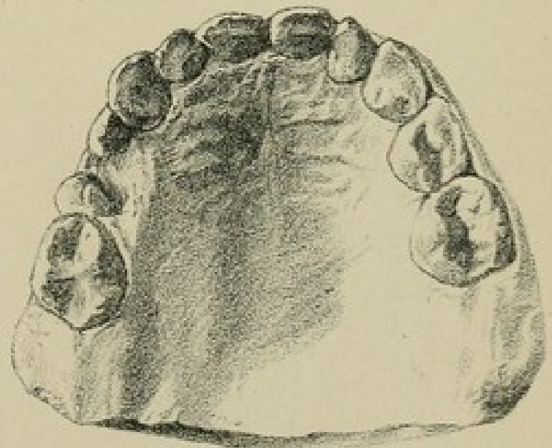

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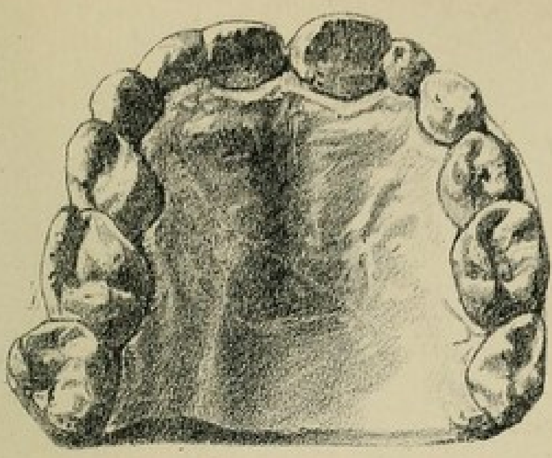
PLATE 3

9 YEARS.



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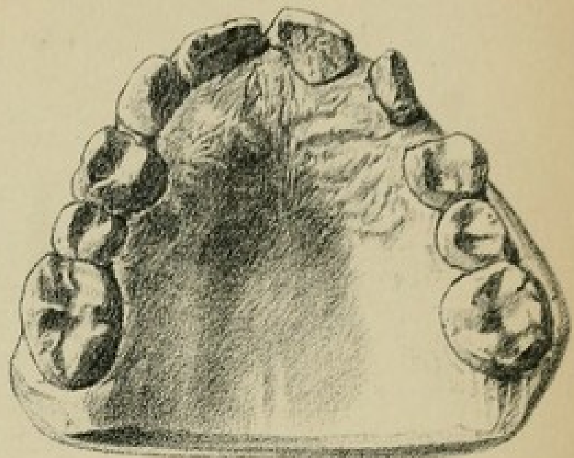

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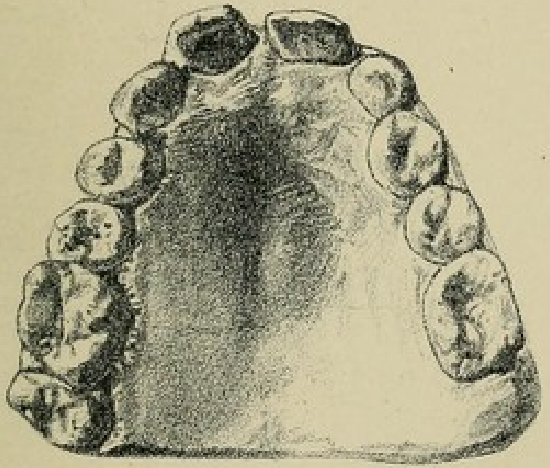

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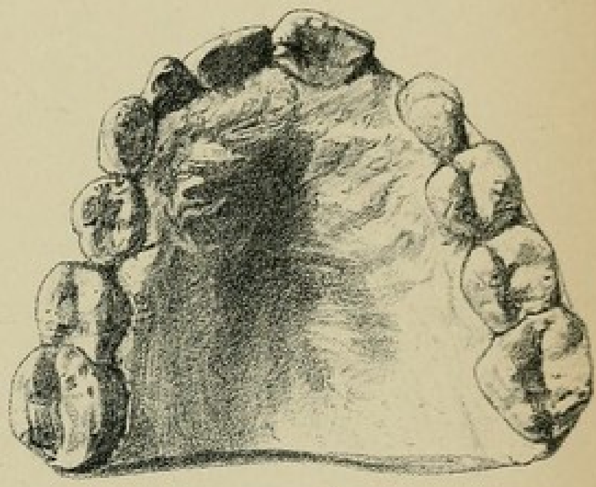

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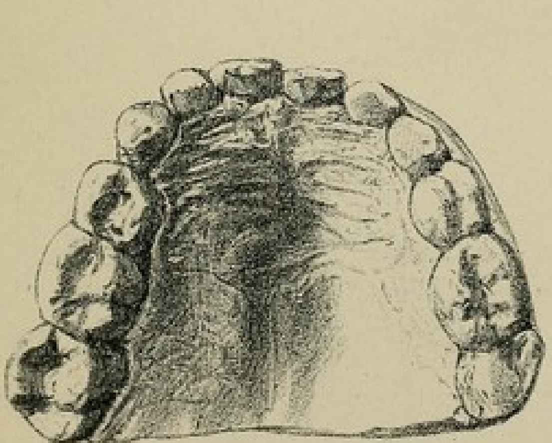

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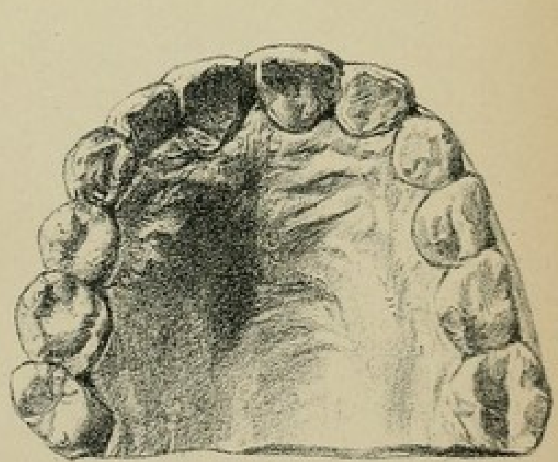

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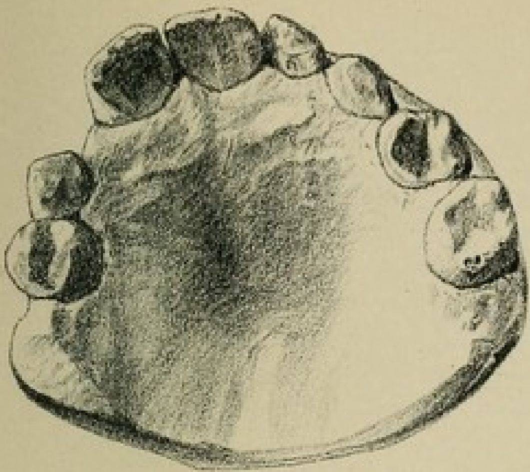
PLATE 4

10 YEARS.



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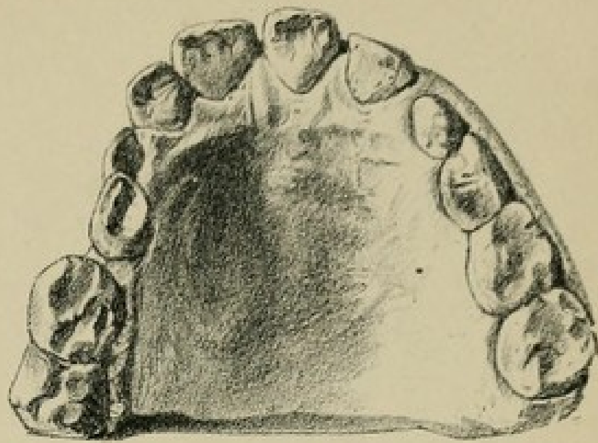

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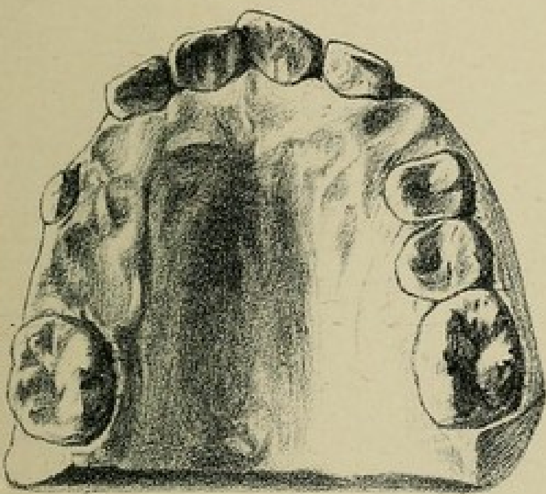

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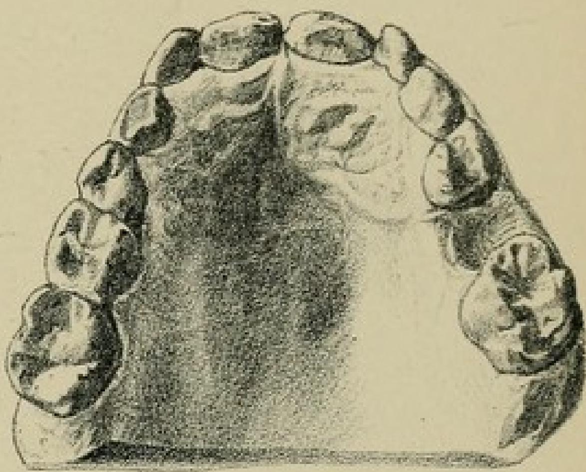

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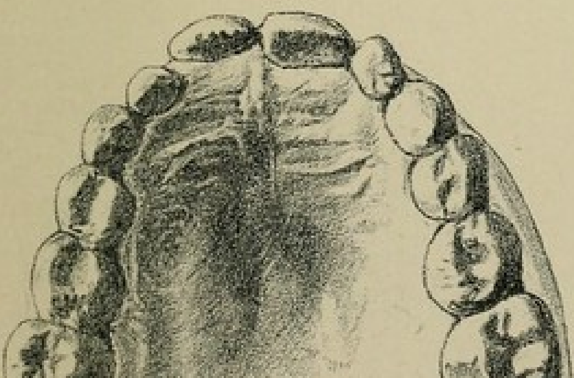

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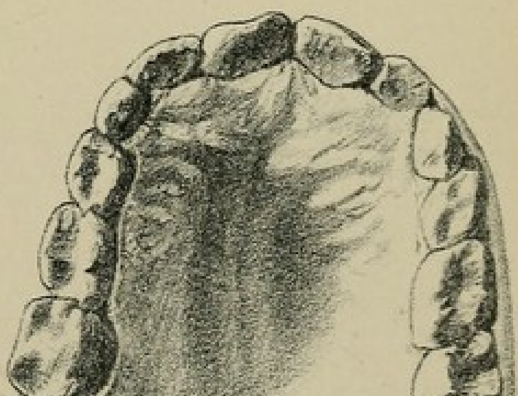

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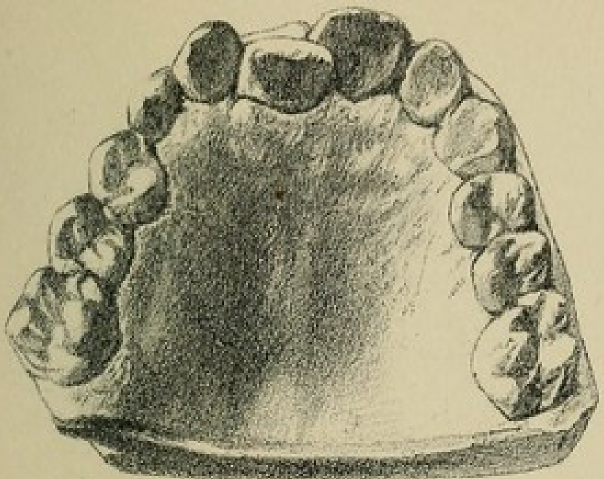
PLATE 5

11 YEARS.



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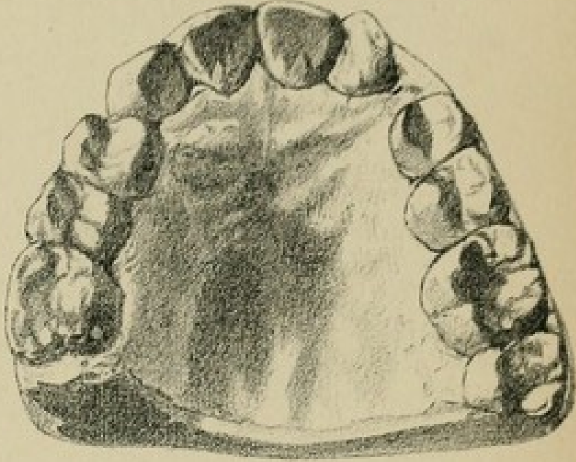

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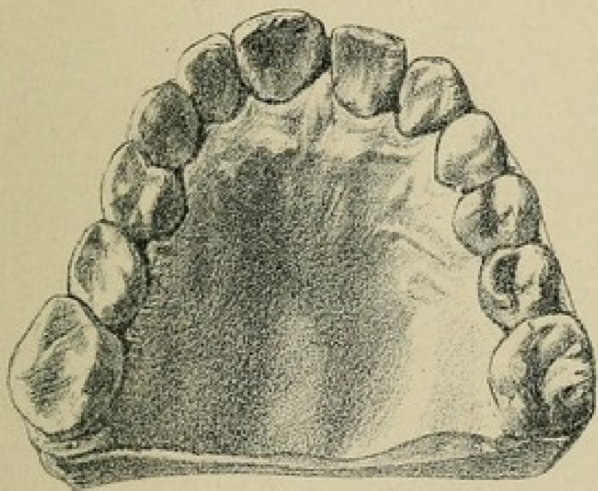

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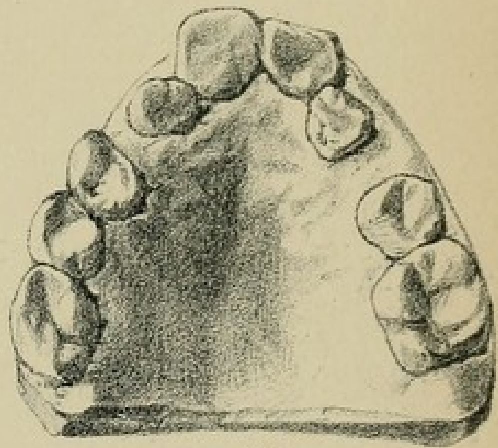

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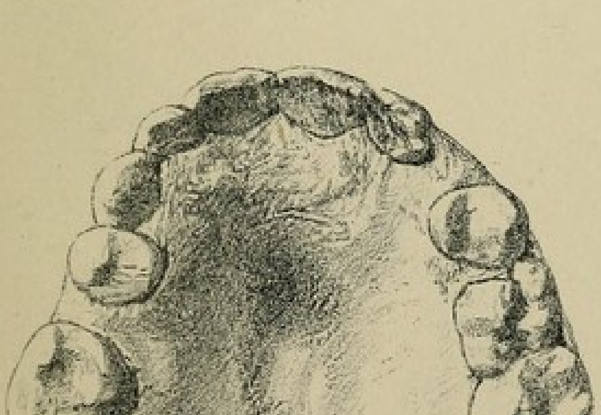

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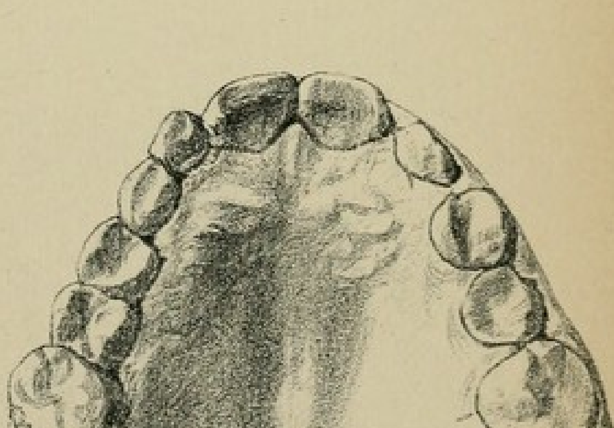

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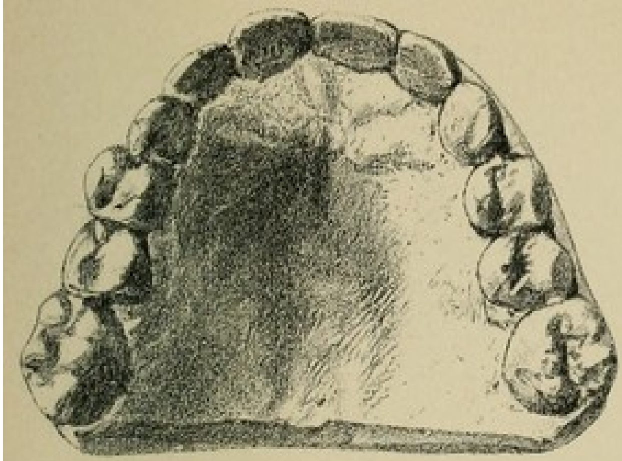
PLATE 6

12 YEARS.



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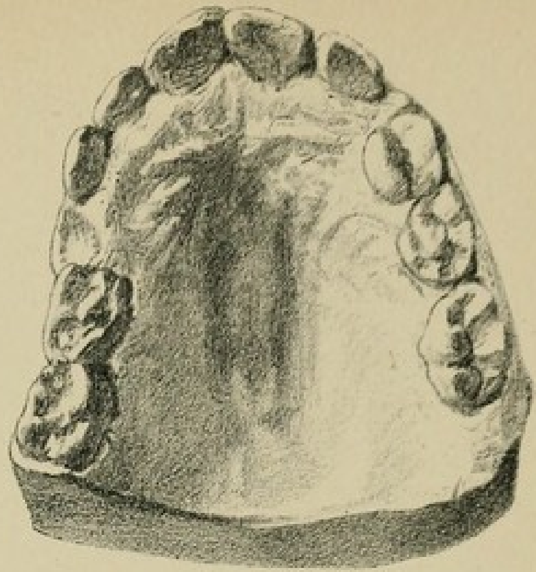

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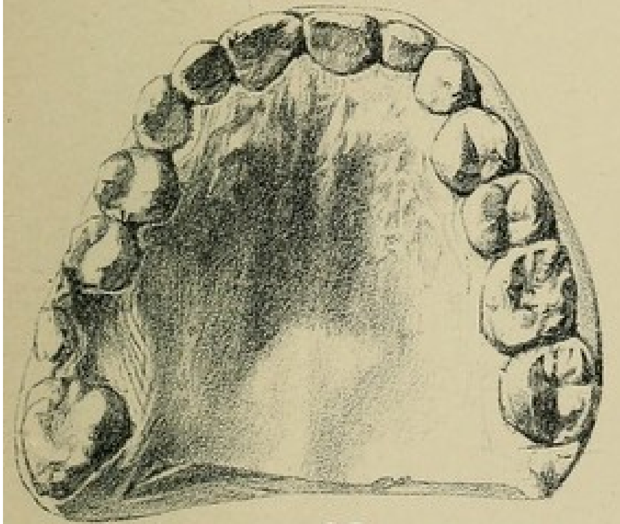

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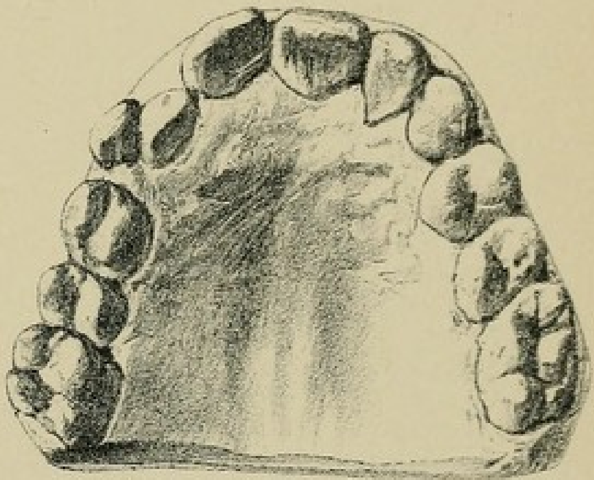

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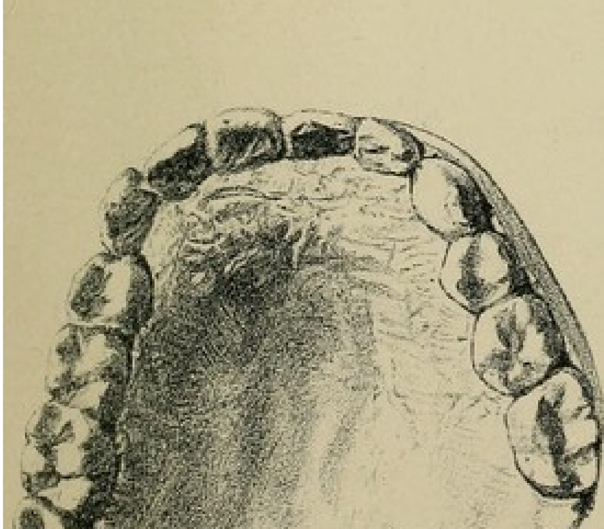

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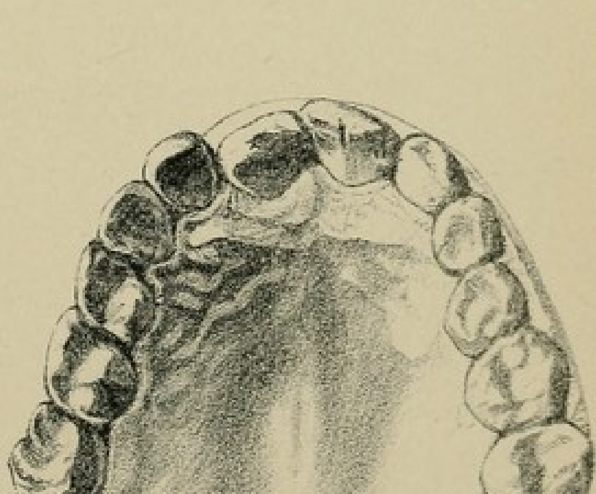


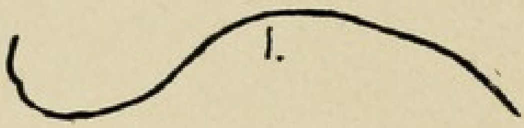
36

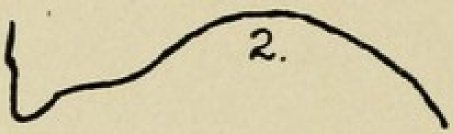
ANTERO-POSTERIOR AND LATERAL

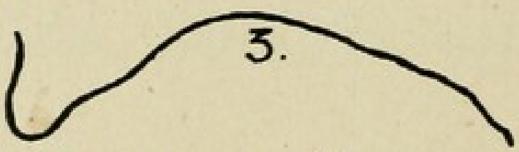
ILLUSTRATIONS OF THE VAULT

PLATE 7

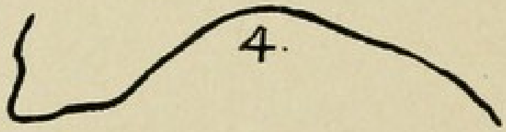
Six years of age.







Seven years of age.



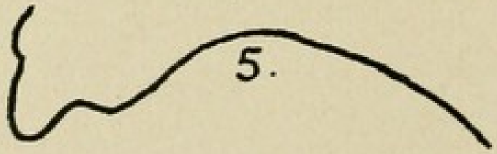
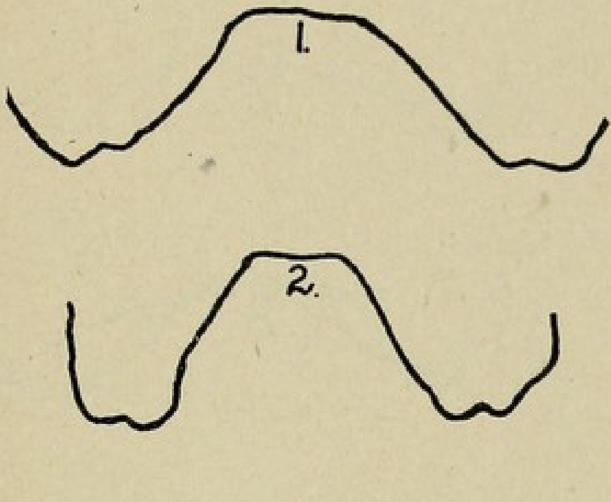


PLATE 8

Six years of age.



Seven years of age.

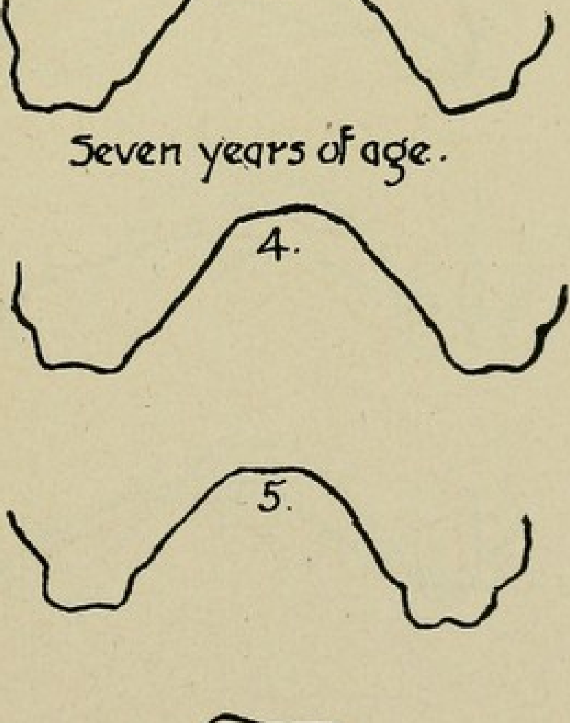


PLATE 9

Eight years of age.

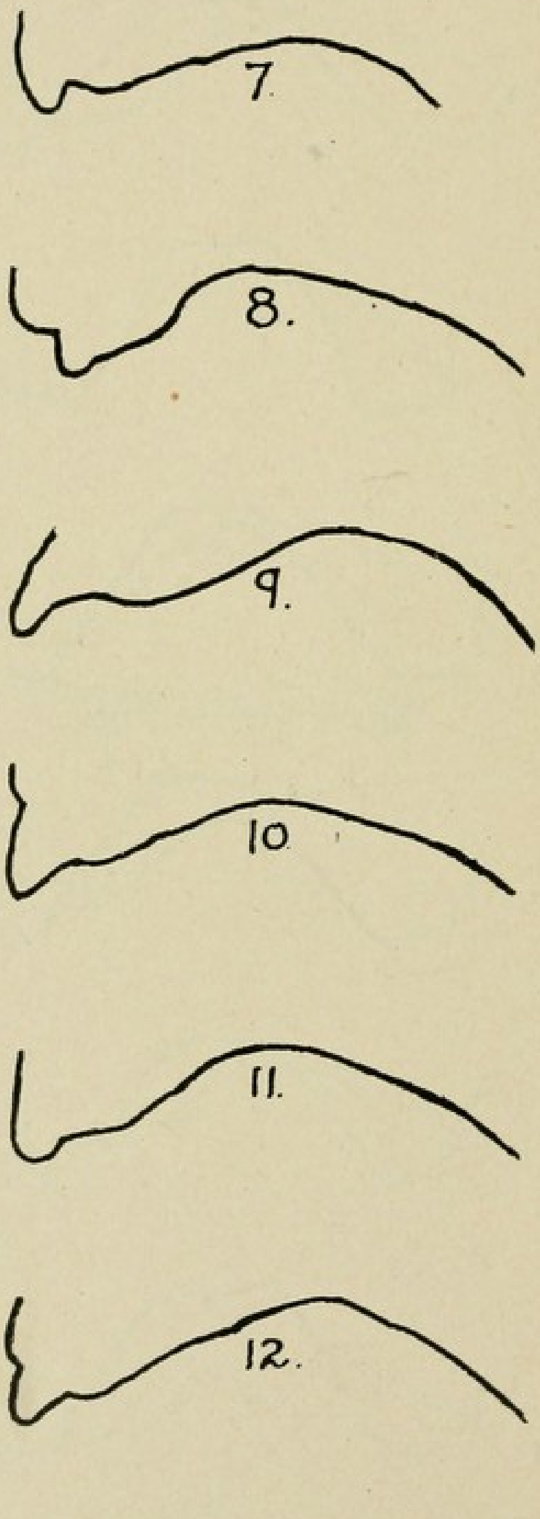


PLATE 10

Eight years of age.

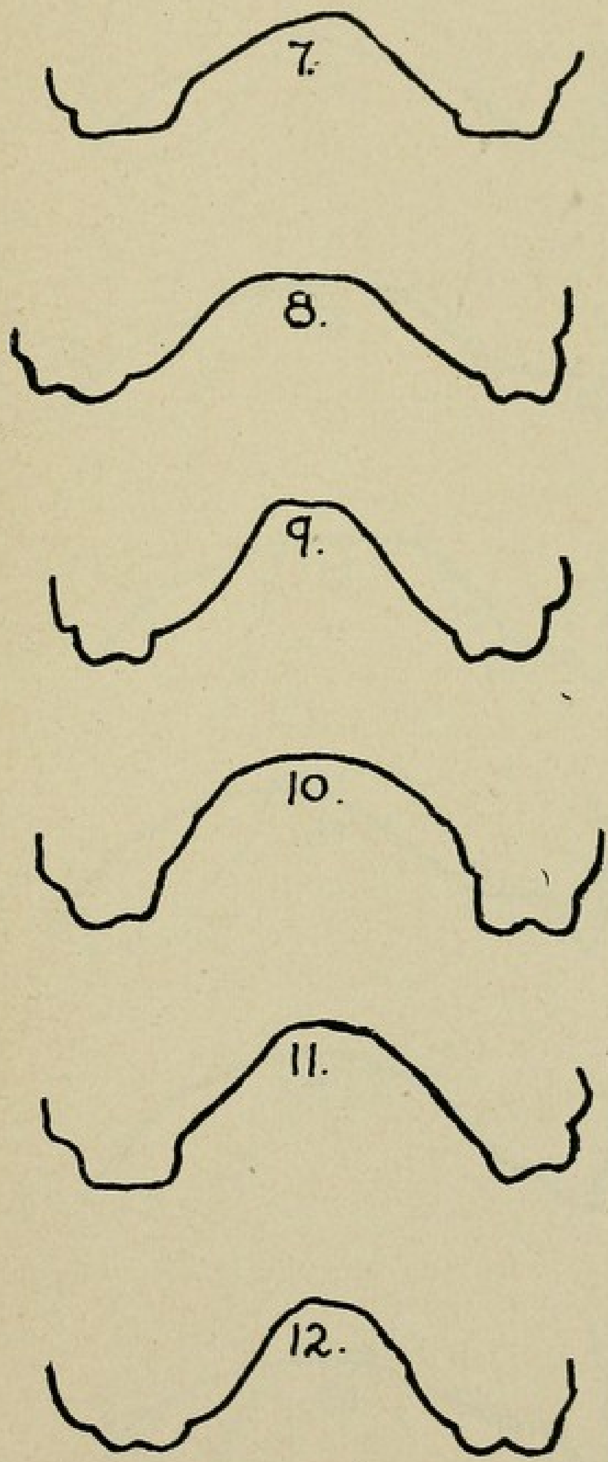


PLATE 11

Nine years of age.

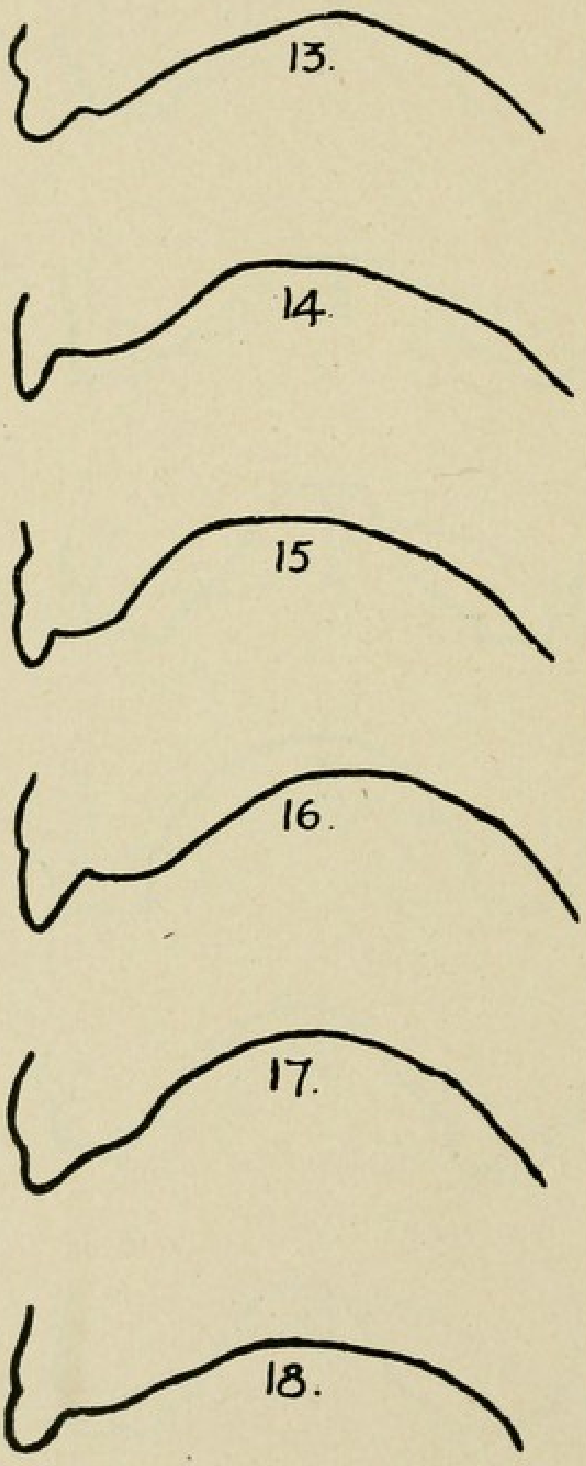


PLATE 12

Nine years of age.

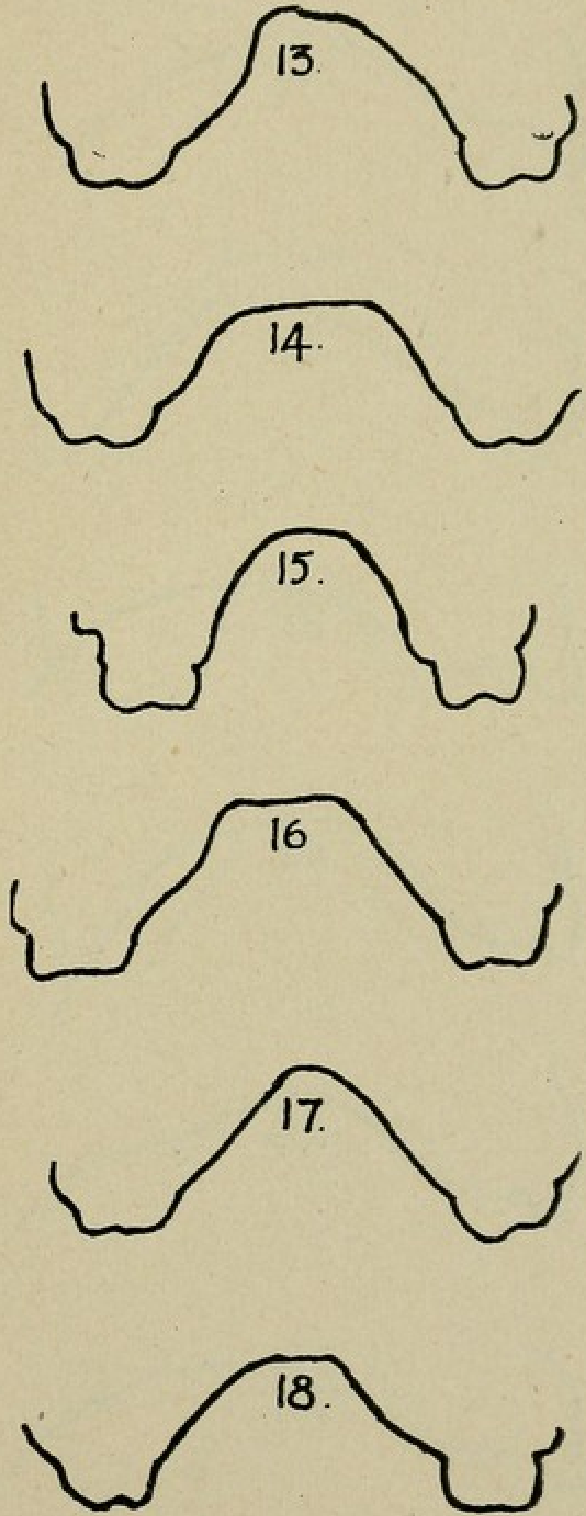


PLATE 13

Ten years of age.

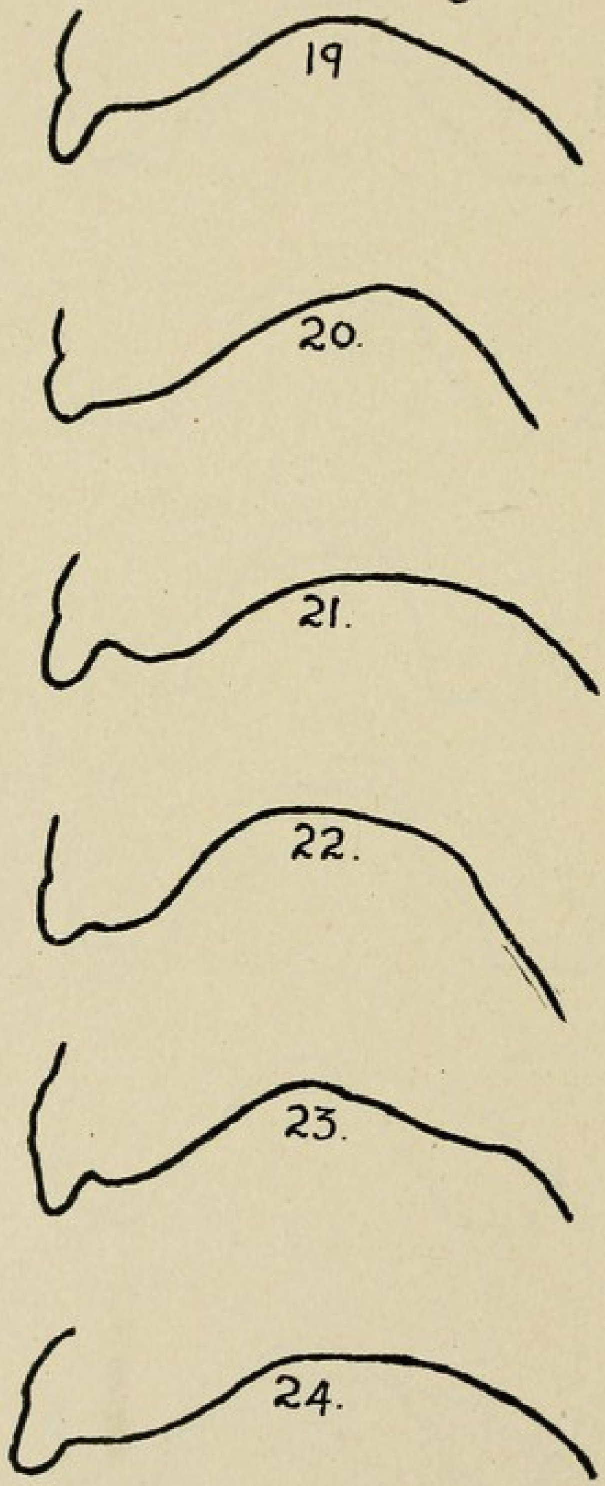


PLATE 14

Ten years of age.

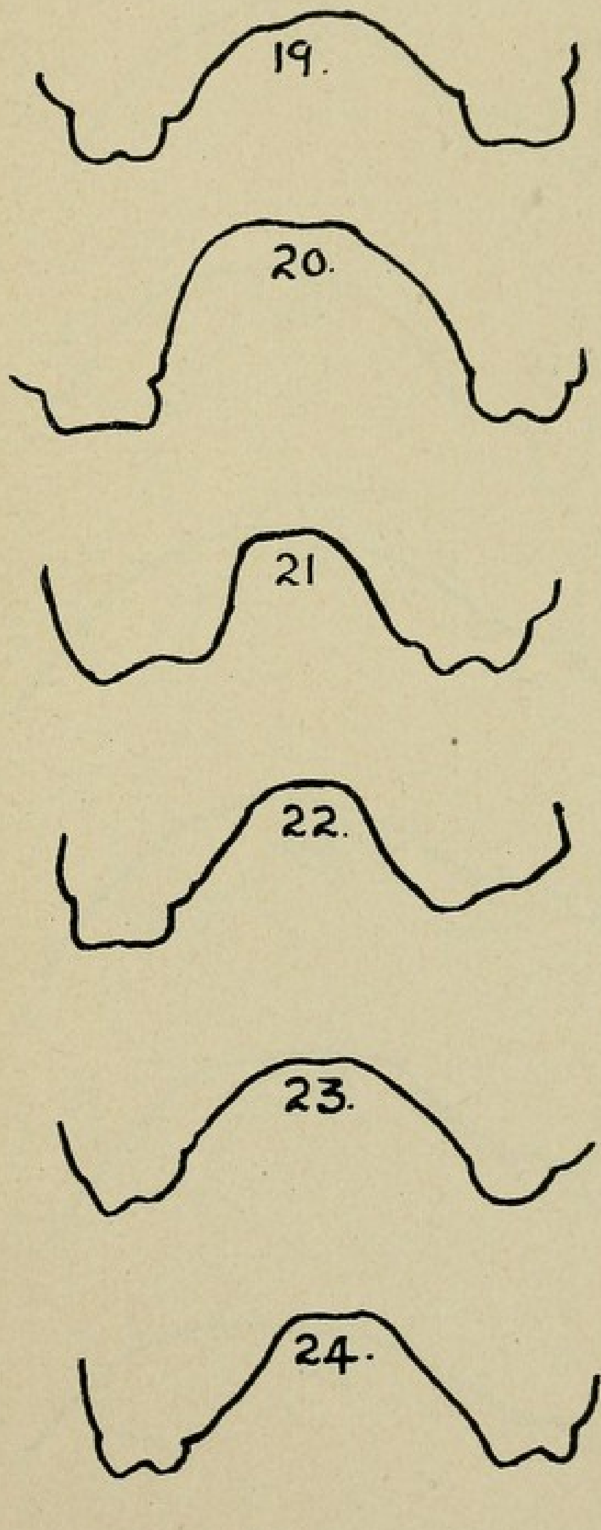


PLATE 15

Eleven years of age.

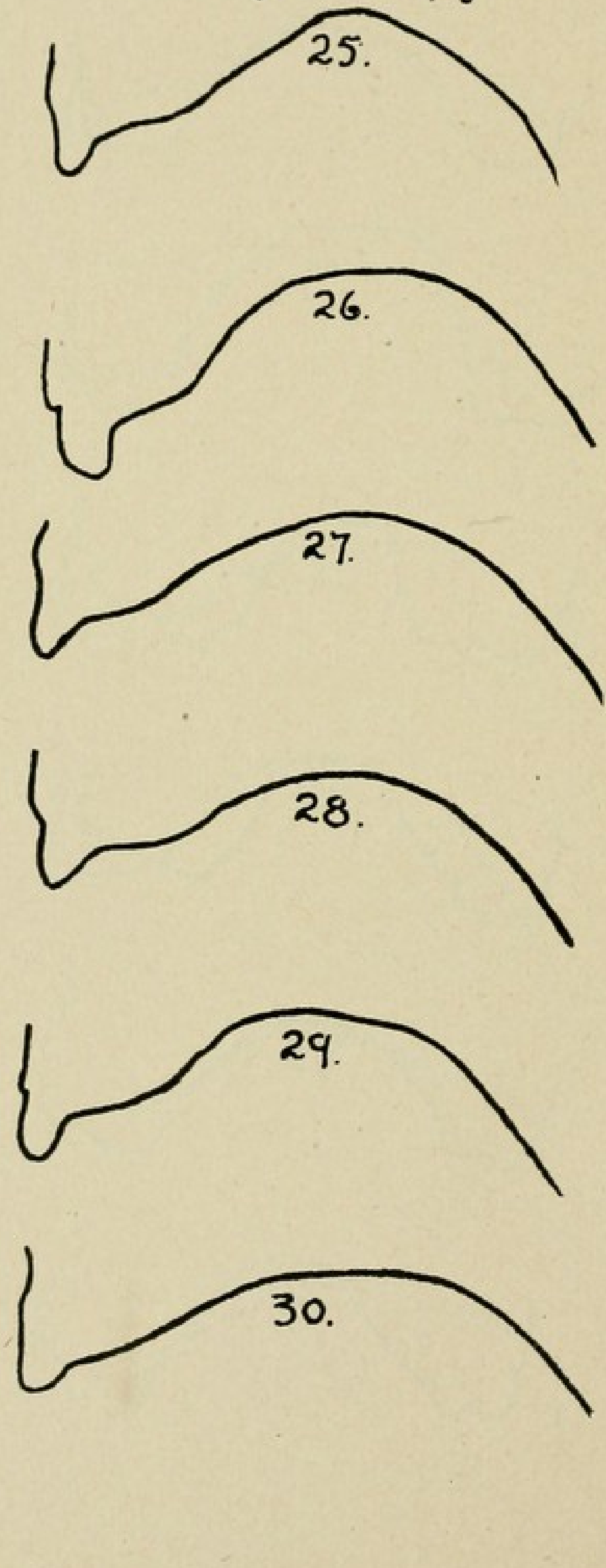


PLATE 16

Eleven years of age.

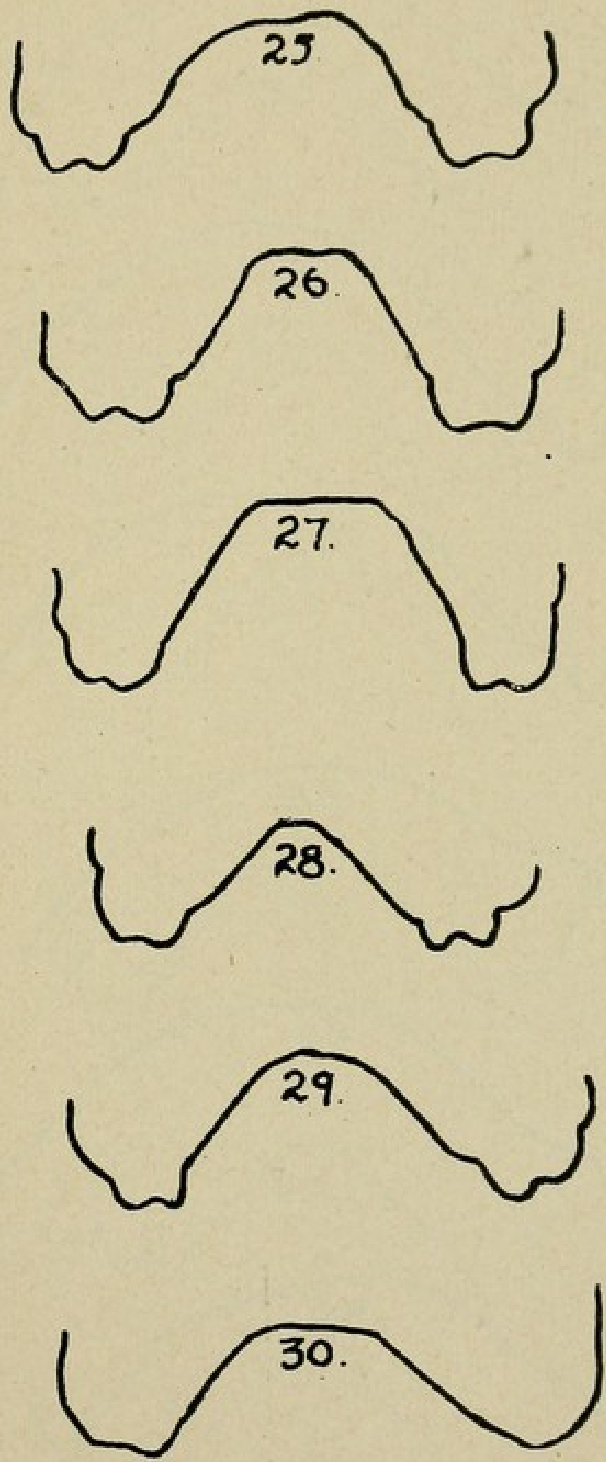


PLATE 17

Twelve years of age.

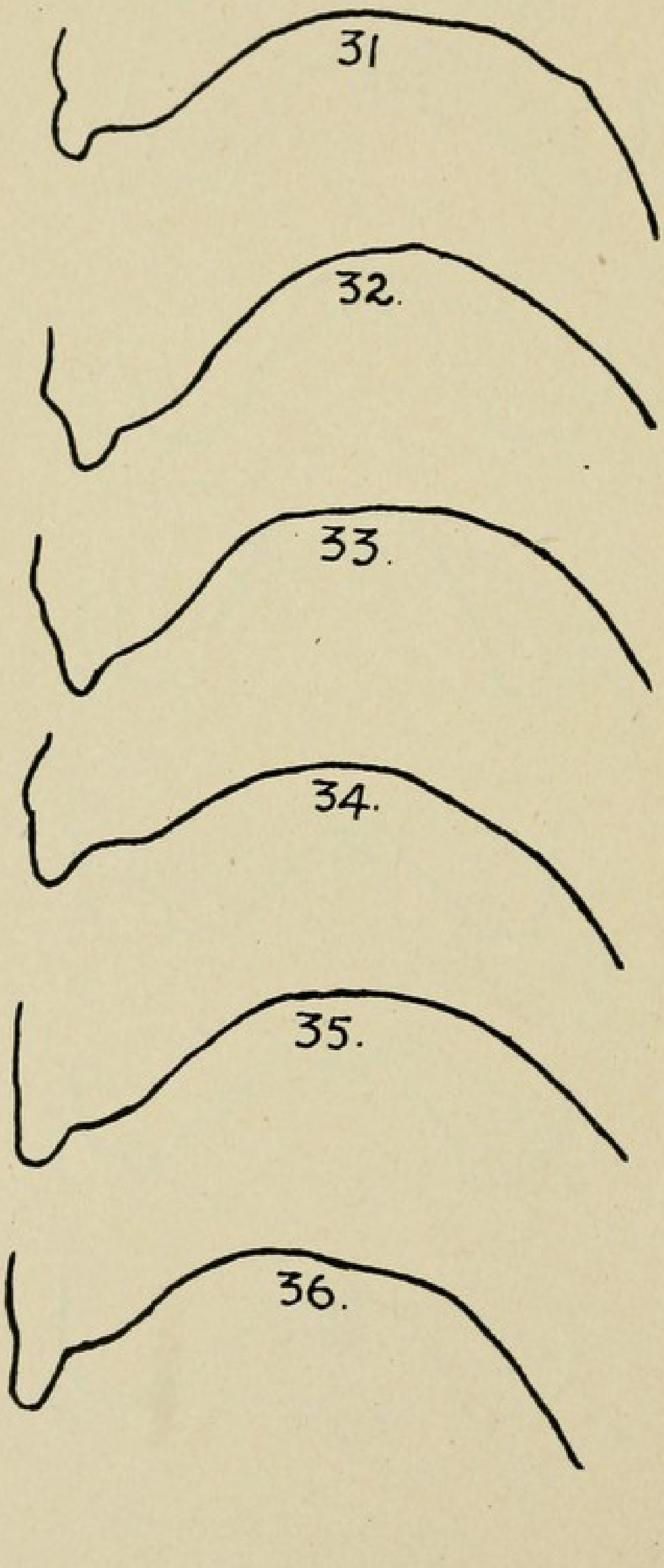


PLATE 18

Twelve years of age.

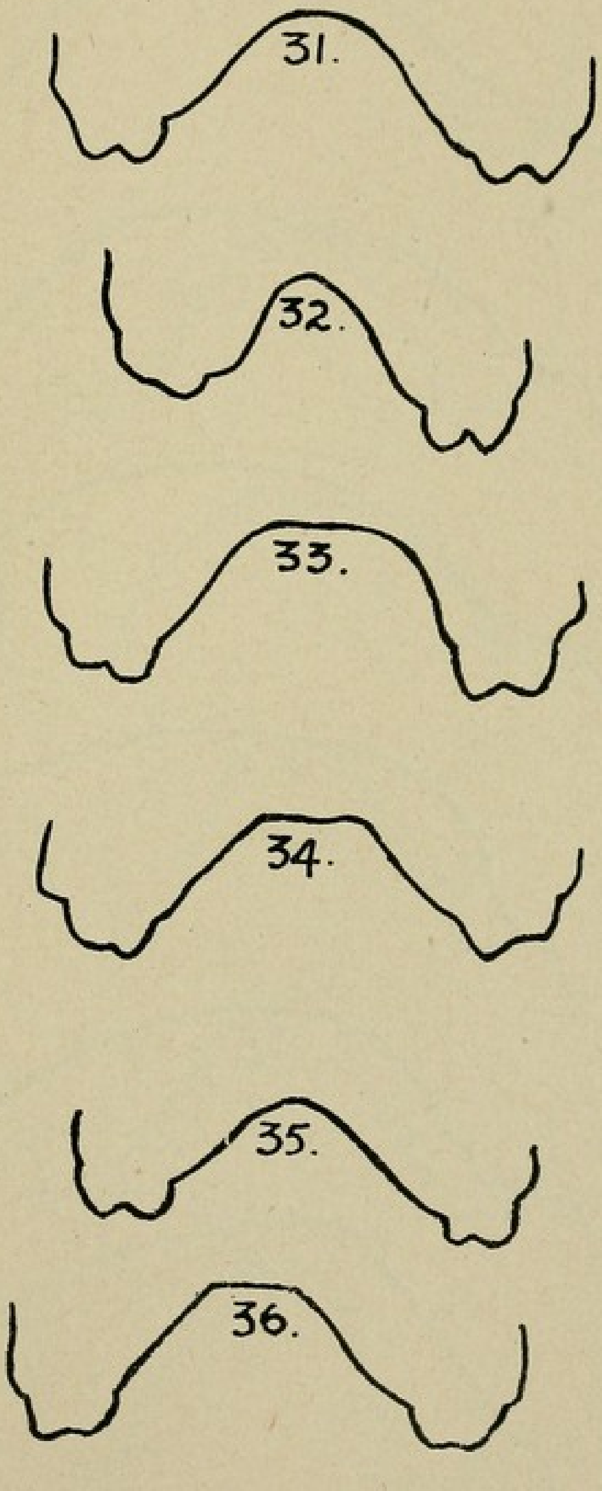


PLATE 19

Brachycephalic. White.

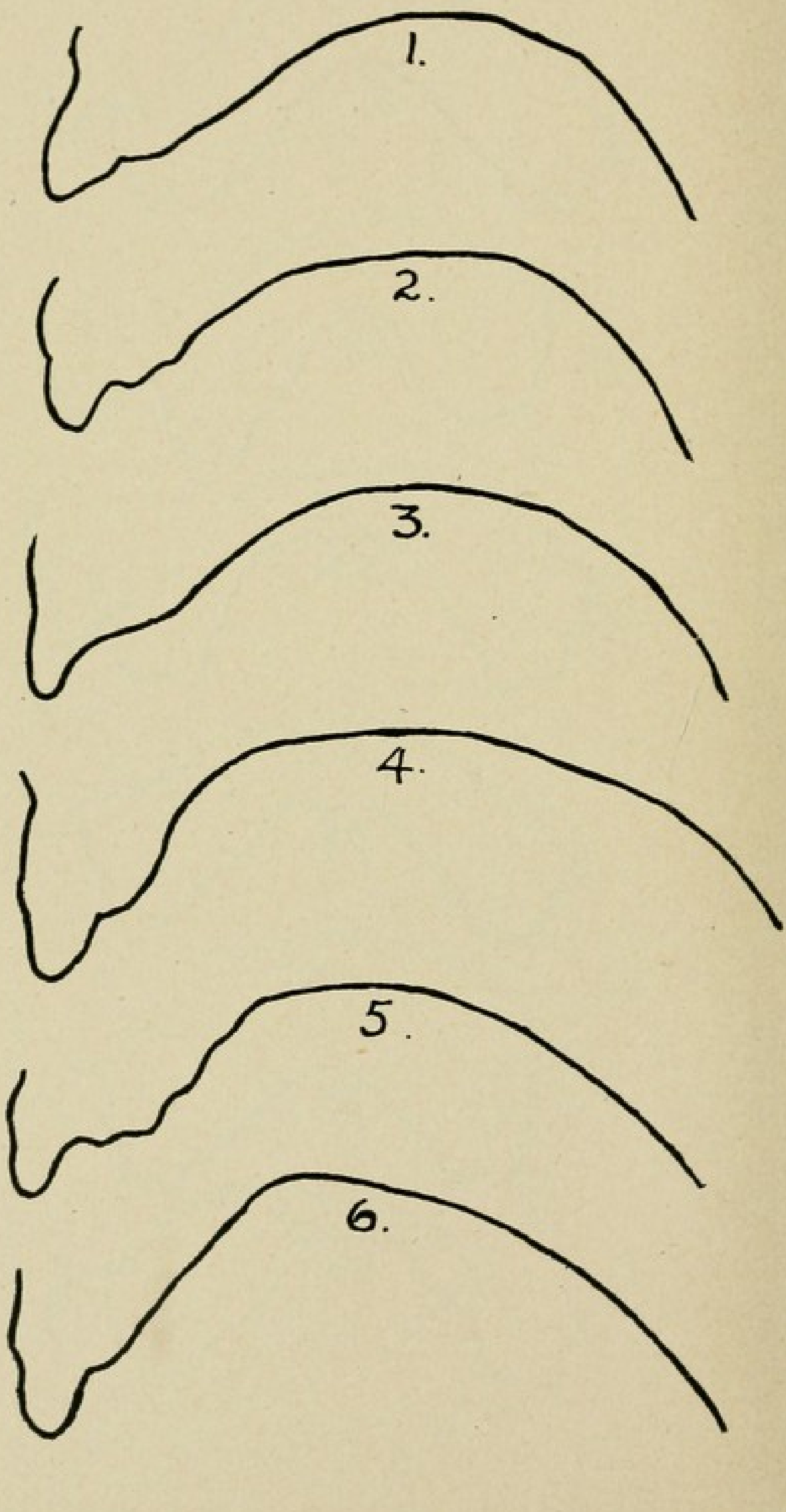


PLATE 20

Brachycephalic. White.

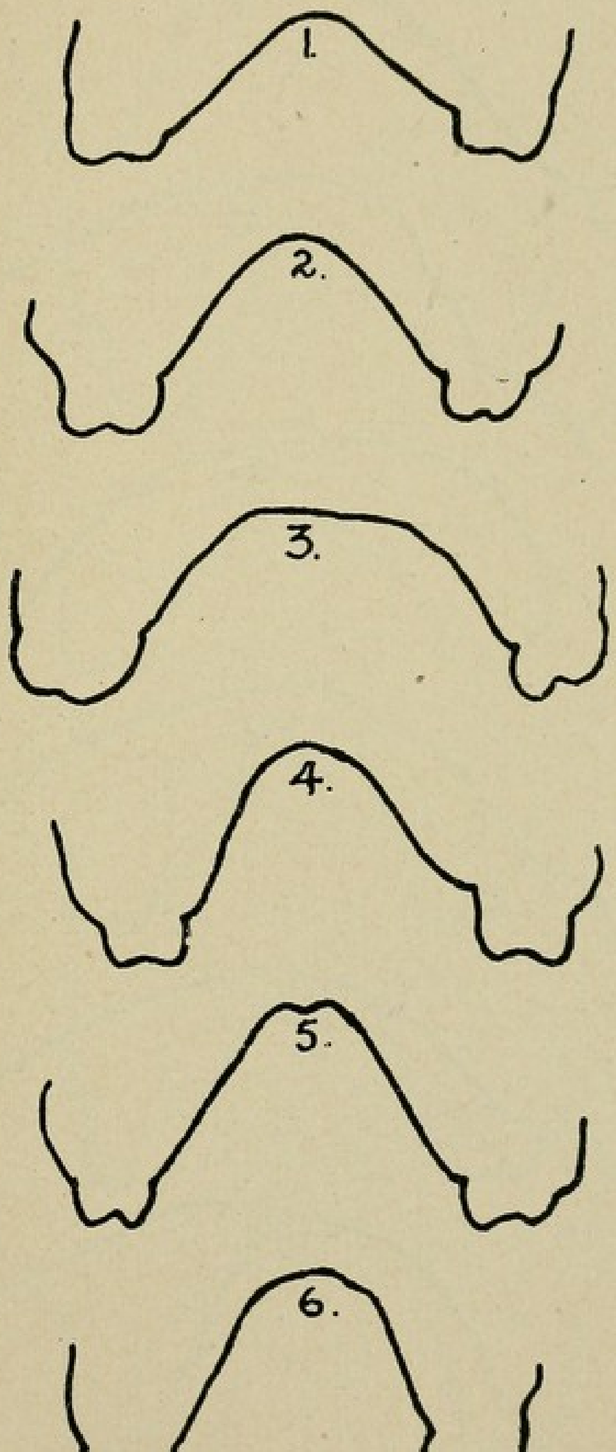


PLATE 21

Brachycephalic. White.

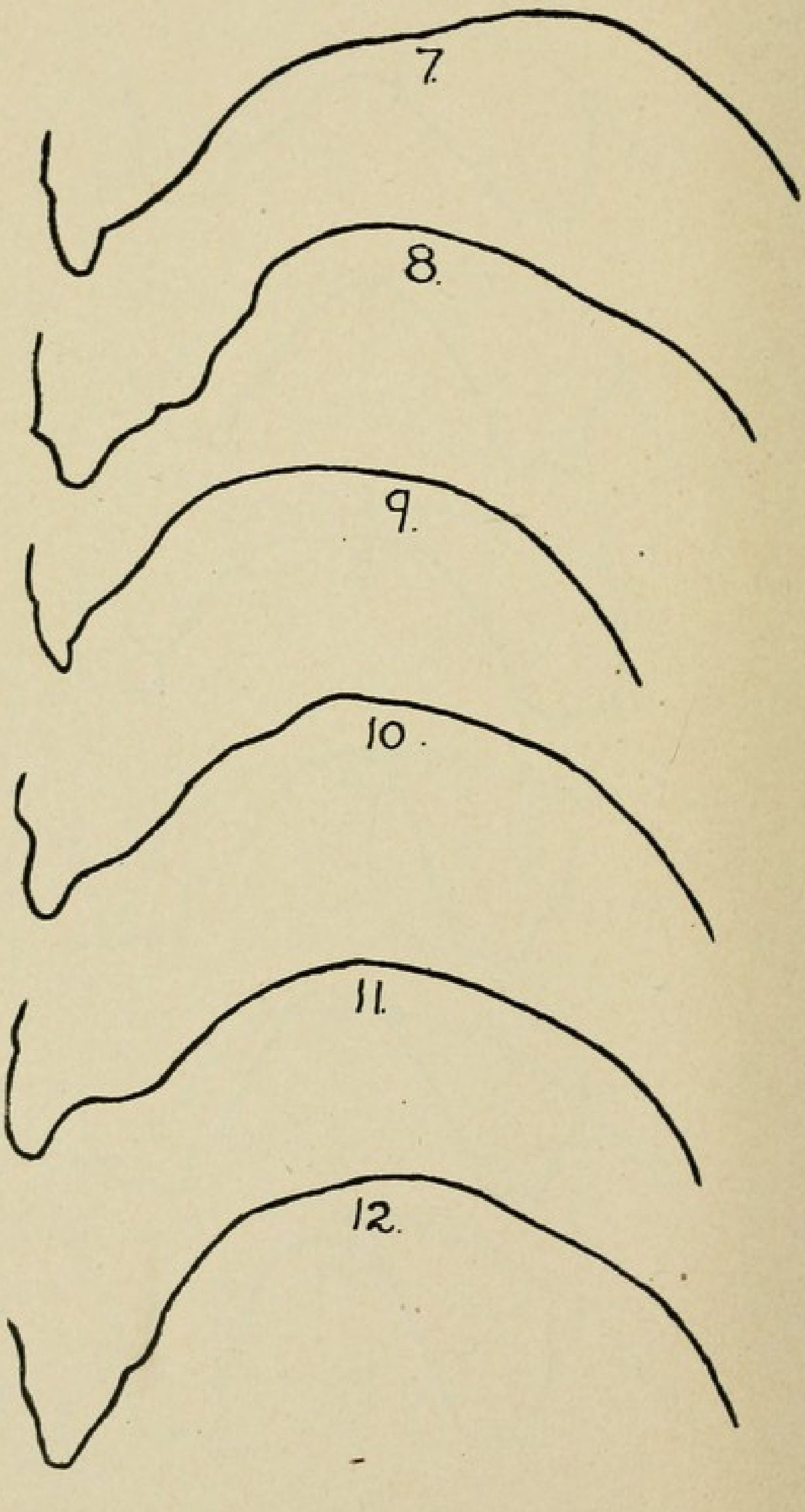


PLATE 22

Brachycephalic. White.

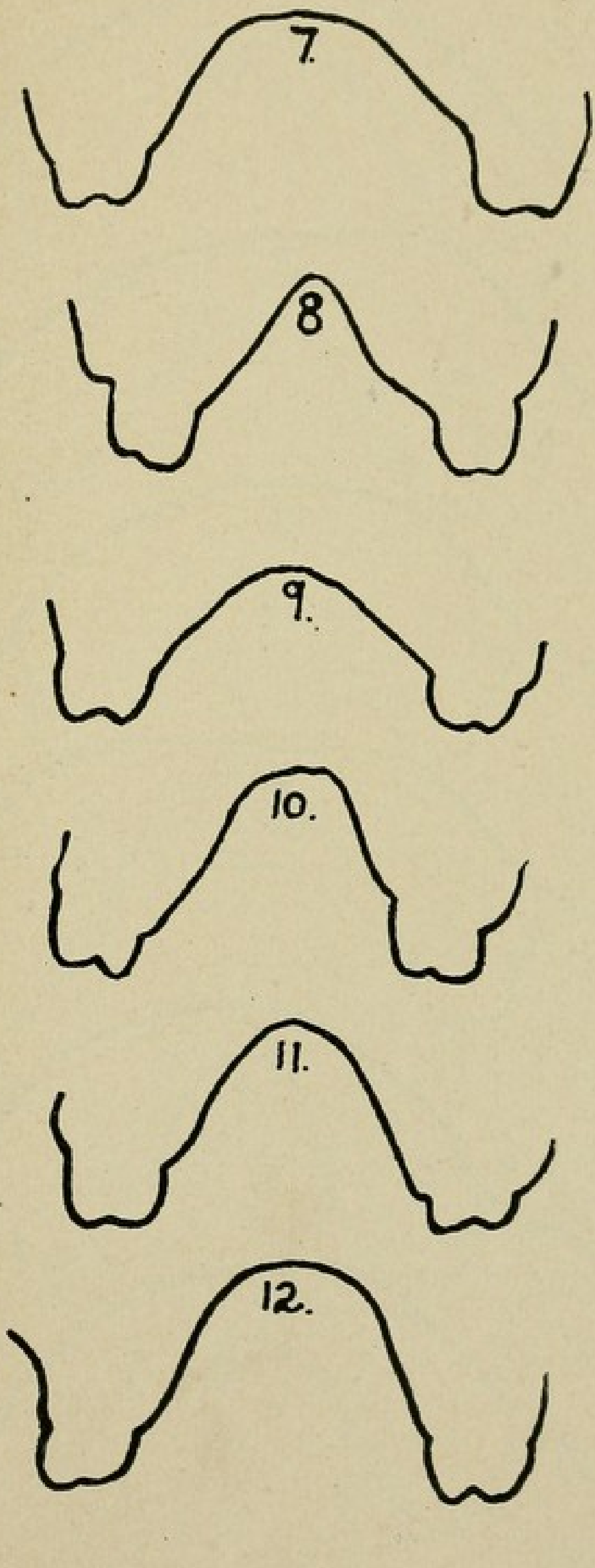


PLATE 23

Mesocephalic. White.

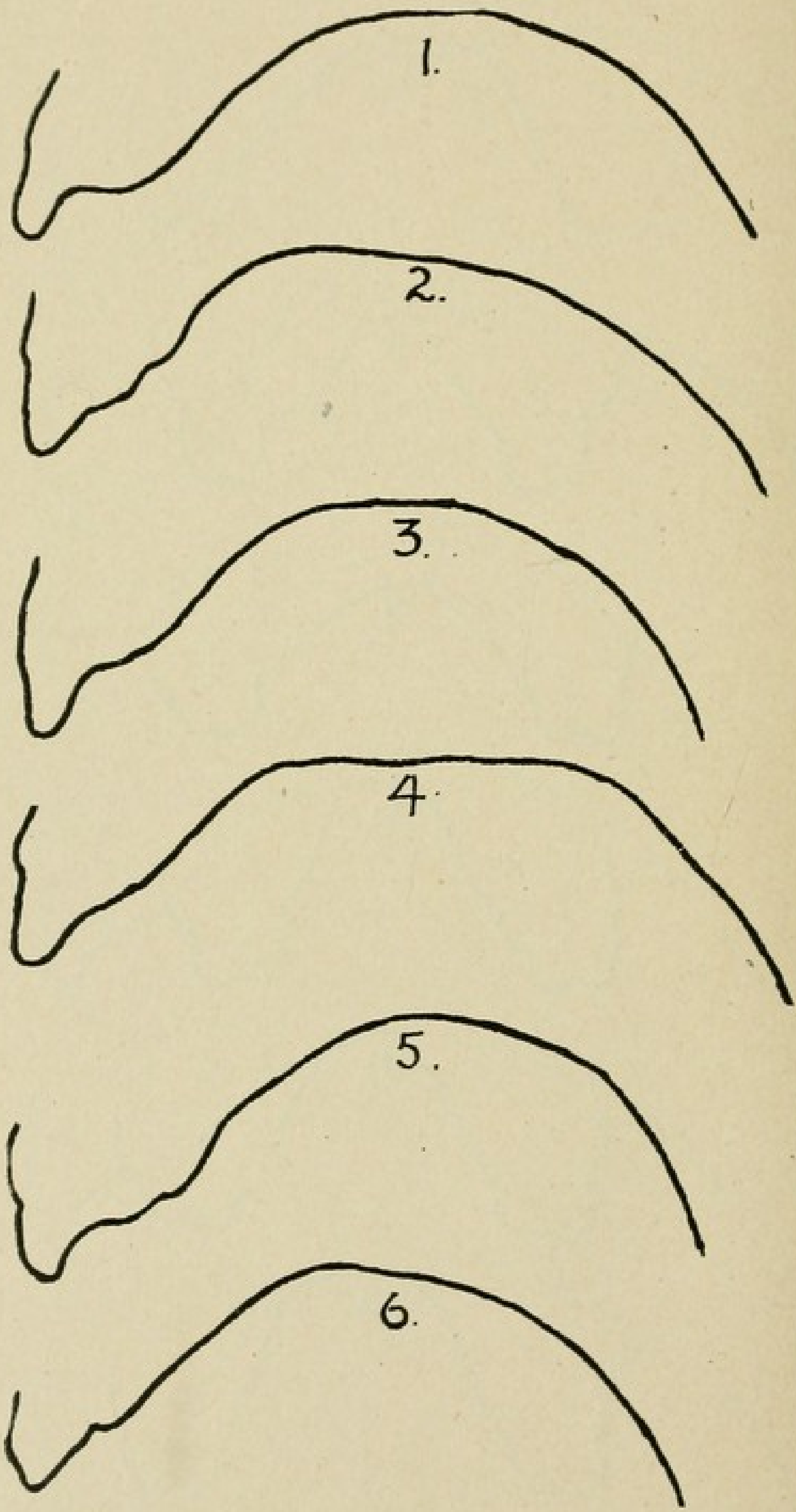


PLATE 24

Mesocephalic. White.

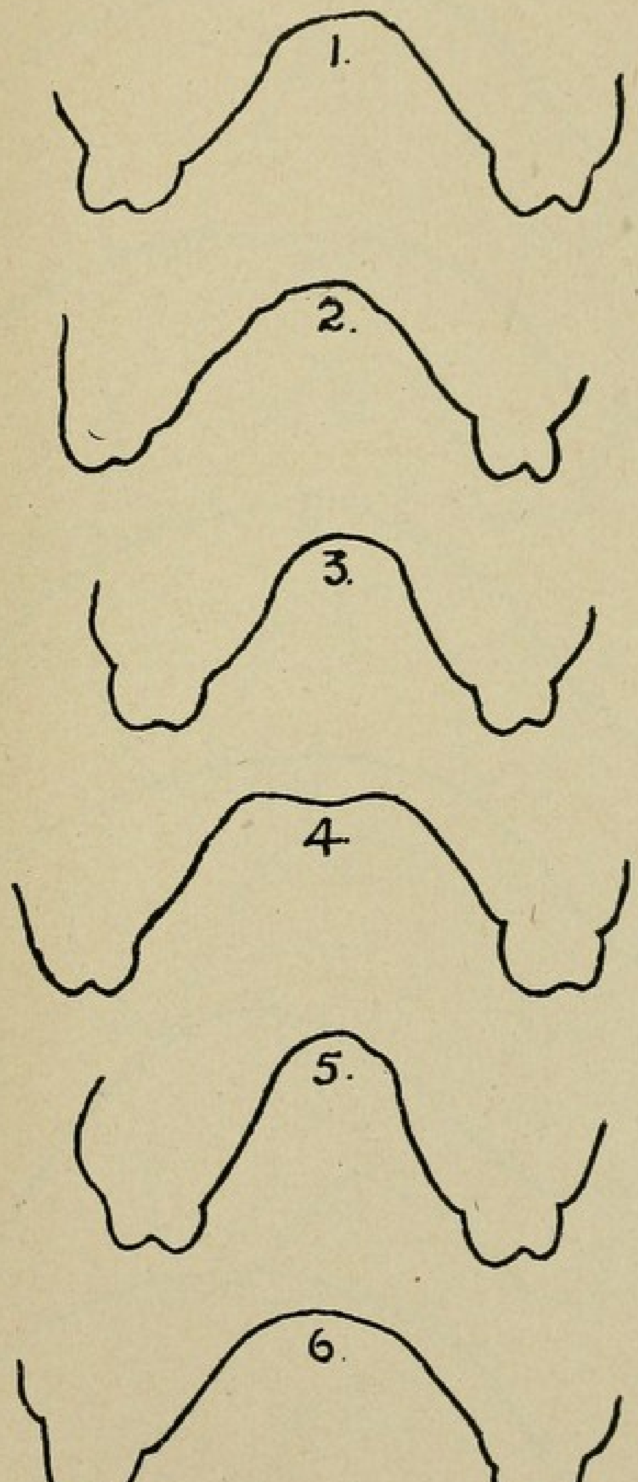


PLATE 25

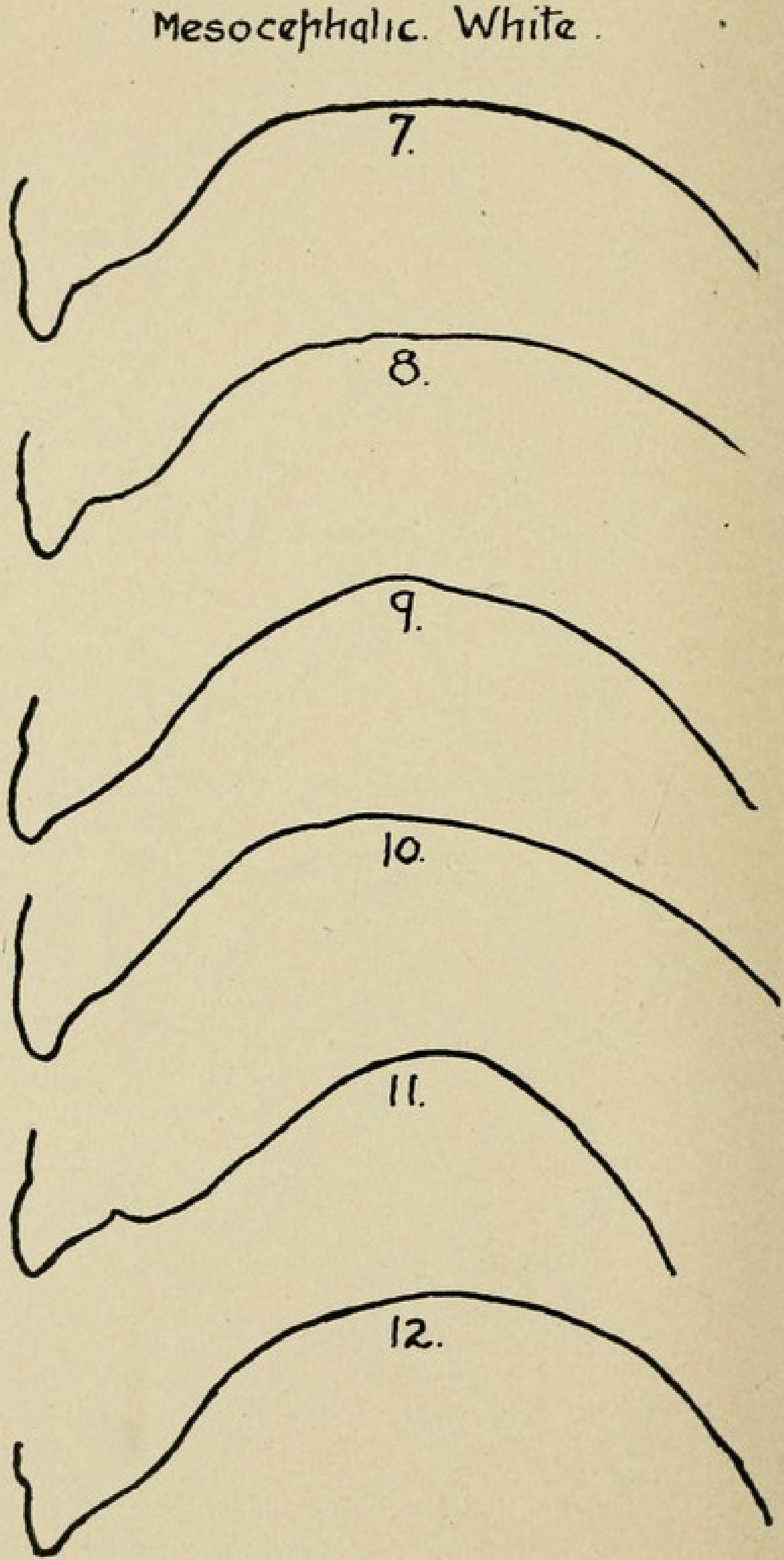


PLATE 26

Mesocephalic. White.

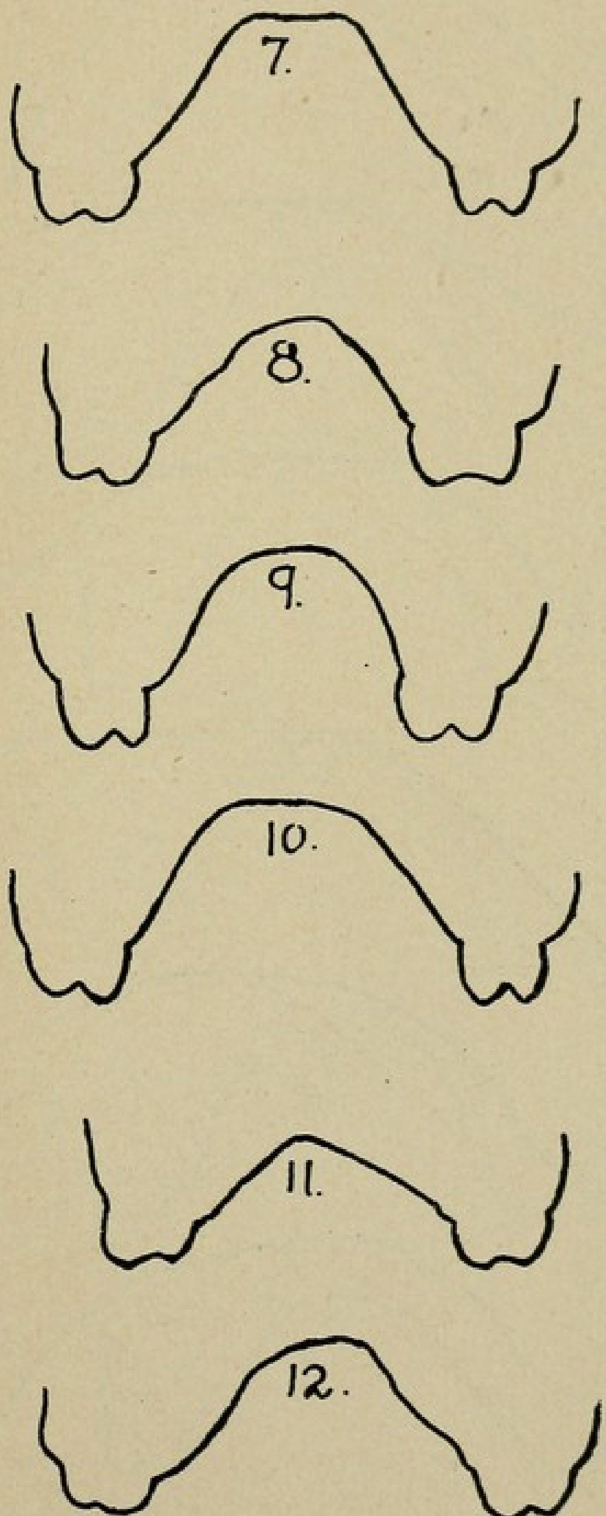


PLATE 27

Dolichocephalic. White.

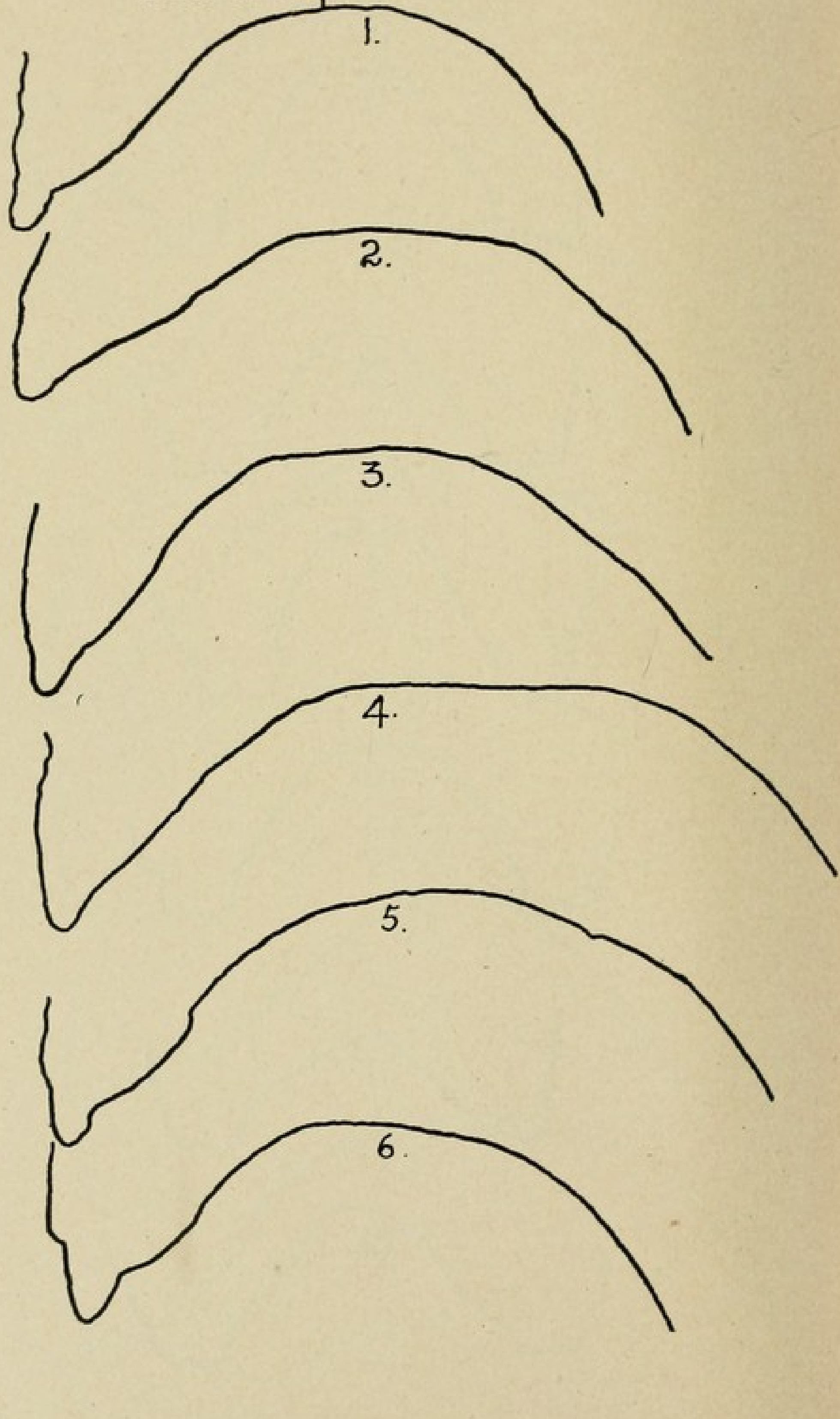


PLATE 28

Dolichocephalic. White.

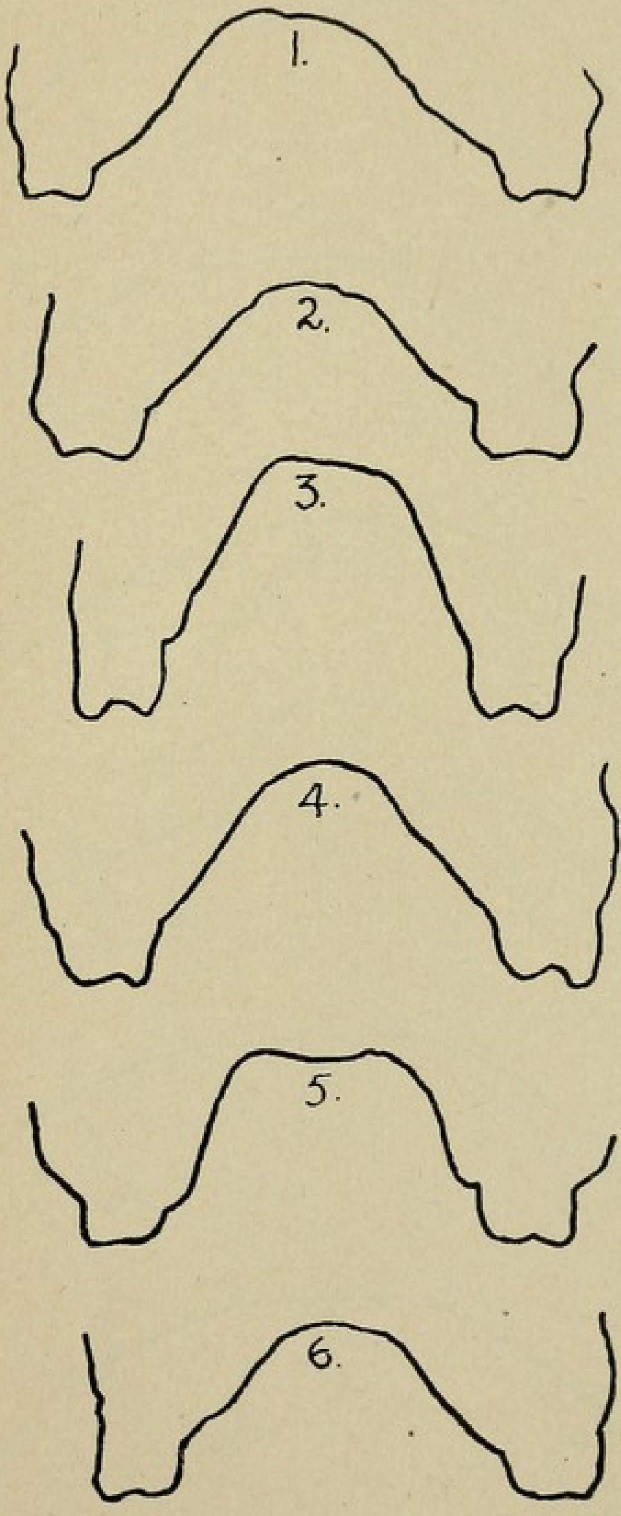


PLATE 29

Brachycephalic. Colored.

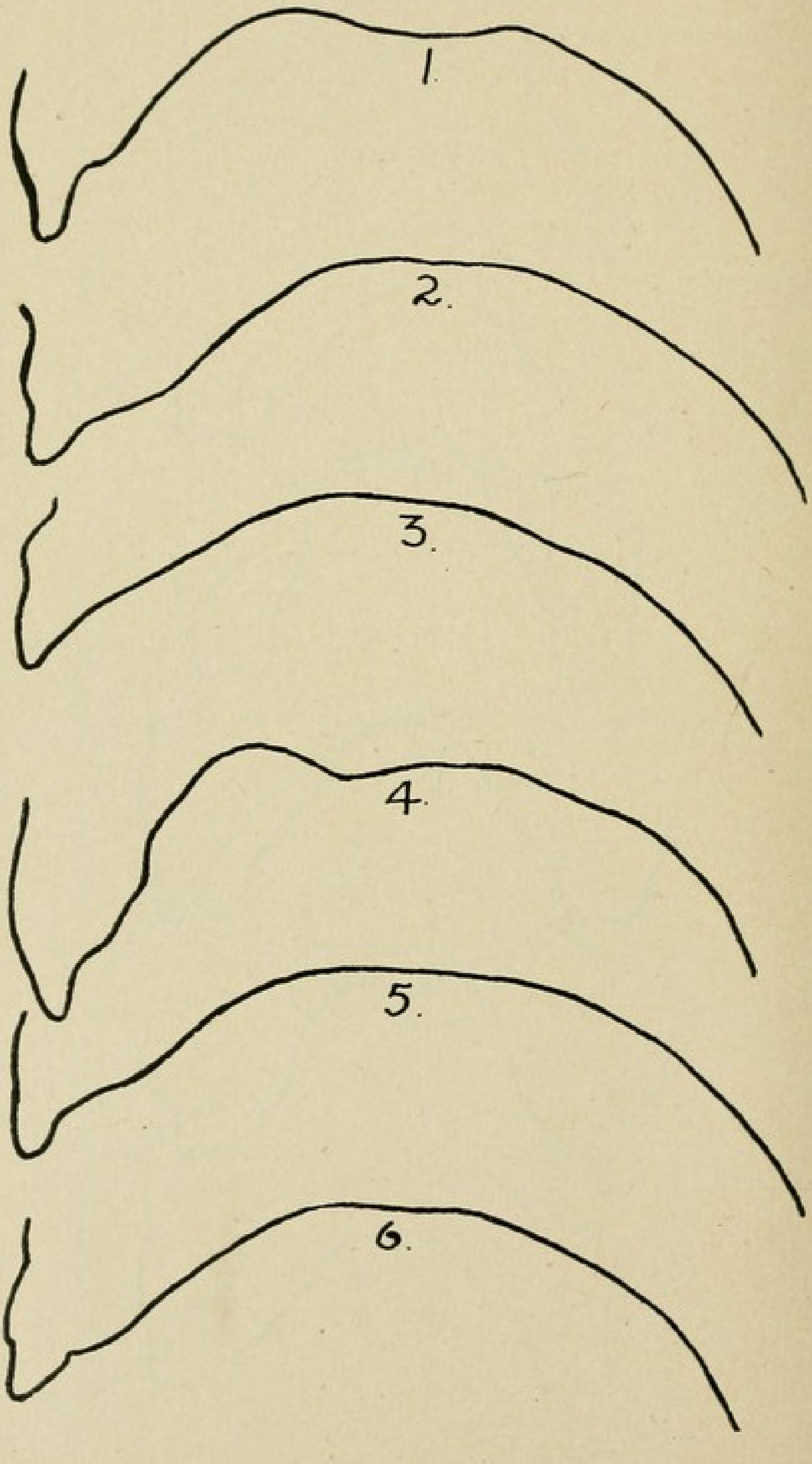


PLATE 30

Brachycephalic. Colored.

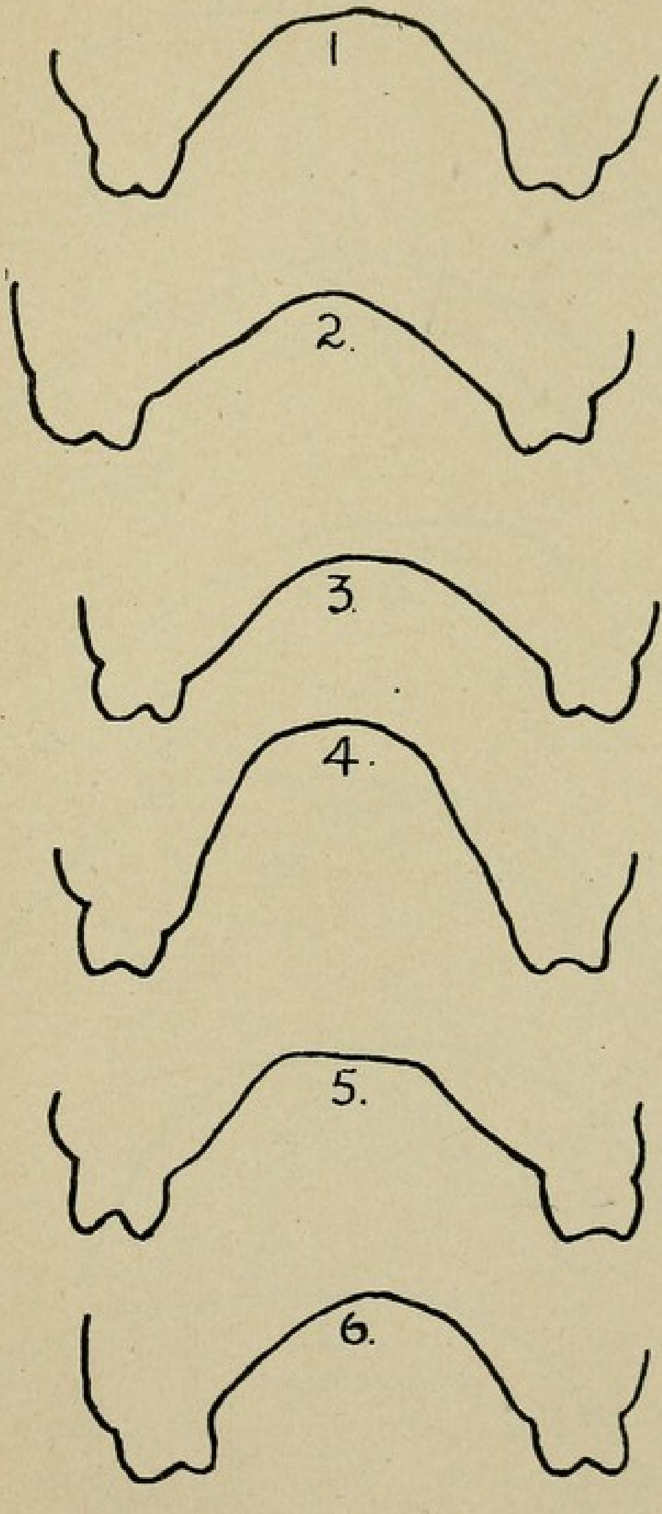


PLATE 31

Mesocephalic. Colored.

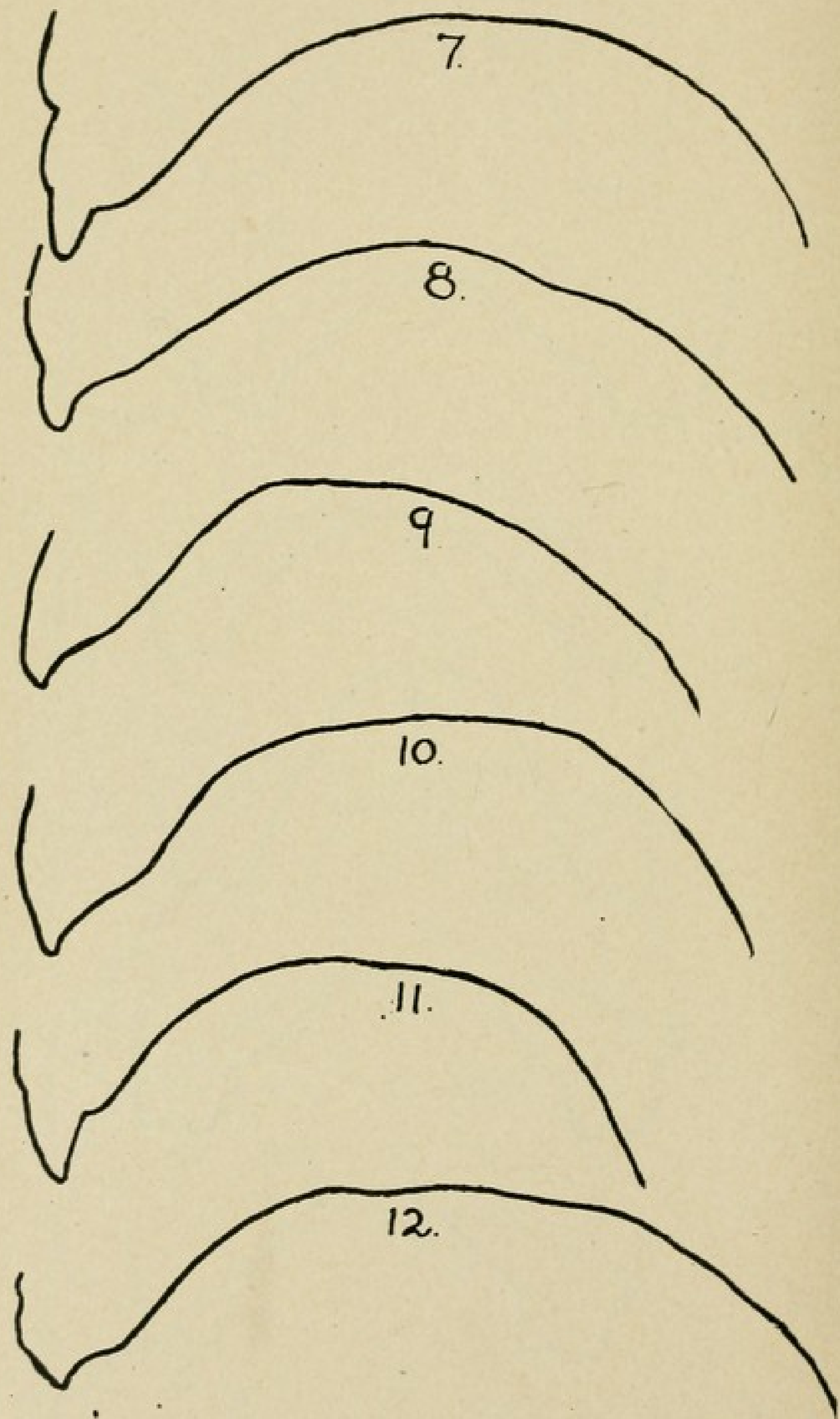


PLATE 32

Mesocephalic. Colored.

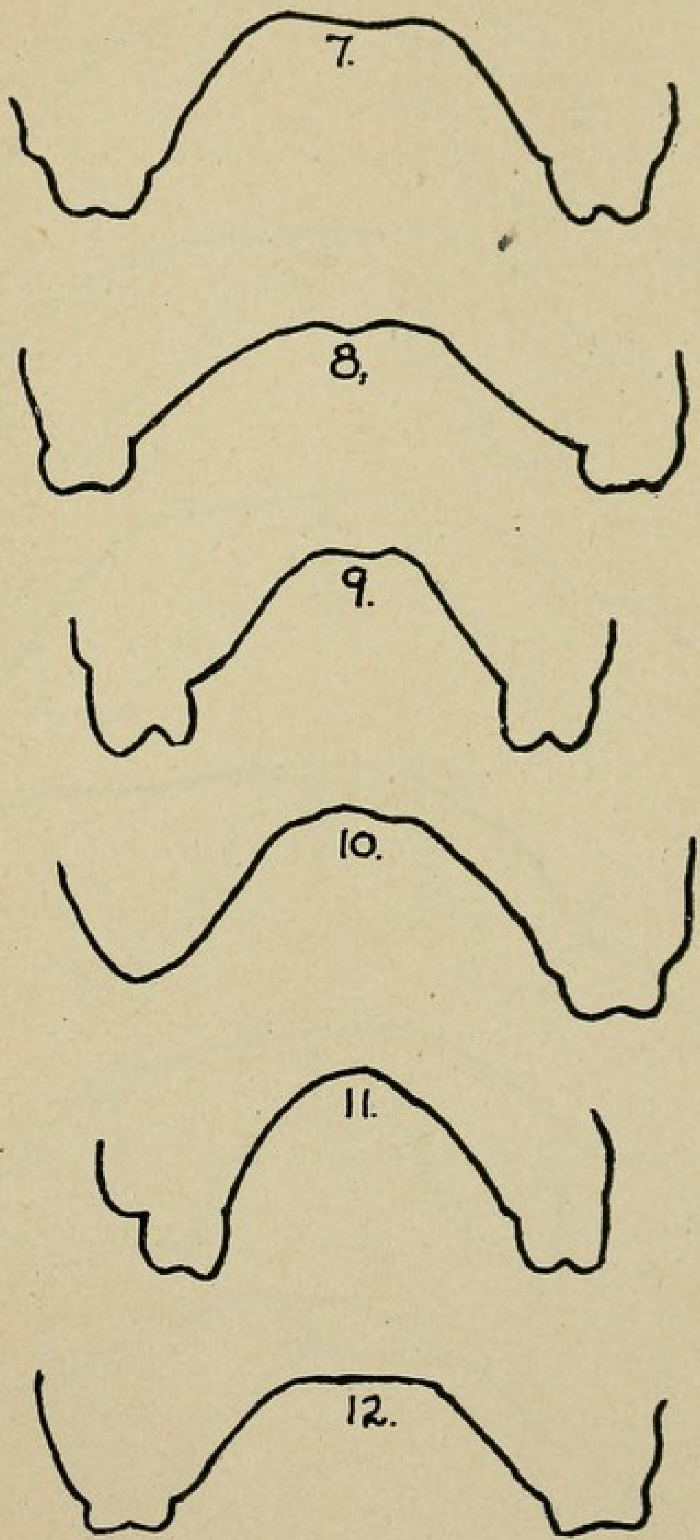


PLATE 33

Dolichocephalic. Colored.

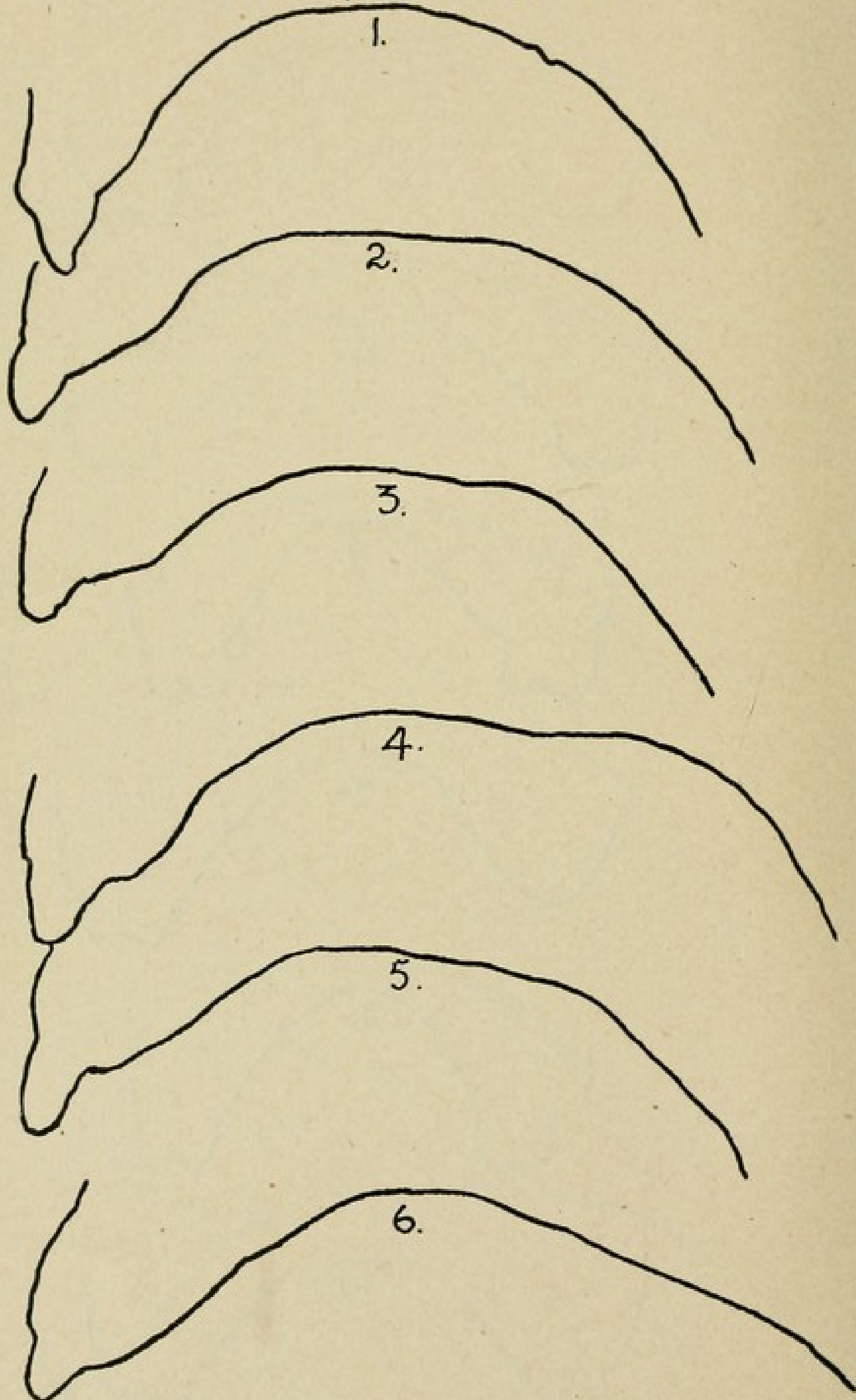


PLATE 34

Dolichocephalic. Colored.

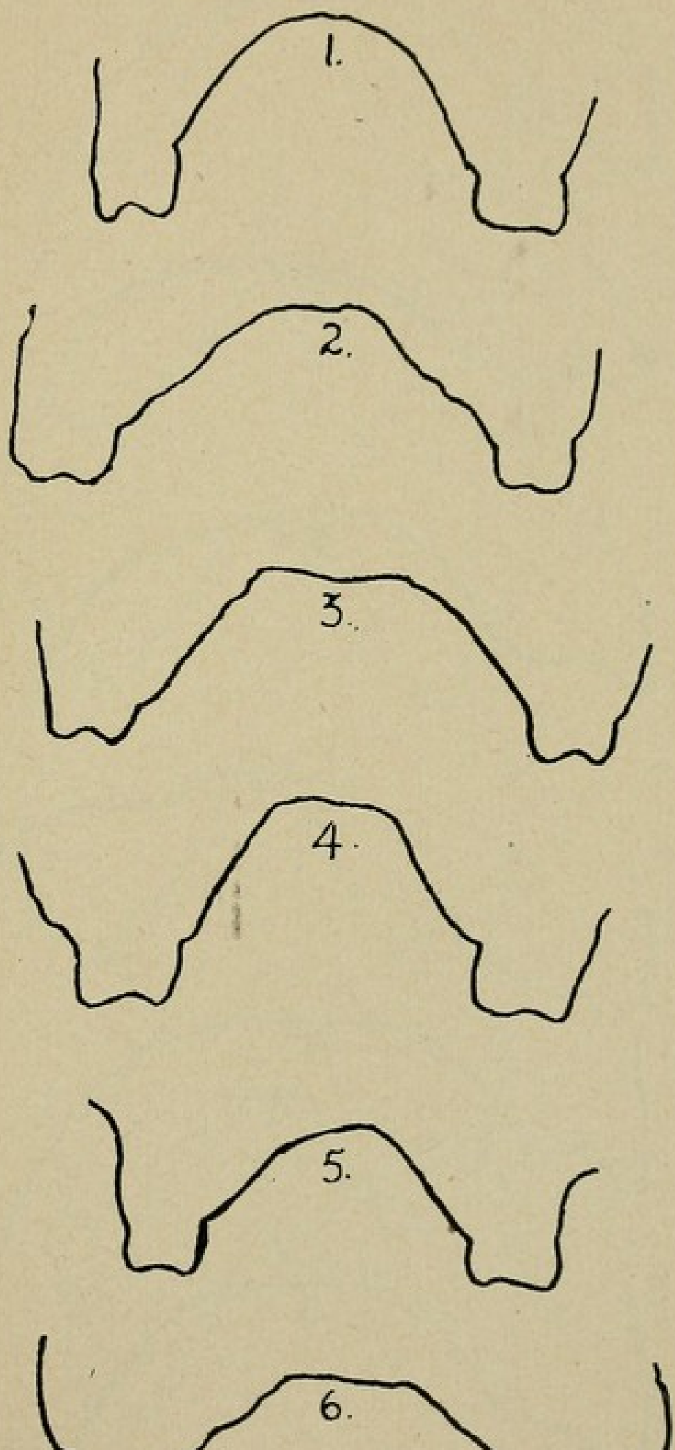


PLATE 35

V shaped Vault.

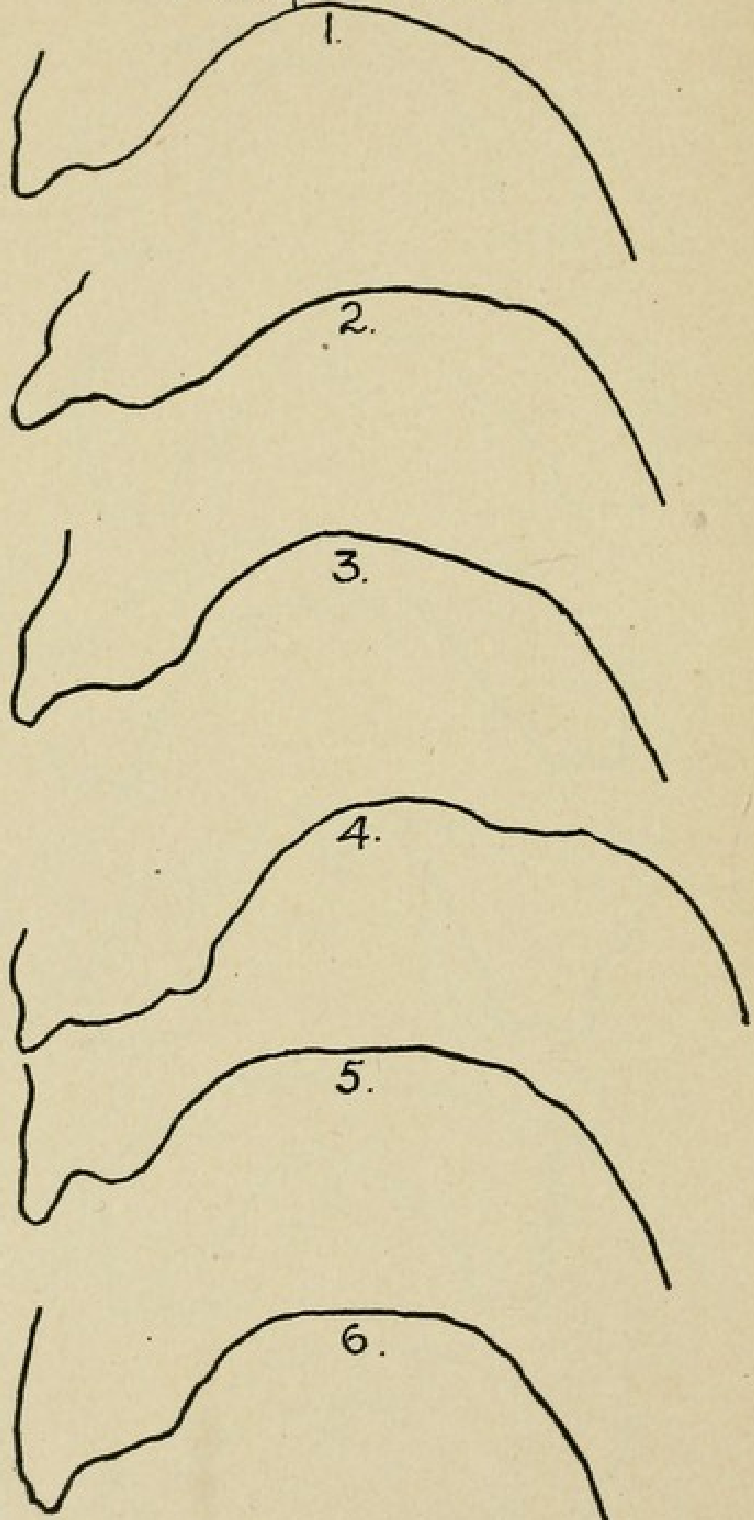


PLATE 36

V shaped Vault.

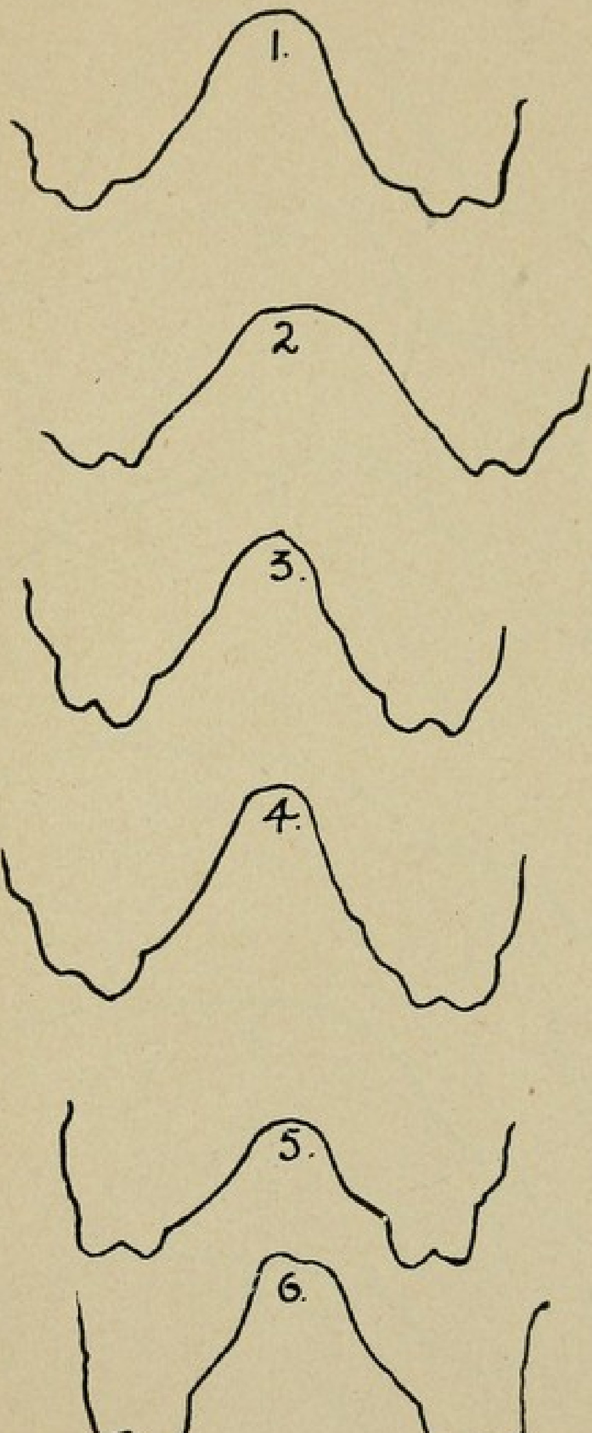


PLATE 37

Semi V shaped Vault.

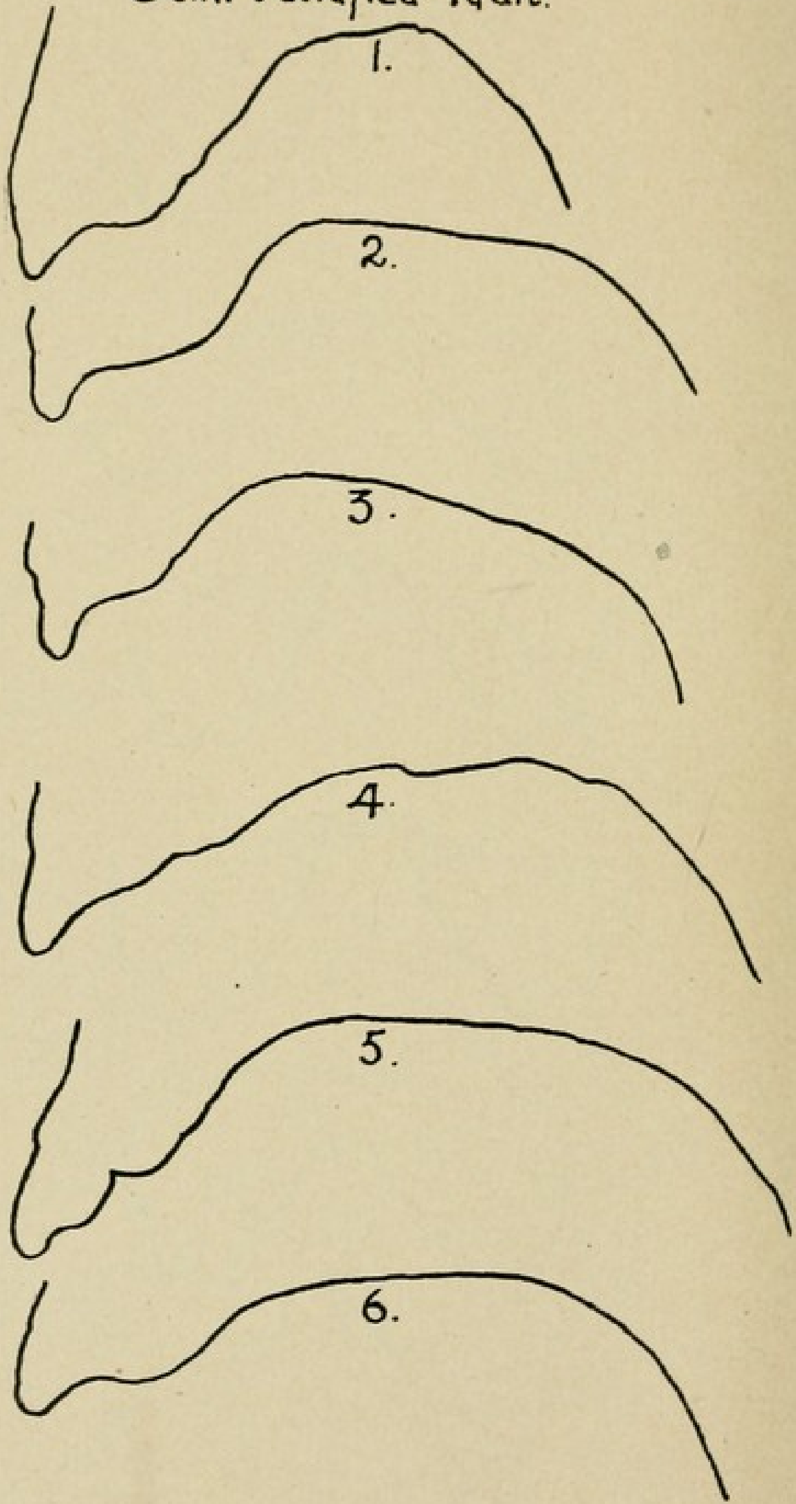


PLATE 38

Semi V-shaped Vault.

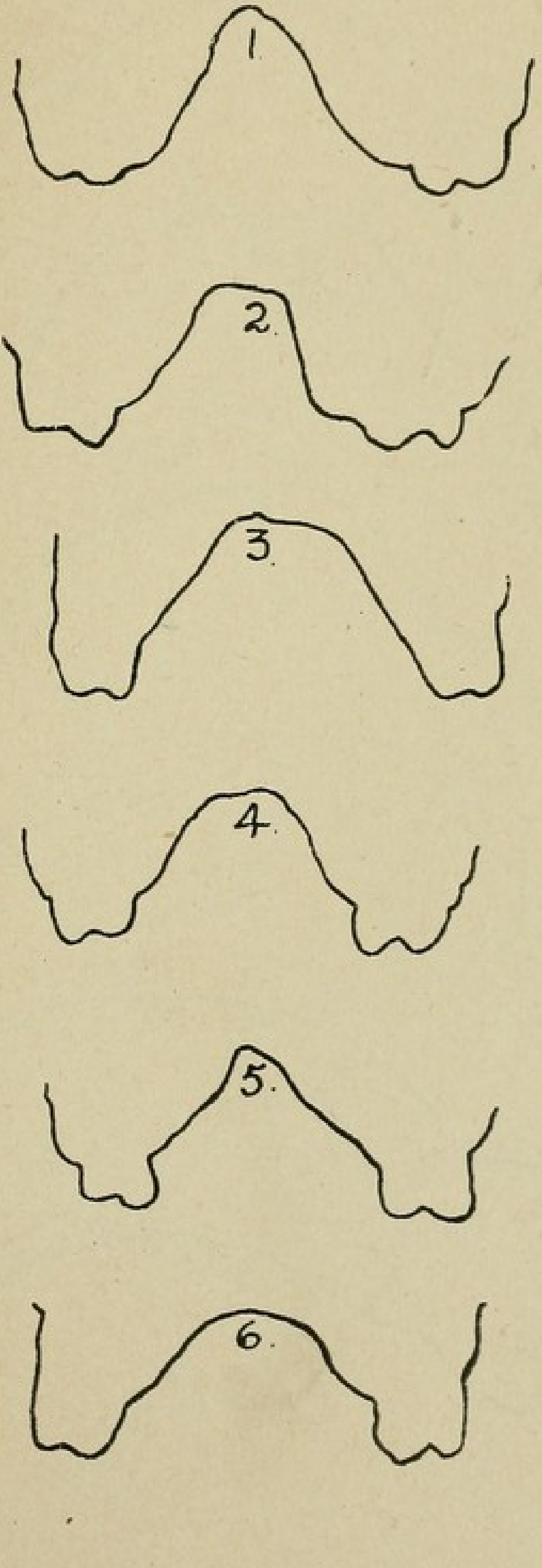


PLATE 39

Saddle-shaped Vault.

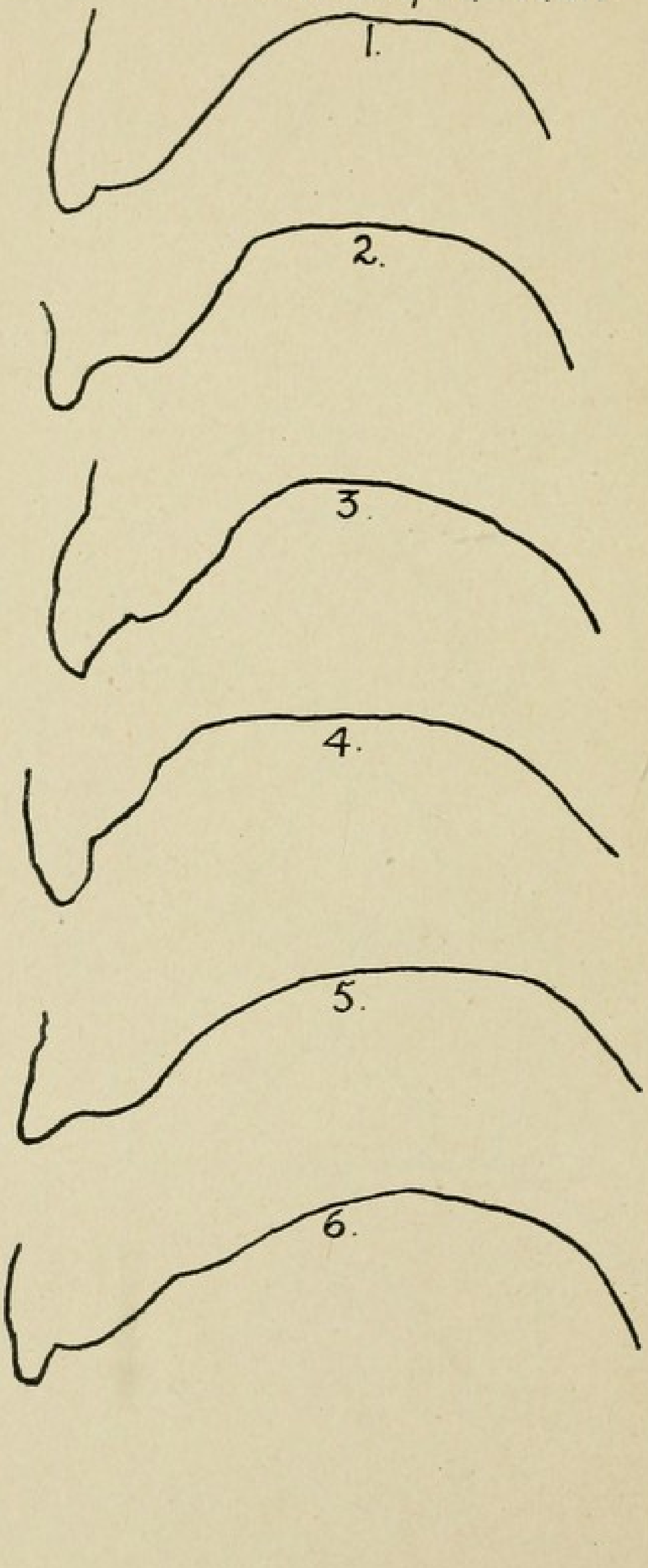


PLATE 40

Saddle shaped Vault.

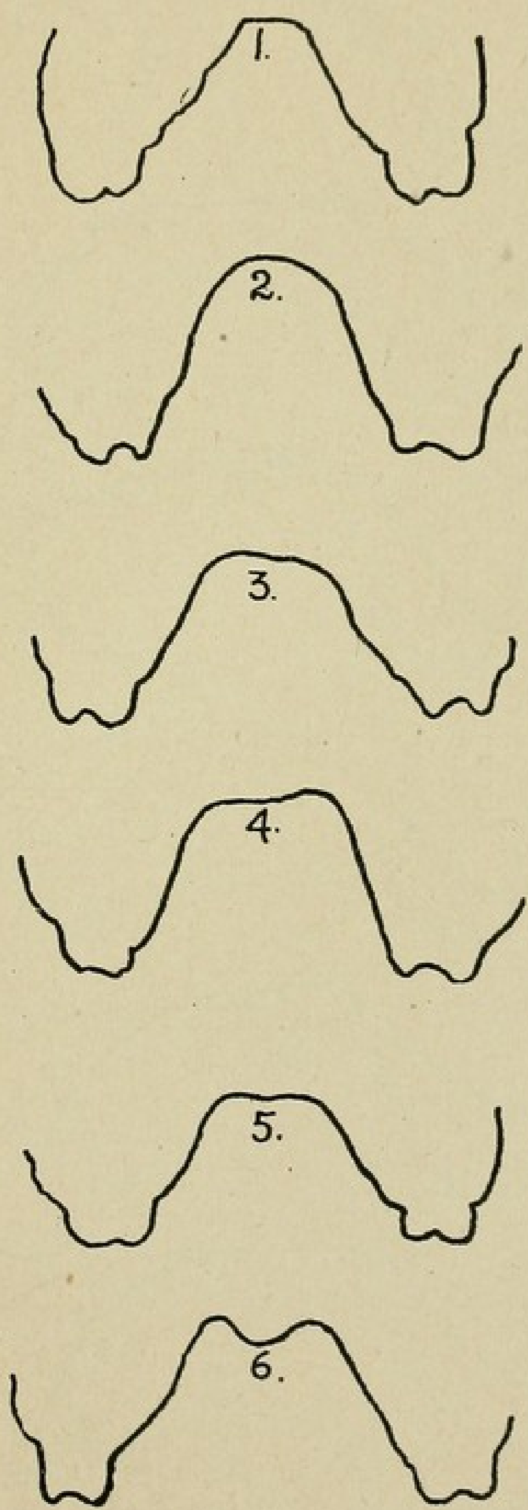


PLATE 41

Semi-saddle Vault.

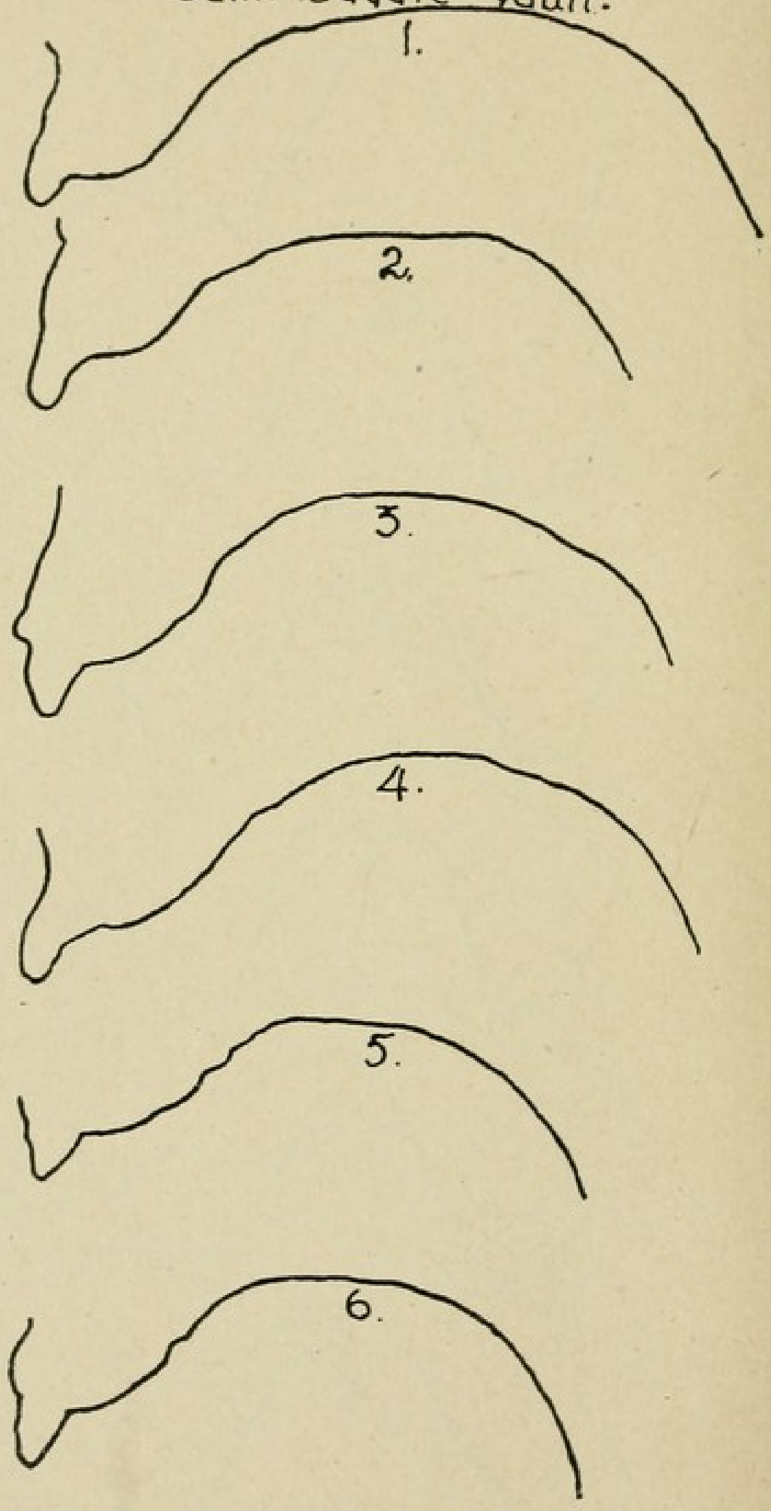
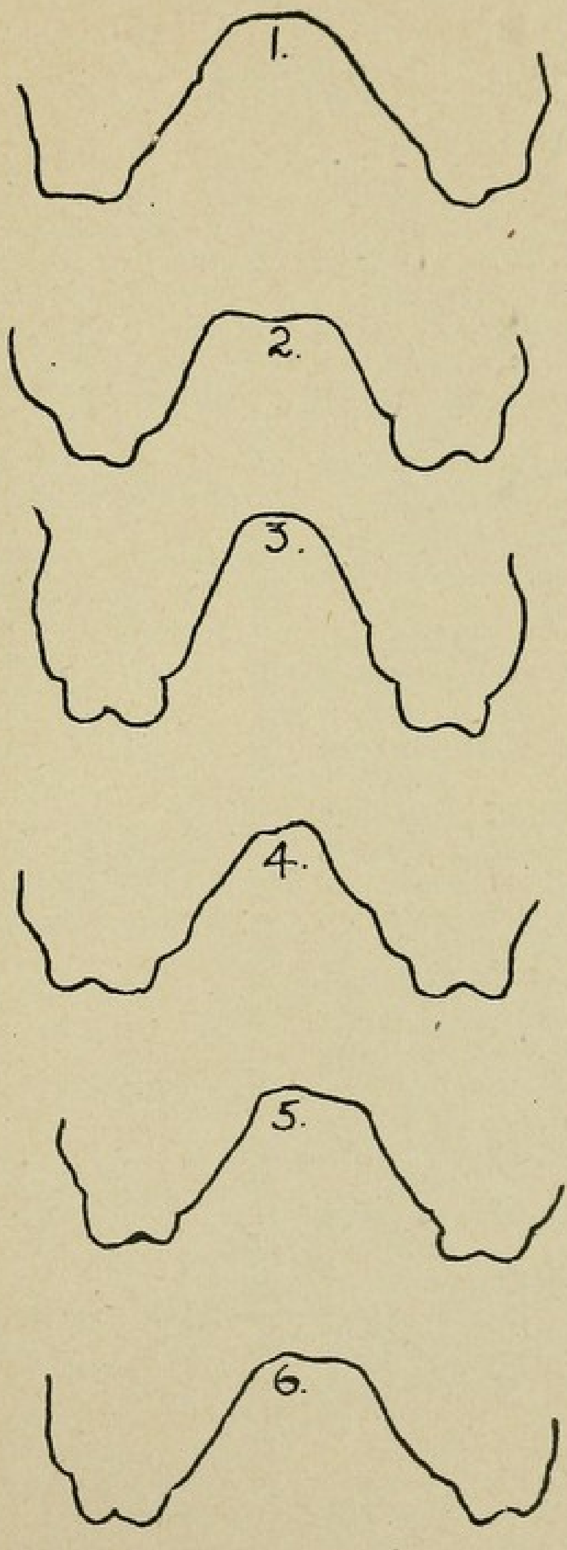


PLATE 42

Semi-saddle Vault.



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