Ethnographic odontology : the Inca Peruvians / by A.H. Thompson.

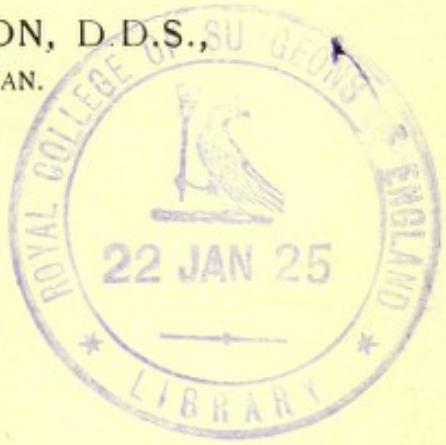
ETHNOGRAPHIC ODONTOLOGY; THE INCA PERUVIANS.

With compliments

BY

A. H. THOMPSON, D.D.S.,

TOPEKA, KAN.



Read Before the National Dental Association, 1902.

Reprinted from DENTAL DIGEST, January, 1903.

ETHNOGRAPHIC ODONTOLOGY; THE INCA PERUVIANS.

It is not my purpose to tax your patience by making any extended apology or giving any explanation of the general value of the study of the ethnology of the teeth. That has been done elsewhere. Suffice it to say now briefly that my studies in comparative odontology have naturally led up to the subject of the comparative study of the teeth of the various races of mankind, with the object of differentiating the characteristic ethnic features. I have been greatly disappointed that the literature of the subject, in which I hoped to find data from which to form deductions, was not only very meager, but that what little has been written upon the ethnologic characters of the teeth is of little value, owing to the want of exact observations of the minute anatomical features of the teeth, which we, as dentists, are accustomed to observing in practice. I shall not attempt to discuss what has been written upon the general subject at this time, but confine myself to the presentation of some original work that I have attempted in one small field, and which is intended to be more suggestive than exhaustive. I shall not even try to present an analysis of what I have been able to glean from this field, but undertake the description only of what I have observed. We are not yet in possession of the data to make any generalizations or deductions in any field of dental ethnology, so that our first duty is the accumulation of facts and their classification. That is what I shall attempt in this paper—the presentation

of classified observations in a very limited field. I hope also that this study will interest some of my hearers sufficiently to induce them to take up the investigation of some race that may lie at their hand, and thus contribute to the general fund of knowledge upon this important subject. We must have masses of facts, from which it is to be hoped in time that valuable deductions may be made, but

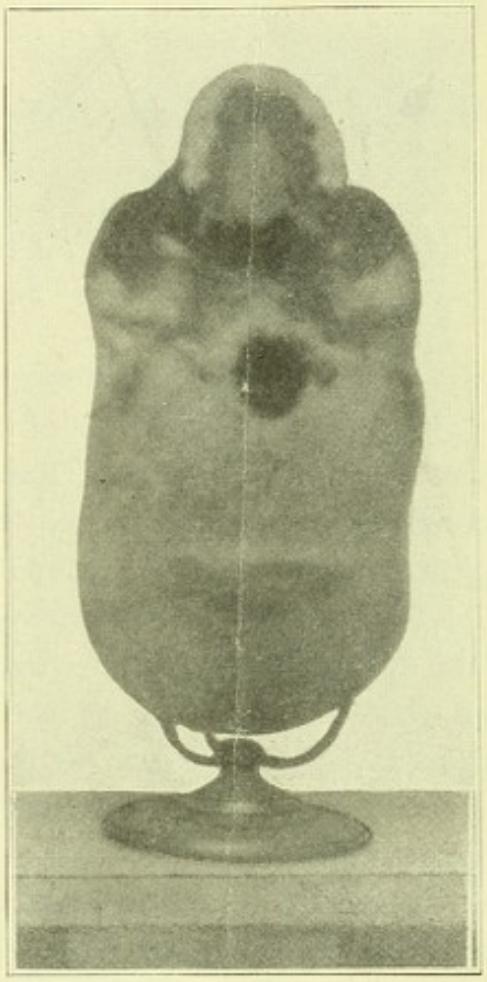


FIG. 1.

Elongated, compressed skull of Peruvian of the plateau.

that time is not yet, and we must avoid above all things too hasty generalizations.

I have been enabled to carry on some investigations upon the teeth of the ancient Peruvians in various museums of the United States which are especially rich in their skulls. I made extensive and minute notes upon about 500 Peruvian crania, from various parts of that country, and while this is not a great number, they

may be considered as fairly typical, and the averages would not probably be altered much in a larger number, considering the minute details noted. The conclusions, I think, may safely be trusted as fairly representative of the general characteristics of the whole people, but may perhaps be modified in some respects by further observations.

The ethnology of the Peruvian nations is very obscure and not well made out. Most writers speak of them as being rather heterogeneous, and that the empire of the Incas in its palmy days was made up of many various tribes which had been conquered and absorbed into its body, but without much assimilation. Prichard says that, "The Andean family comprehends the principal nations of the South American Cordillira, including Peru, Chili, and some adjoining countries. These nations, though differing in language and manners, have certain traits in common. They are of a clear olive brown and small of stature. The Quichua or Inca Peruvians were the most important of this stock, among whom nearly all the civilization of South America existed. The Quichuas were the dominent race and had considerable mental culture and ability, and developed a wonderful civilization on the high plateaus of the Andes. The Quichua Peruvians were of small stature, so that the skulls are not large, and those of the Incas and upper classes are refined and delicate in structure, quite like the better class of Europeans. They are, indeed, quite of the type common to highly civilized nations. There is considerable uniformity within different groups, as with the large, coarse Aymaras of the Titicaca region, who dominated the plateau, and of the other group, the smaller and finer Quichuas of the coast and the Inca classes. These were mixed during the progress of the Inca consolidation of the tribes of the regions of Peru, for the Incas had the policy of all great conquerors —of moving and mixing populations. So the two main types of the bandaged long-heads of the Aymara, coarse peoples, whose home was the plateau, and the other group of the smaller, refined type, Quichuas of the coast, who flattened their heads, are mixed considerably by immigration. Still, they were not homogeneous and are readily distinguished by their peculiarities, both osseous and dental."

The skulls of the Peruvians are usually small or medium in size,

and of the brachycephalic form, with a tendency to bulge at the parietals. The forehead is narrow and receding, and the glabella and superciliary ridges are not prominent, except in large, coarse skulls. The jaws are light and orthognathous, prognathism not being prevalent in the higher types. The head, being narrow at the frontal region, and wide and bulging at the parietals, presents a type that is striking and characteristic, but the most extraordinary thing about the Peruvian skulls is the artificial deformation that

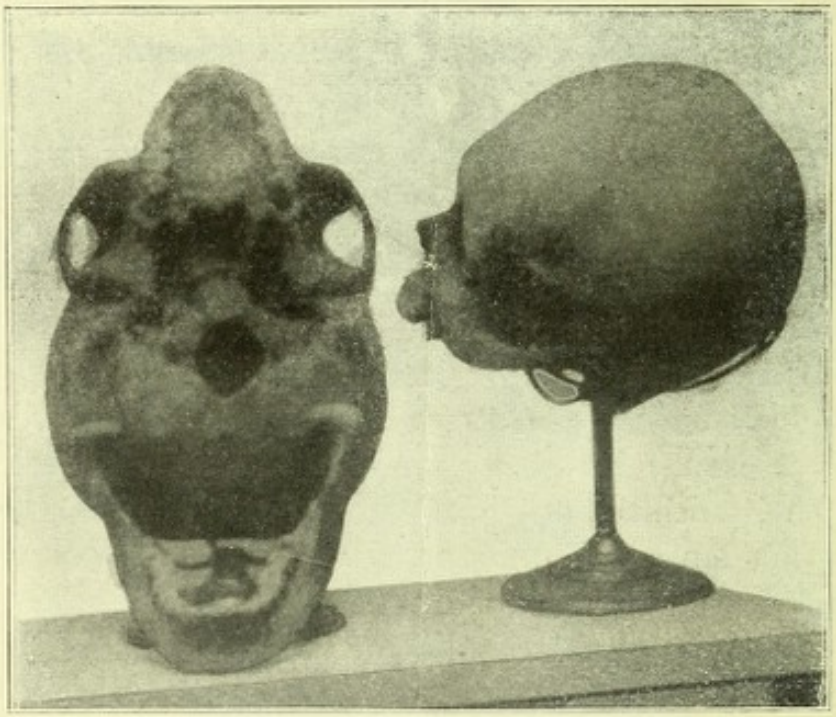


FIG. 2.

Flattened, compressed skull of Peruvian of the coast.

was practiced for the mere purpose, apparently, of changing the shape of the head in accordance with the dictates of fashion.

Prof. J. Wyman says, "The Peruvian crania present two modes of artificial distortion commonly seen, namely, those from the chulpas or burial towers of the district of Lake Titicaca being lengthened, while those from nearly all other localities are broadened and shortened by flattening of the occiput. Round about Lake Titicaca and the region of the plateau are found the elongated skulls, which are altered in shape so as to be small in diameter and longer behind than normal. This was evidently accomplished in

infancy, while the bones of the head were soft and pliable, by binding with thick, stout cords of hair and wool, wound round and round. Skulls have been found with the tightly wound cords still in position. That children often succumbed to the cruel custom is evidenced by the number of young crania that are excessively elongated. These elongated skulls are found principally in the Aymara district, and it is supposed that this tribe inaugurated the custom, and it then extended to nearly all the region of the plateau and thence down to the coast. Along the coast the fashion of compressing the skull was different. The head was flattened from forehead to occiput as if between boards, so as to project greatly at the parietals. This was the style at Pachacamac, Aucon, and other coast places. This form is quite like that of the Flathead Indian and other tribes of the Northwest coast of North America. The bulging of the parietals is very marked, and is not always symmetrical, but often "lop-sided," so to speak. One side apparently got the better of the other and soon went beyond control and bulged permanently more than the other. A deep valley often ran over the parietal suture between the bulged sides."

M. D'Orbingy observes, "In the flattening of the frontal bone, in the projection that it forms over the bones at the upper part, there has evidently been compression before and behind, which has forced the mass of the brain backwards by pushing, as it were, the frontal bone over the parietals. . . . There is also obliteration of the sutures at all points affected by the pressure, even in the heads of the youngest subjects."

Our especial interest in these compressed crania is to observe if the custom had any effect upon the form of the jaws. We might expect that the distortion of the bones of the cranium would affect the position and articulation of the upper maxillary at least and cause deformity of the arch, but this was not observed in any of the compressed skulls examined. The arch was full and normal and of beautiful outline in nearly all that had full dentures. Neither the elongated nor the flattened forms seemed to present any deformity that might not have arisen from congenital causes. There were deformed jaws, of course, and some of them were associated with the artificially compressed skulls, but it was not appar-

ent that the deformity could have been in any way connected with or due to the compression.

One interesting feature was the frequency of the Inca bones in the lambdoid and parietal sutures, especially the former. They occurred with great frequency, of every size and location in these sutures, the most common perhaps being a large triangular bone at the junction of the sutures. The Incas made a specialty of them,

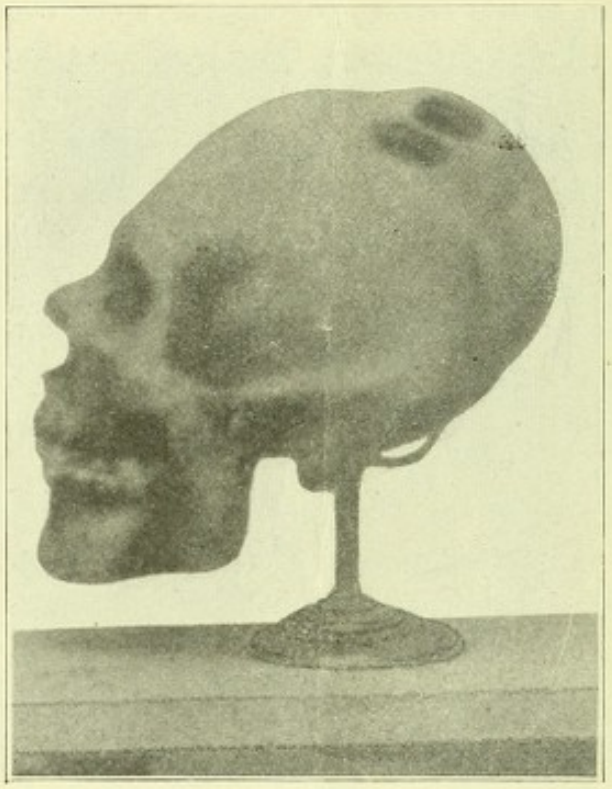


FIG. 3.
Elongated Inca skull, with double trephine.

so that the old name for these aberrant elements in their anatomy seems quite appropriate.

A conspicuous facial feature was the high nose, which the Incas and aristocratic classes possessed as an evidence of blue blood. It was a distinctly aristocratic feature, as is shown by the high nasal bones of the Inca. Mr. Squier found some of the descendants of the Peruvians in modern Chimu whose profiles compared with those of the portrait vases found in the ruins of Grand Chimu. Portraits of the Incas are also seen with this aristocratic feature, having noses quite of the high Roman type.

A matter of remarkable interest in the skulls of the ancient Peruvians was the number that had been trephined. This operation seems to have been a veritable medical fad among them, if we may judge by the number of skulls that have been operated upon. The operation was evidently performed with a graver or chisel, by simply gouging out four lines that crossed each other and cutting out a square piece. It makes us shudder to think of the operation. Let us hope that they humanely employed the narcotic and anesthetic effects of the coca plant which they used so extensively. That they survived the operation is attested by the skulls that have been found in which the trephined space is partly or entirely closed, with signs of inflammation of the bone. Other skulls show that the victim died before the operation was completed, as it was left unfinished.

The purpose of the operation is not quite clear. It may have had a superstitious significance, but that it was a fad or fashion there seems no doubt. It was probably a medical fad, like blood-letting in our grandfathers' days, and that they had the courage of their convictions the many skulls operated on attest. One reason for performing it probably was for injuries, and as a surgical procedure the treatment was rational. Small perforated wounds of the skull, such as would be inflicted with the star-like stone or bronze club that they used, or spear or arrow heads, would need just such an operation, and there are skulls with such injuries that have been treated by trephining.

The Teeth in General.—The teeth of the Ancient Peruvians presented some general characteristics that must first command our attention. In the first place, having an advanced civilization, we find some corresponding effects on structure due to such environment, as might be expected. Observations made on the skulls show that their civilization and luxurious surroundings, such as they were, had an effect upon the jaws and teeth, resulting in disease, deformity, irregularities, missing teeth, contracted jaws, delicate bones, etc., among the better classes. The writer was reminded that we would need to remodel our concepts in regard to the effects that civilization has had upon the teeth. A half century ago it was quite the fashion to assume that savage and prehistoric people had better teeth than civilized nations, and because they lived closer to nature and ate coarser food. Then some extensive inves-

tigations carried on in different countries on savage and prehistoric skulls disclosed the fact that there was much dental disease and deformity among them, and the pendulum swung too far the other way, and that is where we are to-day. But in the presence of the disease and deformity exhibited by the cultivated Peruvians, we will evidently need to remodel our theories again and return in a degree to the ideas of the pioneers of fifty years ago. This, of course, with some modification as to the prevalence of defective structure and disease as between savage and civilized nations. Here we have an ancient people, but one with considerable culture and living in luxury. Of course there was considerable abrasion of the occlusal surfaces, as might be expected with their usual diet—

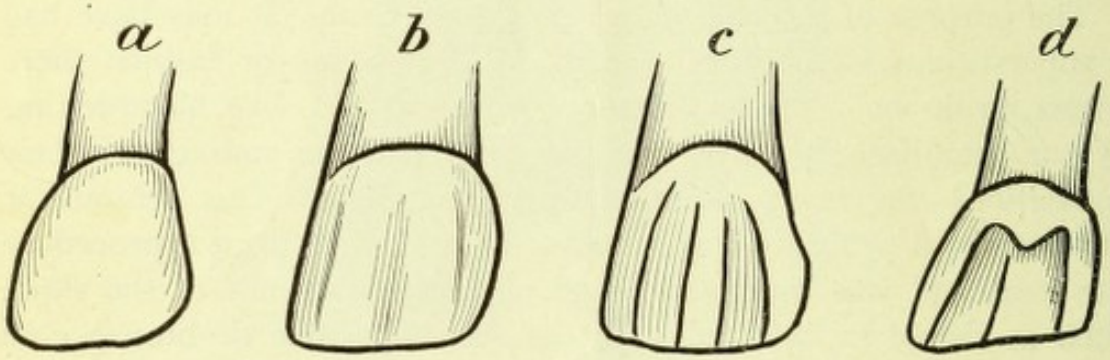


FIG. 4.

Upper centrals from Peruvian skulls. *a*. Narrow neck. *b*. Wide neck. *c*. Ridges on labial face. *d*. Ridges on lingual face.

maize, with its abrading silicious covering of the grain, the grit that entered into the meal prepared in stone mills, and other forms of coarse food. There was much evidence of alveolar abscess from this abrading and exposure of the pulp. Great cysts in the jaws told stories of suffering that were only too plain. No adult skulls were observed in which there was not considerable abrasion, and in the older ones it was very destructive. Only in the young skulls could the pattern of the occlusal surfaces be made out minutely. This wear of the teeth was probably often caused, as in the modern Peruvians, by chewing the coca leaf with its own silica, mixed with a gritty substance called *Llute*, made of wild potato, calcined shells and ashes of cacti, or other plants rich in alkali.

There was some caries which was occasionally very destructive,

but not a great amount. The percentage of carious teeth was very small.

Considerable salivary calculus was found in some skulls, but not many where it was present in great quantity. It was often associated with teeth that were extensively carious, and the disuse of one side had allowed calculus to collect on that side. The deposit was often discolored brown or green, which was probably due to the excessive use of coca leaves.

A remarkable circumstance was the frequent occurrence of teeth that were stained by coca leaves to a dark green or blue. This habit was and is to-day a most remarkable one. The leaves of the plant, *erythroxylon coca,* were considered sacred and the chewing of the leaves was accompanied with considerable ceremony. The plant has always been extensively cultivated in Peru and the use of it is of great antiquity. It is both stimulant and narcotic, and the habitual user requires very little food. Tschudi says "That all who masticate coca have pale lips and gums, and greenish teeth." As the leaves are mixed with unslacked lime in chewing, it is not surprising that the stain should be thorough and permanent. It would be interesting to make microscopic sections of coca-stained teeth to see how deeply it extends. It does not seem to be deleterious to health when not used immoderately among the Peruvians of to-day. Laborers demand it in order to sustain prolonged exertion, which it undoubtedly does. The amount of fatigue which it will enable the Indian to endure is something marvelous. It also assists respiration at high altitudes and materially aids in making life pleasant there. The plant was regarded as mysterious and religious, and was placed in the mouths of mummies and about them, so it entered into the life of the people to a great extent, both in utility and ceremony. It was a great gift to the world also, for the alkaloid, cocain, obtained from it, which we employ so much, has been of inestimable service in the alleviation of human suffering.

The deciduous teeth of the Peruvians were well developed, but without any special characteristics that would distinguish them from other races. This is not unusual, as they are always less differentiated than those of the permanent series. But they are strong and well developed, and show from the abrasion on the occlusal surfaces that they were well used. Like all the organs of

the immature individual, the deciduous teeth have few features that indicate the differentiation that is so apparent in the structure of the adult individual of the higher organisms.

The Upper Central Incisors.—There are some marked differences to be noted between the tribes of the coast and those of the plateau, in regard to the characteristics of the central incisors. The bandaged, elongated-headed people of the Titicaca region especially, who were largely Aymara stock, were larger and coarser in structure and the teeth and jaws partook of these characteristics. Some of the aristocrats, the Inca classes, of Quichua stock, as well as

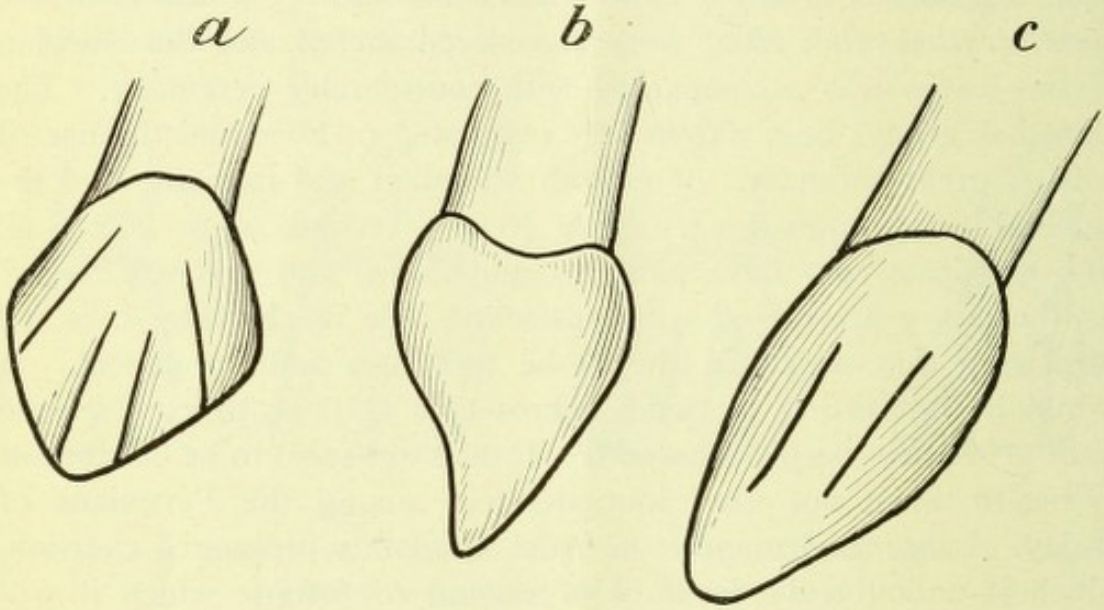


FIG. 5.

Upper cuspids. *a*. Spear-shaped crown. *b*. Mesial view. *c*. Conical form.

most of the people of the coast with flattened heads, were of smaller frame and finer organization. The Quichua skulls in the plateau region were of finer type and resembled the forms on the coast. These types are very interesting, and especially so by reason of their association with types of people that are so distinct. We find these qualities carried out in regard to many characteristics of the teeth.

Upper centrals were not very numerous as compared with other teeth, as they were more often absent from the skulls, probably owing to the short roots which allowed them to be easily detached and lost. Then those remaining were often much worn and abraded, usually to one-third or one-half of their length, and the special

features obliterated, so that the best specimens for study were found in young individuals, and especially when in the crypts and not yet erupted.

On the coast, as in the huacas of Ancon and Pachacamac, where the people were small and of delicate structure generally, we find some marked peculiarities of the upper centrals. They were medium to small in size, and of a general form in that the lower half of the crown was wide and parallel, and from there the crown tapered rapidly to a narrow neck. This form seems to be associated with the coast people, with fronto-occipital flattening of the head. The marginal and median ridges were not marked on the labial face. Transverse ridges were not uncommon, but as these were probably due to pathological causes, they are outside of our studies just now. The sulcus on the lingual face was well marked, with well defined marginal ridges. Cingules were very rare with these people.

With the coarse people of the plateau, of evident Aymara stock, the centrals were of different form. The main characteristic was, that with a large coarse crown with rounded face there was associated a wide neck that was conspicuous. Sometimes in the coarsest specimens there were strong ridges, both marginal and median, on the labial face. These features are distinctly low and apelike. The ridges on the lingual face were of course strongly marked in the coarse tribes, and the cingule occurred more frequently. The roots of the centrals were usually rather short and stout in the coarse peoples and smaller and longer in the finer tribes. Some abnormally short roots were observed.

The *upper lateral incisors* partake of many of the characteristics of the centrals, especially as between the coarser peoples of the plateau and the finer stock of the coast, i. e., the former have large coarse crowns with wide necks, and the latter have smaller crowns with narrow necks. In the unworn specimens of the laterals the edge is wide and well marked, defective crowns, as with Europeans, being almost unknown among the Peruvians, even with the delicate luxurious classes. No peg-shaped laterals were found at all, which would have been unusual if not impossible among a similar number of Europeans. On the plateau the necks were wide with strong ridges, and on the coast the crowns tapered rapidly to narrow necks

and with smooth labial faces. The lingual face was also more smooth on the coast among the finer Quichuas, but with the coarser Aymara peoples of the plateau this face was strongly ridged with a deep sulcus and occasionally a cingule. But even with the latter the cingule was singularly infrequent. Rarely the deformity of the deep groove crossing the basal ridge over onto the neck of the tooth was seen. A few supernumerary laterals were found, but rarely was one totally suppressed, as so often occurs in Europeans. This does occur, however, as has been described by Dr. Dorsey.

The *lower incisors* ranged in size from medium to small, especially on the coast, where they were often quite delicate in form

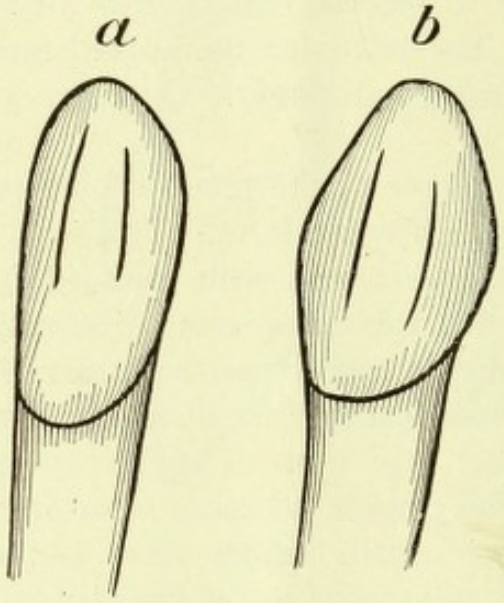


FIG. 6.

Lower cuspids. *a*. Ordinary conical form. *b*. Spear-shaped form.

and size. They were usually wide at the edge, especially the laterals, which had rounded distal corners when unworn. Rarely there was uniformity of width of the centrals and laterals. The necks were usually very narrow and delicate, especially in the finer Quichua types. Occasionally these teeth were very large, especially among the course types of the plateau, and in these the uniformity of size was quite apparent. Excessive wear had been very destructive of these small teeth, so that very few even of the few lower incisors remaining presented unabraded edges. The primitive edge

was found in young individuals, or in the rather numerous cases where irregularity of these teeth had removed them from the area of mastication or use. In such cases the edges were serrated as in the common type of these teeth in children.

The *upper cuspids* remaining are more numerous than the incisors, but present a larger proportion of excessively worn and fractured crowns. Having to bear the brunt of hard usage on account of their strength, the effects are only too apparent. It was rare to find an adult skull in which the cuspids were not worn off one-half or more, or much fractured. Of course this fact prevented the study of their main features except in young individuals. Too often only the general outlines could be made out.

The cuspids presented more variety as to form and size than the incisors. In general they were large and spear-shaped (i. e., the labial outline was like a spear head), with ridges more or less strongly marked on both labial and lingual faces. The labial face was usually full and round, especially towards the cervical border, and the mesial and distal angles were full and either sharp or round. This general form was apparent even when the crowns were worn away one-half or two-thirds, as was too often the case. In the older specimens the labial and lingual faces were worn smooth and rounded. Only in the young were the ridges apparent. The roots were large, long and deeply implanted, some crowns being one and a half inches long, and the eminence was well marked. In the coarser types they stood out strongly at the angles of the arch, making the characteristic squareness, but in more delicate skulls they were reduced, being small and depressed, and the arch was more rounded. In children especially, when the crowns were still in the bony crypts, the point was small and acute, showing a long and sharp type that is rather low. This was especially the case in the more conical types of the crown which occurred on the coast and among the Quichua tribes. In these finer types the cuspid was longer and more narrow, in conformity to the type of the teeth in general. This long conical cuspid is characteristic of many low races and of some of the quadrumana. Sometimes the bulge of the labial face was absent, as if worn away, and the surface was quite flat. This was found more among the coarse types of the plateau, the full face being found more in the conical types. Transverse grooves

were present on some crowns, but these were evidently pathological or were the result of the corrosive action of the coca-lime mixture that was chewed so much.

The *lower cuspids* do not present many distinguishing features. Like the most of the other teeth there are some differences between the coast or Quichua people and the plateau or coarse stock. In general these teeth are large and conical, but on the plateau they are larger, with a tendency to flattening of the labial face and spreading of the mesial and distal faces so as to approach the spear form of this face of the upper cuspids. On the coast they are more conical, with the labial face full and rounded, the mesial face flat and perpen-

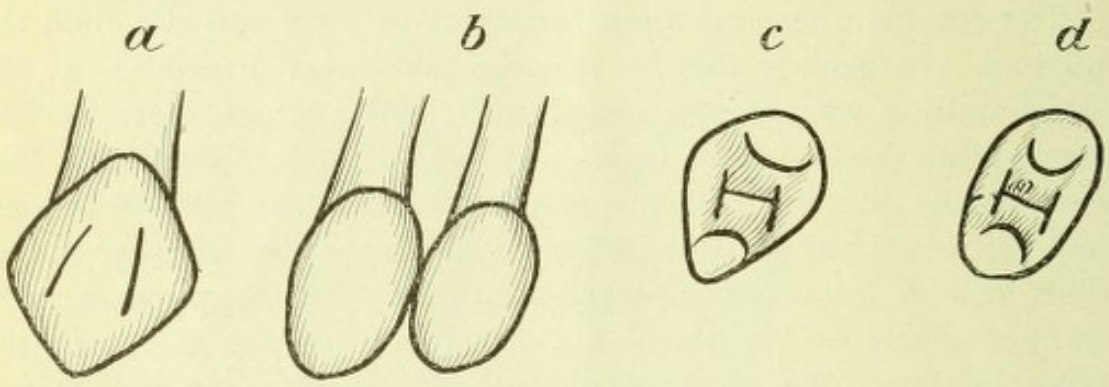


FIG. 7.

Upper bicuspids. *a*. Flaring form of buccal face. *b*. Oval form. *c*. Occlusal face, showing wide buccal cone and very narrow lingual. *d*. Oval form of occlusal face.

dicular, as in Europeans, and with more or less fullness of the distal strong ridges also in this class, but rarely or never a cingule. In worn teeth these ridges are of course obliterated and both faces of the crown become smooth, especially in the more conical cuspids of the finer coast people. With the latter both faces are more smooth than those of the plateau, at any rate. As these teeth were exposed like the upper cuspids to hard usage, they likewise became the victims of destructive abrasion, so that in all adult skulls they were much abraded and in aged subjects were worn to the neck. This fact face in the well known form. In the coarse form of the plateau there are often, in unworn teeth, conspicuous ridges on the labial face, at the marginal edges and in the middle. The lingual face has interfered with the study of their microscopic features except in young or unworn specimens.

The *upper bicuspids* in all of the Peruvians, except a very few skulls of very low and coarse type, were comparatively small—even more so than among Europeans—as compared with the other teeth in the same denture. This is in accordance with the idea of degradation due to defective structure consequent upon civilization. Both on the plateau and on the coast, among the coarse and finer types alike, the general form of these teeth is with the crown flaring on the buccal face, i. e., is much wider at the marginal ridges than at the neck. This form is modified in old skulls in which the teeth are much worn by the interstitial wear, when the proximate faces become quite flat. There seems to be a perceptible difference between the outlines of the crown of the bicuspids of the long-headed people of the plateau and the flat-headed people of the coast. In the former the buccal cone is quite wide mesio-distally and the lingual cone is much narrower in the same direction. On the coast, however, the two cones are more equal in size and the outline is more flat and less oval than on the plateau. This is only general of course, as exceptions occur among both peoples, as stray individuals of the other tribes may have been among them, but the rule as applied to both is sufficiently uniform to have a value for classification.

The *second bicuspids* were usually smaller and flatter than the first. With all of the features less strongly marked, the contrast was often striking. The excessive wear to which these teeth were subjected had the effect of obliterating the occlusal pattern in most of the adults and in all of the older skulls. When found in young individuals the cusps were well marked, rounded, and not much ridged or sharp, and very rarely were they high and strong, except in very coarse individuals. As a rule the cusps and ridges were not sharp nor well developed, but decidedly degenerate in type. No cases could be found in which three roots were apparently present, as sometimes occurs in low races as a reversion.

The Lower Bicuspids.—These teeth present so many distinctive features, and are so interesting from the ethnical standpoint, that it will be desirable to go into some detail in their description. The *first lower bicuspid* varies greatly in some of its features, and especially in regard to the lingual cusp or tubercle. This ranges all the way from a full form that is on a level with the buccal cusp, down to the mere tubercle like a cingule on the basal ridge. Between

these extremes there are all sorts of variations in regard to the height of this cusp. To distinguish these variations, it will be necessary to classify them in a scheme, something like the following: What we will call the *first* position of the cusp is that shown at a, Fig. 8, where the lingual cusp is on a level with the buccal, and together they form the full bicuspid type of the tooth. The wider marginal ridges make a different-shaped crown, but still this type of the full lingual cusp makes a bicuspid crown. The next is the *second* position of the cusp, when it is about ⅛ inch below the first (as at b). This is the type of most frequent occurrence in the Peruvians and

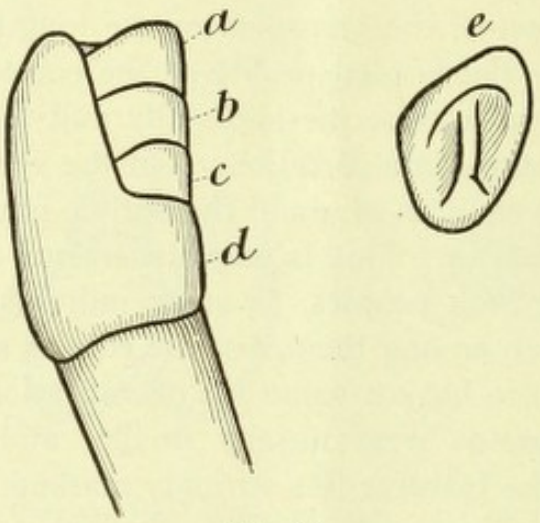


FIG. 8.

First lower bicuspid. *a*. First position of lingual cusp. *b*. Second position. *c*. Third position. *d*. Fourth position. *e*. Occlusal face, showing peculiar form of disto-lingual projection.

also in Europeans and other civilized peoples. The *third* position is that between the second and the fourth (as at c). The *fourth* position is the lowest (as at d). This is the lowest type of the crown, when it seems to be a mere cuspid with a cingule upon its lingual face, which is indeed the form of this tooth in the lemurs and the insectivora. By this classification, after making a tabulated arrangement of the percentages, the following averages were found among the Peruvians, taking all together: Five per cent had the lingual cusp in the first position and were of full bicuspid form; sixty per cent had it in the second position; thirty per cent in the third position, and five per cent in the fourth, i. e., a mere cingule on the basal ridge. Of course there were some differences between

the coarse tribes of the plateau and the finer stock of the coast, as with the other teeth, but this was not followed out.

Of other features, it was observed that the first bicuspids below were of larger size among the plateau tribes and smaller with the people of the coast. One general feature was the full bulge of the buccal face, which was well marked. Then also, the very wide marginal ridges usually exaggerating the well known bell-shape of the crown. Nearly all of these teeth are described as "flaring" in my notes.

Among the coast tribes there often occurs a form of the lingual cusp, mostly when it is in the third position, which is a peculiar feature. This is a prolongation of the lingual ridge disto-lingually so as to appear as a shelf or talon. This peculiarity was found in a number of cases. Sometimes the entire crown was also distorted to form a partial diamond-shape, although this talon occurred also when the crown was full and round. This is interesting as a unique and unusual feature, but it is without any ethnic significance that could be observed.

Among the coast tribes there is often a conical form of this tooth that is associated nearly always with the cusp in the third position or as a cingule. This is a low type, as it simulates the cuspid which, as observed before, recalls the form of this tooth in the lemurs and the insectivora.

Wear of course obliterated the lingual cusp when in the first position, and sometimes in the second, but unless it was very excessive the third position was not approached, hence a diagnosis could be made in most of the first bicuspids. The indications of the height of the cusp remained fairly well, even when the wear had been considerable. The transverse ridge was usually quite complete across the face of the crown. It was divided by a groove, of course, when the cusp was in the first position and sometimes in the second, but rarely in the third or fourth. But the ridge was always strong, whether divided or not.

The Second Lower Bicuspid.—The crown is of the typical bell-shape in most of the Peruvians; in all of my notes it is described as "flaring." Some are bulged on the buccal face, but as a rule not so much as the first. Indeed, the full or rounded buccal face occurs only on the very large, coarse specimens, as with the Aymara type

of the plateau. Both the coarse and finer types seem to flare very much. The simple conical type is very rare and found only in the Quichuas, when the tooth approaches the first in type, with the lingual cusp in the fourth position or the cingule.

The most remarkable feature about the second lower bicuspid in the Peruvians is the almost total absence of the tricuspid form of the occlusal face, which we usually associate with civilization and elaborate though degenerate structure. It is the type of high evolution as well as of degraded structure. The ethnic significance of the tricuspid second lower bicuspid is very interesting, but "that is another story." Suffice it to say that it is rarely found in peoples of low culture and coarse structure, but is usually present in higher peoples, as the Europeans. In low peoples this tooth is not developed beyond the type of the first bicuspid, but unlike the first, it is more differentiated in the higher races and usually presents three cusps. It is more or less of an accompaniment of civilization. So that it was with some surprise that the absence of the three cusps was observed in the Peruvians, as some of them were highly civilized and of fine and degenerate structure. Instead of the tricuspid type, the occlusal face presented the transverse ridge usual to the first bicuspid, or next in frequency, a large crescent occupying the lingual border, but undivided by the usual groove into two cusps. A tabulated arrangement of the different types gave the following results: Fifty per cent had the strongly marked transverse ridge similar to the first bicuspid, but with the lingual cusp or crescent on the level of the buccal cusp; twenty-five per cent had the well marked crescent on the lingual border, but without the transverse ridge; ten per cent were like the first bicuspid, with the lingual cusp depressed to the third or fourth position; ten per cent were of full bicuspid type, and but five per cent were of the elevated tricuspid type. This is a remarkable showing and indicates the low stage of this tooth among the Peruvians. It shows also that some surprising things can happen in the pursuit of this study, as in other fields of which we know but little. We will need further data before we can decide definitely in regard to this feature, as well as many others in this new science.

The Molars.—The study of the molar series opens up many interesting questions and brings us face to face with some great bio-

logical problems. The path of the evolution of the human molars is so well marked out, and they bear in their forms and features so much of the history of their phylogeny, that they serve to illustrate, as few other organs do, the history of the wonderful processes of organic evolution. We find ourselves in the presence of the stupendous workings of the Master Genius of nature, and guided by the light the phylogeny of the molars furnish, we begin to see more clearly the way of a possible solution of questions that affect the destiny of the race, but again "that is another story."

The *upper first molar* in most human races is usually larger, stronger and more constant in the type of its cusps, than any of

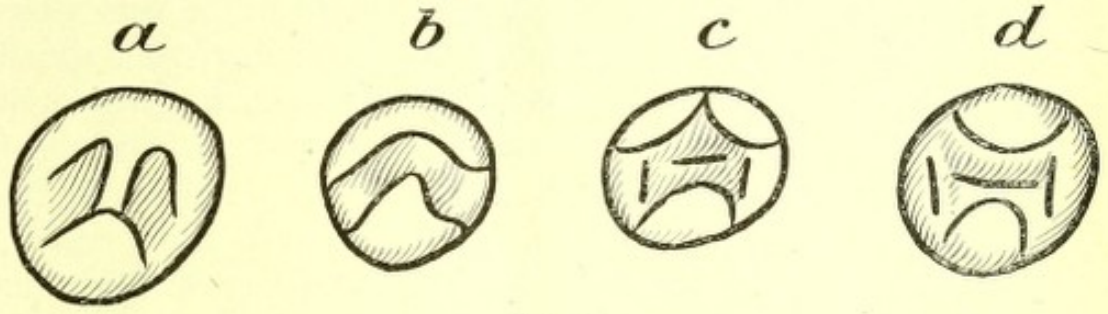


FIG. 9.

Second lower bicuspid—occlusal face. *a*. Transverse ridge form, like first bicuspid. *b*. Crescent form of lingual cusp. *c*. Tricuspid form. *d*. Bicuspid form.

the other upper molars. We are accustomed to observing this in our practice among Europeans, in whom it is very constant. It presents fewer variations and has less tendency to degeneracy of type. So in our observations of this tooth among the ancient Peruvians it was with some surprise that we found considerable variation and degeneracy of its elements. It was most constant to what we consider the normal type among the coarser peoples and most variable among the finer stock, the Quichuas, in whom there was a surprising and unexpected degeneracy. We found first that the ordinary square type of the crown was far from common, and that it often had the diamond or trapezoidal form. These departures from the normal type were caused by the reduction of the different cones of the crown. For instance, the diamond-shape would be produced by the depression of the paracone and the hypocone, the protocone and metacone being as large or larger than usual. The trapezoid would be caused, as usually happened, by the depression of

two cones in a pair, as the protocone and paracone, so that the mesial half would be less in size than the distal. Then the distal cones would be depressed, making that half smaller. This kind of deficiency of form was quite common. Sometimes the hypocone alone was reduced as in the second molar. Rarely it was totally suppressed and made a tricuspid crown. The number of these deficient first upper molars was so great as to be impressive, but they were found most largely, as before remarked, among the finer tribes.

The usual worn condition of the teeth in adults of course obliterated the finer features of the occlusal surface, so it was only in young subjects or in accidentally unworn molars that these could be made out. In these it was found that, except in the very coarse subjects, of course, the cusps were not high and sharp, but usually low and rounded, with few grooves and ridges. A few were quite wrinkled, which is a low quadrumanous type and not common in the first molars, although it is in the third. A wrinkled occlusal face indicates a declining evolution and reversion to a low type.

The fifth cusp, or hypoconule, on the lingual face was very uncommon. This supernumerary cingule is very erratic, being found in low and high races, seeming to be both a reversion and a higher evolution. Only one or two were found in several hundred skulls. We cannot yet guess what this surprising absence signifies. This is one of the many problems that we will pass on unsolved to our successors.

A conspicuous lingual groove was found on most of the first upper molars. This groove divides the two lingual lobes of the crown, and in some races, especially the lower, runs on over the neck and onto the lingual root. This was a very conspicuous feature among all Peruvians, both coarse and fine stock, and is a low characteristic, for it is a remembrance of the time when the root was divided into two fangs. It is not common in Europeans nor in any high races, but is present in most low peoples.

The crowns were usually "flaring" in form, that is, more or less bell-shape, except when worn flat on their proximate faces by interstitial wear in old subjects. The type of molar with thick neck, which occurs among Europeans, seemed to be of rare occurrence in the Peruvians.

The *second upper molar* of course presented more eccentricities of form than the first, as it is always more variable, especially in regard to the hypocone. In Europeans this element is nearly always much reduced, and is entirely absent in a number of cases as we meet them in practice. This was found to be the condition also with the Peruvians, as was to be expected, so there is not much to be presented that is very different. The coarse plateau tribes and the refined coast people exhibited little difference, so the percentages

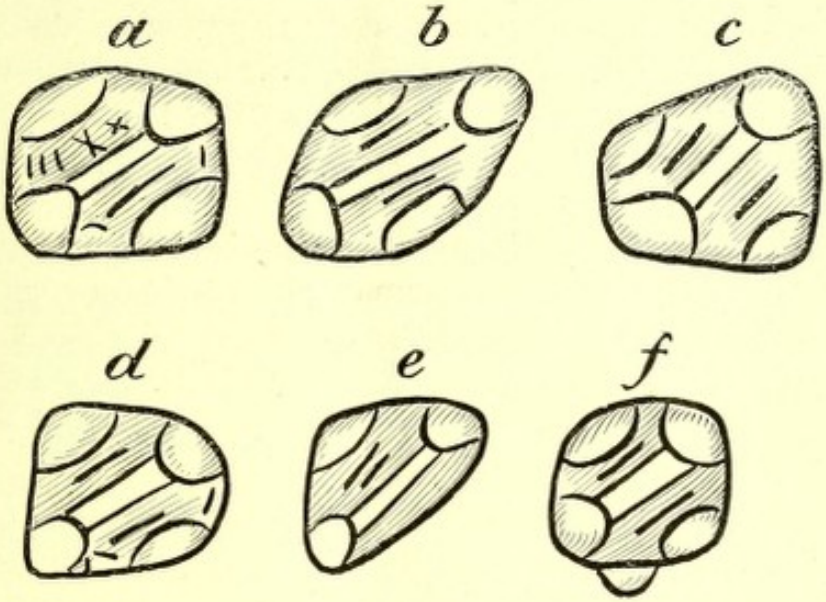


FIG. 10.

First upper molar—occlusal face. *a*. Usual square, normal form. *b*. Diamond form, paracone and hypocone reduced. *c*. Trapezoidal form, paracone and protocone reduced. *d*. Trapezoidal form, metacone and hypocone reduced. *e*. Triangular form, hypocone entirely absent. *f*. Fifth cusp, hypoconule, added to protocone lobe.

are taken together. In the former we would have expected a larger number of full, square second molars, as is common with coarse peoples, but such was not the case, the percentage with them being about the same. The general percentages of all together were as follows: Square like the first molar, the hypocone good, fifteen per cent; of trapezoid form, the hypocone reduced but not absent, forty-five per cent; of tritubercular form, the hypocone entirely absent, twenty-five per cent; metacone also reduced, six per cent; diamond-shape and other deformities constituted the remainder. This list of averages reads very much like that of an equal number

of Europeans, with quite as large a number of tritubercular and trapezoid crowns of triangular shape. Prof. Cope said years ago that this was a lemurine feature, and the reversal to that type was indicative of great degeneracy. The tritubercular molar is found away back in early geological times, even before the first appearance of the quadritubercular crown in Eocene times.

There are not many features of the upper second molar which are variable that do not depend on the presence or absence of the hypocone. The general conformation of the crown depends almost entirely upon its stage of development. Very often the metacone is reduced also, which contributes to the formation of the trapezoid. Occasionally the protocone is reduced and the hypocone enlarged, which produces the diamond form. The two distal cones are always depressed below the ordinary plane of the mesial tubercles, which is normal, but aside from this the deficiency or enlargement of the crown of this tooth is very erratic in the Peruvians. The lingual groove was not very common, except in some of the square crowns, which simulated the first molars in other respects also.

The roots of the second molar were of the three-fanged type apparently, especially in the square crowns like the first molars. In some sockets there was only a rough connate alveolus like that of the conical third molar, and often the two buccal roots were fused or the lingual and buccal would be fused, just as in Europeans.

The *lower first molars* were of great uniformity, of the usual trapezoid outline, with little variation except in size. They were very large in the plateau tribes and smaller in the others. They were more constant in form than the first upper molars and presented fewer aberrations from the usual normal type. The crowns were very flaring, of full bell-shape, spreading widely at the marginal ridge. In some coarse subjects they seemed to be of the oblong outline common to the apes and low races, but this low type was not usual. The variability of the prolongation in the rear depended largely on the position of the fifth tubercle, the hypoconulid, as to whether it was on the buccal margin or was swung round to the rear. When in the latter position the crown was more projecting in the rear.

A typical low feature was the wide sulcus on the occlusal face, the usual triangular ridge not being pronounced. This is character-

istic of the lower molars of the quadrumana, which are all alike. The triangular ridges appear later in the higher forms of the anthropoids.

Sometimes the buccal or lingual marginal ridges were cut by cross grooves, making supplemental tubercles. This variation would make six tubercles on this tooth. This peculiarity was noticed on young subjects where these teeth were unworn, and especially when not quite erupted. It was a curious reversion to the multitubercular form of the lower molars. It has occurred in other races and so has no ethnic significance.

The first lower molar was frequently the subject of destructive wear, so that the finer features were often obliterated, and the wide, worn surface presented the well-known, smooth, polished

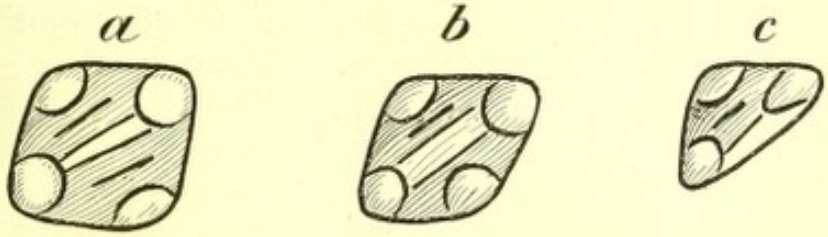


FIG. 11.

Upper second molar—occlusal face. *a*. Square form, like first. *b*. Hypocone reduced. *c*. Triangular form, hypocone entirely absent.

appearance with which we are so familiar in tobacco chewers. Probably it was often due to the same cause, i. e., the keeping and chewing of the "quid" of coca with its gritty ingredients directly over this tooth. There does not seem to have been as much interstitial wear of the lower molars as of the uppers, so that the flaring bell-shape of the crowns was always conspicuous.

The *second lower molar,* like the second upper, is rather eccentric and irregular in form in the Peruvians, quite as it usually appears in the higher races. In the apes and the lower races of mankind it has the fifth tubercle, the hypoconulid, just like the first, and is in perfect harmony with it both as regards size and shape, but in the higher races, especially the Europeans, it is typically and usually quadritubercular, having lost the hypoconulid in the process of its evolution. This is a degenerate type, but the writer has elaborated that elsewhere. (See paper on "The Phylogeny of the Fifth Tuber-

cle of the Second Lower Molar of Man," Trans. of the International Dental Congress, Paris, 1900.) The ethnic significance of this tubercle still remains to be worked out, and taken throughout all races, it would form an interesting topic for study.

Among the ancient Peruvians the degeneracy of the second lower molar was not so marked as was expected, considering the advance the people had made in culture and their consequent general degeneracy. It was found by carefully tabulated estimate that of the whole number examined seventy per cent had the fifth tubercle like the first molar; twenty-five per cent had only four tubercles, the hypoconulid being absent, and the remainder were irregular, partial fifth tubercle, etc. Destructive wear obliterated the features in some, of course. The result of the percentages arrived at was rather surprising, considering the cultural stage of the Peruvians. Of course the most molars with five were found among the coarse people, but were not confined to them by any means. The coast people, especially at Pachacamac and Ancon, had also a larger proportion of five tubercles than of the quadritubercular form. The results would show that this tooth among the ancient Peruvians of all classes had not evolved as far on the road to degeneracy as with Europeans. The significance of the fifth tubercle is of considerable importance in estimating the cultural stage of a people, and if judged by that the position of the Peruvians is still quite low.

The shape of the crown varies with the presence or absence of the fifth tubercle. When present of course the hypoconulid causes a distinct projection of the marginal ridge in the rear, but when absent the crown has a more square form and perpendicular sides, as we observe in Europeans.

In the quinquetubercular form the sulcus is usually quite wide, like the first molar, the triangular ridges being low; but with four tubercles there was the usual cruciform type of surface, the triangular ridges being well developed.

The roots bore some relation to the presence or absence of the fifth tubercle, so far as could be observed. In the quinquetubercular form they were wide and well apart, as in the first molar, but in the quadritubercular type they were more connate and closer together.

The *third molars* are more or less erratic in all races, so there is not much ethnic significance to be attached to their irregular

variations. In general they are more perfectly developed and nearer the typical form of the other molars in the lower races than in the higher. In the latter they are usually very erratic and degenerate in form and structure, but beyond this we can say but little, as no special value can be placed upon their variations. Indeed, these teeth begin to be deficient in size as compared with the other molars in the chimpanzee, but that also "is another story."

In the Peruvians we found great variation and deformity of the *upper third molar,* quite as much as among a similar number of Europeans. Of the number examined it was found that only six per cent were of full form like the other molars; forty per cent were tritubercular in form, large and small; fifteen per cent were

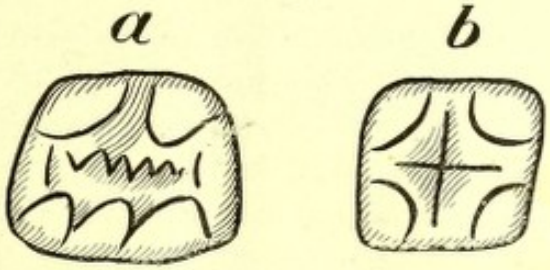


FIG. 12.

Lower second molar—occlusal face. *a*. Five cusped form of normal first molar, found (as ancestral type) as a reversion in second molar. *b*. Degenerate but usual form of quadri-cuspid type of lower second molar in higher races.

trapezoid, with four tubercles more or less irregular; ten per cent were of bicuspid form; ten per cent were totally suppressed, etc. So that the irregularity was very conspicuous and with little value as regards the ethnic significance of the variations. We can only say that they were very degenerate and indicated an advanced stage on the path toward suppression.

The *lower third molars* were generally larger than the uppers and somewhat better developed. They were not so regular in eruption, however, as they presented more cases of diverted direction and impaction. Of the number examined, five per cent were irregular in eruption and impacted, most being tipped against the second molars—some above and below were directed outward, and but very few to the inside; five per cent were totally suppressed, and of these some probably yet remained in the jaw; sixty-five per cent were full size, with four or five tubercles like the other molars; twenty

per cent were small, with four tubercles or irregular; five per cent had the wrinkled occlusal face sometimes found, which is a reversion to the form of these teeth in the orang. A small proportion had abnormally large crowns, as if an attempt to produce the fourth molar had been made and the abortion was fused to the third molar, as is sometimes distinctly observed. Altogether the lower third molars were better developed, but yet were very erratic and irregular, like those of the higher races.

In conclusion, I will offer nothing in the way of a summary, for this study has been only in the way of an experiment, with the purpose of assisting in discovering characteristics that might possibly be considered ethnic. For this purpose, however, we have not yet sufficient data and cannot have without much more extensive observations, so my work must be considered as suggestive merely and as an effort to blaze the way for more elaborate studies and investigations. My mission will have been accomplished if I shall have interested students in the subject of ethnographic odontography sufficiently to induce one here and there to take up and pursue the work among different races. Years of study and masses of material will be required before we can safely venture upon definite generalizations and deductions. I can only hope that this imperfect contribution to the great subject will stimulate the study and gathering of that material.