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The Canine Teeth---

Normal Functional Relation of the Natural Teeth of Man (continued)

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A STUDY OF THE MORPHOLOGY OF THE DENTITION OF HERBIVORES AND CARNIVORES

The morphology of the dentition of herbivores and carnivores is in sharp contrast to that seen in the primates. This is due to a high degree of specialization. In reference to the evolution of the dentition of other mammals Le Gros Clark states as follows: (13)

"On the other hand, the early mammals which descended from the trees to enter on terrestrial careers developed all sorts of specializations quite rapidly. For example, their limbs tended to lose their grasping functions, and to become adapted simply as supporting struts for the body or as instruments of high speed, and so they lost one or more toes and other elements such as the clavicle. Their molars in many cases tended to become exceedingly complicated *grinding mechanisms* in order to deal efficiently with hard roots or rough grass (as

in the Herbivores), or they became modified to form sharp shears for cutting flesh (as in the Carnivores)."

Figures 15, 16, 17, 18, 19, 20, illustrate the teeth of the commonly known herbivores of today, the horse and the ox. (13) Figure 22 illustrates the teeth of a dog, which are typical of the carnivores. The anatomy of the teeth of the carnivores is strictly designed for a shearing, cutting action, which is not unlike that of the premolars and molars of man and apes, the

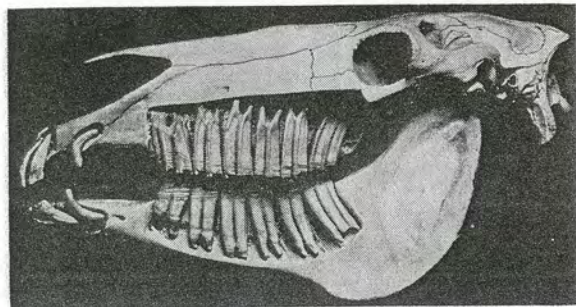


Figure 16. Skull of Horse, Five years old, Sculptured to show embedded parts of teeth. From Sisson-Grossman: "Anatomy of Domestic Animals, 4th ed., 1953, Philadelphia and London, W. B. Saunders Company.

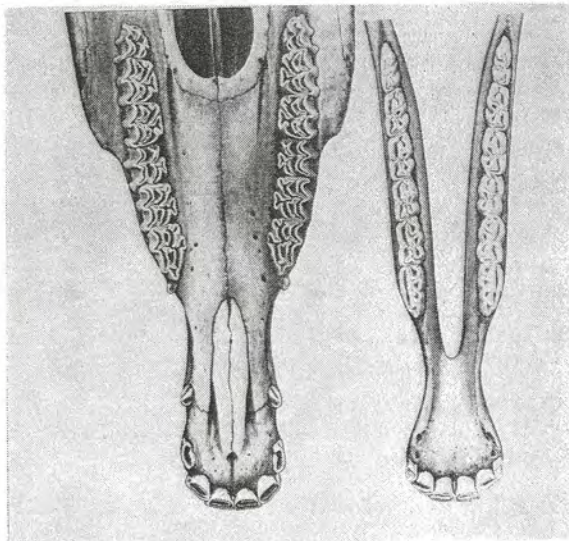


Figure 17. The Teeth of the Horse. The Permanent Teeth. Left: Upper teeth of horse, about four and one-half years old. Right: Lower teeth of horse, four years old. From Sisson-Grossman, "Anatomy of Domestic Animals," 4th ed., 1953, Philadelphia and London, W. B. Saunders Company.

cusps being more pronounced. The canines are quite enlarged and possess the overbite which prohibits lateral movements of the mandible. The herbivores, on the other hand, show only a rudimentary form of canines (or none at all) which are completely out of function, thus permitting free translatory movements of the mandible so that the opposing molars may glide upon each other permitting the grinding action so necessary for the trituration of grasses. In the lateral view of the skull of the horse (figure 16) note the edge-to-edge relation of the incisors for grasping and cutting and the lack of development of the canines, which have become entirely useless either for offense or defense or for guiding mandibular movements. The lateral or buccal view of the premolars graphically illustrates the lack of cuspal interference during translatory movements quite unlike the intercuspal relation of those in man and anthropoids.

In Figure 17 we note the highly specialized and complex form of the occlusal anatomy of the premolars and molars for greater efficiency in grinding and trituration of grasses, herbs, etc., (not unlike the inverted cusp posteriors for artificial dentures). A cross section of the molar (Figures 18 and 19) illustrates the anatomical structure of crown and root. Note the distribution of enamel plates and the intervening sections of cement and dentine. Two substances of unlike texture and density, one wearing down more rapidly than the other as attrition takes place. The softer intervening sections of dentine and cement wearing down more rapidly than the enamel plates to form a deep fossa to hold the food while the enamel plates shear it. Neither man, anthropoids nor carnivores possess this compensating factor. Another compensating factor is the constant eruption of the crown as attrition takes place, thus retaining the vertical dimension of the mandible to the maxilla until the entire crown has been worn down to the root. This also is not the case in the carnivores, anthropoids or man.

Attrition of the teeth as seen in primitive man from ancient pre-historic time to recent "primitives," has led many writers

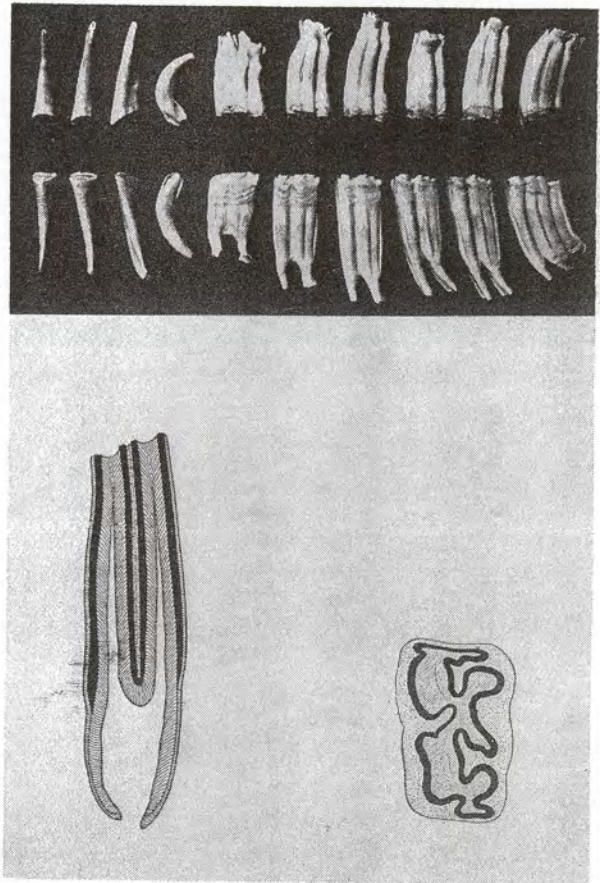


Figure 18. Upper: Teeth of Horse, Six years old, Right Side, Medial View. Lower Left: Buccal Surface. Frontal Section of Lower cheek tooth of Horse. Outer Line: Cement. Black areas; Enamel, shaded areas. Dentine. Clear area. Pulp cavity. Lower Right: Cross-section of lower cheek tooth of horse. From Sisson-Grossman: "Anatomy of Domestic Animals," 4th ed., 1953, Philadelphia and London. W. B. Saunders Company.

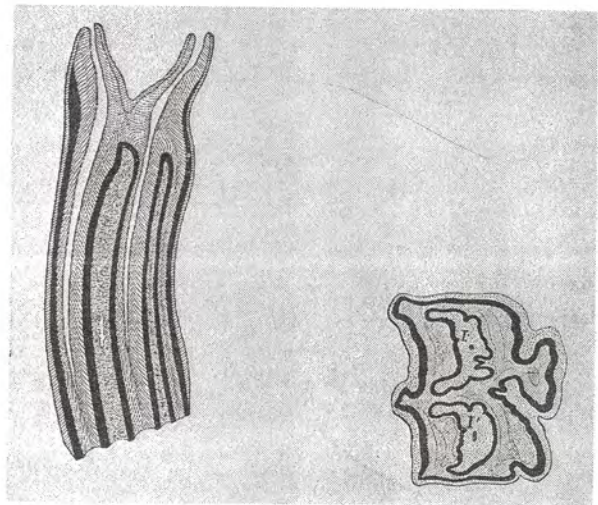


Figure 19. Left: Frontal section of upper cheek tooth of horse. Right: Cross-section of upper cheek tooth of horse. From Sisson-Grossman, "Anatomy of Domestic Animals," 4th ed., 1953, Philadelphia and London, W. B. Saunders Company.

in dental science to believe that man's natural mandibular movements are similar to the movements seen in the herbivores. Man has not specialized to the extent that herbivores have, and basically the morphology of his teeth remains the same as seen in Dryopithecus. Prof. Theodore McCown of the University of California concurs with this, and states that their primary function is for the purpose of masticating a frugivorous, carnivorous diet. (14).

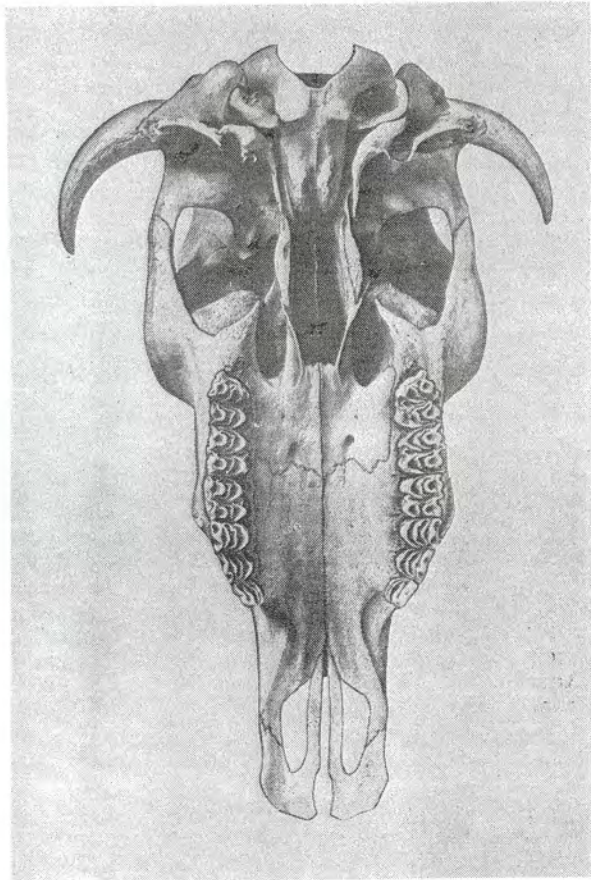


Figure 21. Skull of Ox, without mandible, Ventral View. From Sisson-Grossman: "Anatomy of Domestic Animals," 4th ed., 1953, Philadelphia and London, W. B. Saunders Company.

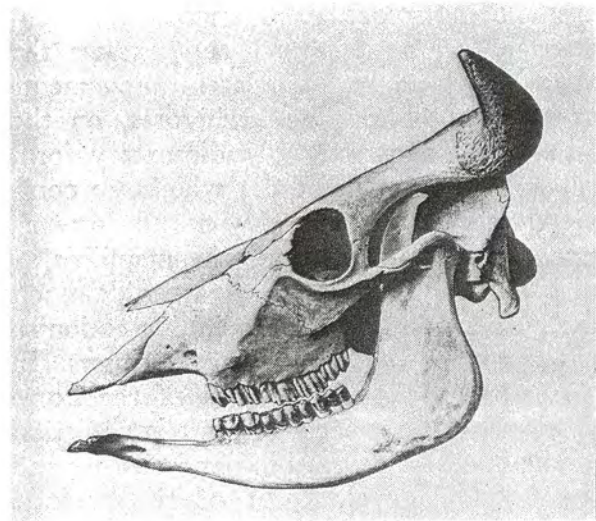


Figure 20. Skull and Mandible of Ox. From Sisson-Grossman: "Anatomy of Domestic Animals," 4th ed., 1953, Philadelphia and London, W. B. Saunders Company.

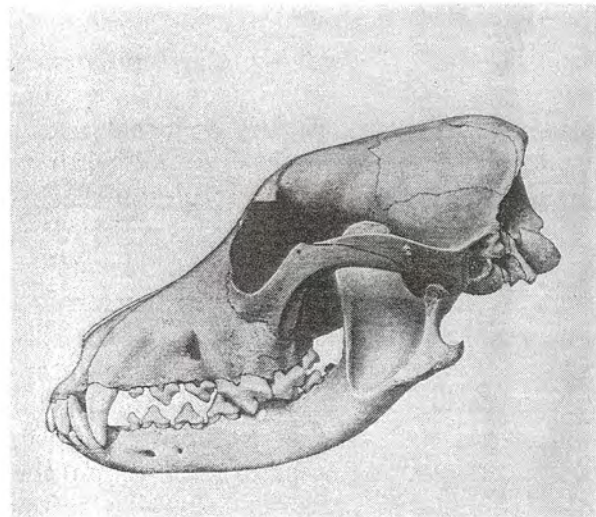


Figure 22. Skull and mandible of dog; Lateral View. From Sisson-Grossman. "Anatomy of Domestic Animals," 4th ed., 1953, Philadelphia and London, W. B. Saunders Company.

THE PRE-WHITE AND PRESENT AUSTRALIAN ABORIGINAL

It is interesting to note in comparing the translatory mandibular movements of man and herbivores that Hector Jones of Toowamba, Queensland, Australia, also agrees that such horizontal movements as seen in man are not normal for his species.

In his article, Jones goes to great lengths in trying to prove the correctness of his ideas as to the causes that brought about the edge-to-edge bite of the incisors and canines as seen in specimens of the teeth of primitives. (15) To do justice to his

work and its importance in this particular phase in the study of dental science, I feel that I should quote his article in practically its entirety. The following numbered paragraphs, numbers one to fifty-three are direct quotations of Hector Jones' article:

1. "The literature of physical anthropology indicates the value attached to the possible discovery of an ancestral form, in which the canines differed from the canines as known in all species of man, and approximated the condition seen in the anthropoid apes—interlocking canines. Many authorities are convinced that this feature characterized the dentition of the primitive ancestral type of early man. Turning our attention to the apes, and the other families of primates, we see interlocking canines of varied size and shape. In the males they are larger than in the females. In the Chimpanzee, the canines are relatively smaller than in the other apes and lower families, so that many physical anthropologists have learned to look for a remote human ancestor displaying relatively larger canines than exist today, with a diastema in the maxilla.

2. "The writer suggests that in forming some conception as to what we may reasonably expect in the earliest human forms, we should look not so much for interlocking canines of the anthropoid type, as canines having the relative dimensions, and in particular the occlusal relationships which are so often to be seen in the primary dentition. The deciduous teeth are formed long before eruption, even before birth, and it surely is quite a likely assumption that the primary dentition displays a greater resemblance to the primitive secondary, than

does the human secondary dentition of today.

3. "Admittedly, there are dangers by which we are surrounded in assuming relationships of this nature. Gregory in deprecating any such line as a general principle, points out that in physiological processes the course of development is fundamentally anticipatory rather than reminiscent in character, because the most pressing business of the embryo is to provide the ground plan for an adult of its own species. And yet it is a fundamental principle of evolution that the development of the human embryo discloses the many links with other forms of life.

4. "The function of teeth, be they primary or secondary, is to masticate coarse food and prepare it for digestion. As Campbell has pointed out, the foot of the Australian aboriginal child differs in no regard from that of the adult; nor is there any reason for thinking that it should be otherwise.

5. "We propose to assume that characters which are observable in the primary dentition are not merely attributes of the "milk" dentition—if we may use a term which is apt to convey a wrong conception or function and structure—but may record primitive characters, which have long since been lost to the secondary dentition.

MESIO-DISTAL MEASUREMENTS

6. "Turning to Keith's "New Discoveries relating to the antiquity of man," where he is discussing the dentition of Australopithecus, we find the following table of mesio-distal tooth measurements (in mm):

	Milk Dentition					Permanent Molars		
	I ¹	I ²	C	M ¹	M ²	M ¹	M ²	M ³
Gorilla.....	7.5	6.5	9.5	9.0	10.5	14.6	15.2	14.1
Orang.....	10.5	8.0	10.5	8.5	11.5	11.7	12.0	10.0
Australopithecus.....	5.2	4.5	6.5	9.2	10.0	13.0		
Chimpanzee.....	8.6	6.5	8.0	6.0	9.5	10.0	10.2	9.0
Man.....	7.1	5.0	5.3	6.8	7.5	10.7	9.2	8.5

7. "The writer has not had the opportunity of examining the wealth of material which is available to others in well endowed institutions in city centers, and must ac-

cept the figures for the anthropoid apes. However, he has made examinations of a number of children (European) and the figures obtained do not accord with those

given by Keith for man. It will be observed that in the mesio-distal diameters, that given for the second deciduous molar is slightly more than that for the central incisor, and that the lateral incisor, the canine and the first deciduous molar all have a smaller mesio-distal diameter than the central incisor.

8. "This is not the writer's experience, and he feels that an error of some kind has crept into the figures cited. The measurements obtained by the writer accord very well with those contained in Black's "Dental Anatomy" (1892, pp. 10-12).

9. "In order to estimate the extent of the diminuation of the canine which seems

to be apparent in man as compared with the anthropoids, the writer measured the primary dentition of a number of children of whom he was able to secure impressions, and of the secondary dentition of a number of adults. The figures were, in each case, dimensioned to the arbitrary figure of 100, which were allotted to the central incisor. The measurements given by Black were similarly treated. The mesio-distal measurements in millimeters for the maxillary deciduous dentition are as follows, with the proportioned figures immediately below. It is proposed in the following tables to explore relative dimensional relationships between the central incisor and the canine.

Table I
A. DECIDUOUS TEETH

	I ¹	I ²	C	D.M. ¹	D.M. ²
Jones.....	6.5	4.9	6.9	7.0	9.2
	100	75	106	107	141
Black.....	6.5	5.1	7.0	7.3	8.2
	100	78	107	112	126

B. PERMANENT TEETH

	I ¹	I ²	C	p ¹	p ²	M ¹	M ²	M ³
Jones.....	9.0	6.9	7.8	7.3	7.0	10.4	9.8	8.8
	100	76	86	81	77	115	109	97
Black.....	9.0	6.4	7.6	7.2	6.8	10.7	9.2	8.6
	100	71	84	80	75	119	102	95

10. "In the teeth under consideration Black's figures obviously give the same result of those obtained by the writer, and it is clear that relatively the deciduous canine is quite substantially larger mesio-distally than its permanent successor.

11. "Let us examine the mesio-distal

tooth diameters of the gorilla, orang, Australopithecus and chimpanzee as given by Keith, these being the only measurements of anthropoid deciduous dentition available. The same method of comparison is used as previously, that is, the mesio-distal diameter of the central incisor is dimensioned to 100.

Table II

	I ¹	I ²	C	IM ¹	IM ²
Gorilla.....	100	86	126	119	140
Orang.....	100	76	100	81	109
Australopithecus.....	100	86	125	177	192
Chimpanzee.....	100	75	93	69	110

It is with the canine figure only that we are concerned, and two features at once strike us:

1. The likeness between gorilla and

Australopithecus to the lateral incisor also.

2. Orang and chimpanzee are much closer to man in this comparison.

LABIO-LINGUAL MEASUREMENTS

12. "If we contrast the labio-lingual measurements of the human deciduous dentition with those of the permanent den-

tion using Black's figures, and the especially dimensioned form of comparison used above, we see that the deciduous canines are very different from the permanent canines.

Table III

A. DECIDUOUS TEETH					
	I ¹	I ²	C	DM ¹	DM ²
Black.....	100	96	140	170	200

B. PERMANENT TEETH								
	I	I ²	C	P ¹	P ²	M ¹	M ²	M ³
Black.....	100	85	114	150	125	168	164	151

13. "What is the inference from this array of figures? The writer desires to show that we may look for an ape-like or pre-human ancestral being in which the canines would be relatively larger mesio-distally and labio-lingually, in comparison with the incisor teeth, than are to be seen today, and would bear a somewhat similar ratio to the permanent incisors like that which deciduous canines bear to the deciduous incisors.

14. "In passing, the similarity between gorilla and Australopithecus already referred to may not be without some evolutionary significance.

15. "MODES OF MASTICATION. Let us now turn to the process of mastication. At the outset, it must be pointed out that man differs from other primates in this regard. Despite the fact that in man the glenoid fossa is basically deeper than in other primates, there is more range of lateral movement in the excursions of the mandible. These latter in the human subject are complex, but are well enough known. Briefly, the mandible is thrust laterally so that the buccal cusps of the lower posterior teeth occlude with the lateral border of the buccal cusps of the maxillary teeth on that side. The temporal, masseter and internal pterygoid muscles then crush the occluding teeth together, and at the same time the mandible moves medially and slightly upward to the position of centric occlusion. On the opposite side, the teeth do not make

contact until just before centric occlusion. Mastication is from lateral to medial, and is unilateral, the teeth of the opposite side being definitely not in contact. The food bolus is, by means of the tongue and teeth, kept on that side only where the shearing stresses are taking place.

16. "There are certain fundamental differences between man and ape in the mode of function of the dental machine, which the writer does not believe have been fully made clear in current literature. In order to investigate these differences the writer made a motion picture of a rhesus monkey having a meal, and of a European with an excellent natural dentition reproducing the movements of mastication. In the case of the European the movements were recorded with the lips open and also with the lips closed. This film demonstrates quite clearly the differences in the mandibular movements of mastication between man and the other primates. With the monkey there are certainly no lateral excursions of the mandible, movement being practically straight up and down. If there is any lateral movement, it is very slight and almost negligible. Comparison of anatomical specimens will prove that monkeys and anthropoid apes are very different from man in the movements of the masticatory machinery, and the difference can all be laid at the door of the canines. These practically prevent lateral movement of the mandible. A slight lateral movement may be attained after

many years, but this is strictly limited and can only result after heavy attrition.

17. "The photographic reproductions of the maxillary and mandibular teeth of a gorilla will indicate that the buccal cusps of the maxilla, and the lingual cusps of the mandible are not worn to any degree comparable with their fellows. The main area of occlusion is gouged out of the teeth to a very noticeable depth, and clearly proves the assertions made earlier.

18. "A very eminent English scientist in a private letter has suggested that, with the anterior teeth edge to edge, the posterior teeth could move laterally. This, however, is impossible as can readily be demonstrated by a simple experiment. Place the anterior teeth in the position for incision; then try by manual pressure at the angle of the mandible to move it to one side. It will be found that the slightest movement is accompanied by movement in the incisor area.

19. "Should we compare the dentition of the apes and monkeys with the dentition of the Australian aboriginal, we cannot but be forcibly impressed by the fact that under attrition, the cusps of the human teeth are completely worn away and present a flat surface. Now it is a different condition that we see in the anthropoid, in which the buccal cusp formation of the teeth tends to persist even when attrition is marked, proving that there is practically an absence of the shearing component of mastication.

20. "The two photographs of a male gorilla taken from the front and side will indicate that in spite of the pronounced attrition which is manifest in the anterior teeth, the posterior teeth still retain their cusp formation.

21. "This difference between man and other primates is of supreme importance, being fundamental. Since the cusp formation, which exists at tooth eruption, tends to persist much longer under attrition in the anthropoid, we should be justified in assuming that the mode of mastication and the mandibular movements seen in them are the more primitive. Man alone of the primates, has learned to incorporate the shearing stress into his masticatory appara-

tus. The result is that in the primitive state, living on rough fare, he suffers rapid occlusal attrition, the cusps being shorn completely away quite early in adult life. To put it another way, man has tended to adopt in this regard the mode of mastication of the ruminants, without possessing any form of compensatory mechanism, such as nature has provided them with, to meet this factor. The attritional wear seen in such fossil types as Rhodesian man, Neanderthal man and Sinanthropus is exactly such as we have described for modern man.

22. "The vertical masticatory movement of the mandible in apes, caused primarily as we have seen by the large canines, has a particular effect on them. Attritional wear tends to keep them sharp. The upper canine is accommodated between the distal of the lower canine and the mesial slope of the first lower premolar, but not so much into a diastema as into the "V" shaped space formed between these two teeth, at the same time overlapping them to some degree.

23. "Let us now examine the canines of the temporary dentition in order to see if any vestige of a similar condition can be seen. Models were made of the teeth of a child of known British extraction, my own daughter when four years old, and the mouth has been under constant supervision since the eruption of the earliest teeth. The features therein described are not universal, but are quite common, and the writer has observed a considerable number of similar cases.

24. "Photographic reproduction of the features to be indicated has not proved easy, but the mandibular cast shows the areas where the maxillary teeth occlude with the lower teeth. The models were held in occlusion and the right mandibular teeth below the line of occlusion were heavily pencilled.

25. "Examination of the models discloses a noteworthy feature. It was observed that in central occlusion, the distal slope of the lower canine makes contact with the mesial slope of the upper canine and that this tends to keep the canine tips sharp. This, the writer believes to be a most important survival of a primitive con-

dition, and is a somewhat similar condition fundamentally to that shown in the canines of the gorilla. This is the means adopted by nature to keep the canines—a weapon of offense—in a proper condition. The canines obviously are relatively large mesiodistally; they project beyond their incisor companions, and to a slighter extent beyond the occlusal surfaces of the molars. Examining the models and testing the lateral movement of the lower indicates that the upper canine has a decided interlocking action. Even from the photographs this is evident in the unpencilled portion of the lower cast, this being the area occupied by the maxillary teeth in centric occlusion.

26. "THE EDGE-TO-EDGE BITE. Should it be pointed out that the edge-to-edge bite does not exist in the models, and that on that score the claim for primitive features in the canines must be queried, the writer would reply that he is not at all convinced that the edge-to-edge bite, as seen in Australians and other primitive types of man, is necessarily a primitive feature.

27. "Campbell has proved that the human edge-to-edge bite is not manifest during the eruption of the permanent teeth, and he supports his argument by means of photographs of four separate stages. Plate 2A depicts two views of the skull of an aboriginal child, facial and profile. In these, the maxillary incisor teeth most definitely overlap the mandibular incisors.

28. "Campbell asserts that:

"The specimens (shown in his illustrations) are quite representative of the age groups from which they have been selected, and are sufficient to demonstrate the assertion that the "edge-to-edge" bite, said to be typical of the Australian dentition, was one which, though present in the adult almost without exception, was a modification only acquired by the attaining of adult age."

29. "In searching for the cause of the aboriginal edge-to-edge bite, Campbell observes:

"In any series of Australian skulls which includes sufficient specimens of varying ages, it can be seen that the presence of the edge-to-edge (bite) is associated with the occlusal wear the teeth have undergone;

that it, a diminution in the cusp height of molars and premolars is accompanied by an apparent shifting forward of the lower anterior teeth relative to the upper anterior."

30. "The practice of prosthetic dentistry will disclose the underlying truth of Campbell's contentions. Any prosthetist knows that in the construction of full upper and lower dentures, "closing the bite" after setting up the teeth demands that the lower anteriors be set up in a more posterior position, or that the upper anteriors be moved forward. The converse requirements of "opening the bite" disclose the conception better, as if the bite opened, it will be readily observed that the lower anteriors appear to have moved backward as well as downward, in relation to the upper anteriors. In our professional duties we frequently observe that clients who have been wearing the same artificial dentures for many years have experienced much alveolar resorption, and that the lower anterior teeth which once were set within the upper incisors. This would seem to bear out Campbell's contentions.

31. "Campbell, however, does not feel that this is a complete explanation of the feature. His research has indicated to him that although occlusal wear has apparently brought the lower anterior teeth forward, the lower molar teeth still occupy the same relative position with regard to the maxillary molars. "Therefore," he says, "it seems as if we must consider the main change as having occurred in the anterior region of the arches. It seems that the condition must be brought about by some change in the relative positions of the anterior teeth in the two arches." His later research indicates that a probable factor is "a widening of the arch in the canine-premolar region."

32. "The writer suggests a factor which seems to him to be fundamentally connected with the acquisition of the edge-to-edge bite, and is possibly a complete explanation of every phase of this characteristic. Primitive man needed powerful incision for the dismemberment of tough food, in particular, meat, which played so large a part in the aboriginal diet. Meat held firmly in the incisor teeth was dragged forward by hand and in this manner divided. Against

the force forward and slightly downward imparted by hand, a corresponding force backward must be applied by the mandible; so that the anterior teeth of the mandible would tend to move slightly forward as a result of the applied force.

33. "Now 'depression' is a regular part of the repertoire of the orthodontist, and teeth may be depressed as desired, where it is considered advisable to move a tooth into its alveolus to some extent from its original position. The surrounding bony structure, the periosteal attachment, or periodontal membrane, and the gingival tissues accommodate themselves to the new position quite normally; so that in any primitive state where continual use of the incisor teeth is a regular feature, the writer feels that the combination of forces described leads to the lower anterior teeth being drawn slightly forward, and at the same time depressed until the posterior teeth come into occlusion together with the anteriors. The dental machine in the primitive state is then complete.

34. "The writer claims that the resemblance between the edge-to-edge bite of man and that of the anthropoid apes is more apparent than real. In anthropoid apes and cartarrhine monkeys movement is practically up and down, so that the anterior teeth must occlude in the same mandibular position, as otherwise incision would be impossible.

35. "The same feature is to be seen in the primary dentition of the apes, the bite being of the same edge-to-edge type that is evident in their secondary dentition. In the baby chimpanzee the bite is absolutely edge-to-edge; in the orang, although the upper central incisors overlap the lowers ever so little, the bite is to all intents and purposes edge-to-edge.

36. "The edge-to-edge relationship in the adult Australian aboriginal is really of a somewhat different order from that of the other primates. First, there is not entire uniformity in the relationship of the lower anteriors to the uppers; in some, the uppers are to a slight extent anterior to the lowers; in others the anterior surface of the crown of the uppers is continuous with those of the lowers. The bite is edge-to-

edge, with a few exceptions; but in some it is only just edge-to-edge, while others occupy various positions between this stage and the absolutely edge-to-edge relationship. These findings were observed and described by Sir William Turner, (1891), and need no illustration. Secondly, in the Australian, the canines reduced in size, perhaps as a result of Keith's "evolutionary bias" are relegated in function to the position of incisor teeth, and owing to this a heavy shearing stress can be obtained by moving the incisor teeth laterally.

37. "The writer has already claimed that the Australian edge-to-edge bite is the result of tearing tough and coarse foods, meat in particular, by means of the anterior teeth. If this were not so, we should expect aboriginals born in the Mission Stations to have an edge-to-edge bite, as an inherited trait, in spite of a European diet. This is most definitely not the case. The writer has examined a number of aboriginals in Mission Stations, and the relationships of the anterior maxillary and mandibular teeth are exactly as in our British race in this continent. There is no trace of edge-to-edge bite, and the overbite can be very pronounced.

38. "Examination of the very few pure aboriginal children in the Mission Stations, all of these being about ten years old, discloses the truth of Campbell's findings with regard to the overbite relationship. There is not the slightest trace of any condition different from that seen in our British children.

39. "Surely no further proof is required that the Australian aboriginal in the relationship of his anterior teeth, differs in no material regard from the European. Quite obviously he inherits no edge-to-edge bite as do the other primates. The writer believes that if a European child could be reared under primitive conditions with Australian aboriginals completely remote from European influence, he would develop in the anterior teeth the same edge-to-edge bite.

40. "THE DIASTEMA. Linked with the search for human interlocking canines is the expectation of finding a fossil human dental arcade with maxillary diastemata to

accommodate the mandibular canines. The literature pertaining to the teeth of fossil man indicates the general expectation that some such condition is considered to belong to the ancestral human form at some remote period. Not yet have the expectations been realized.

41. "Weidenreich (1949) makes reference to the general search for the diastema in his discussion of the features of the *Sinanthropus* dentition as follows:

42. "In the chapter dealing with the canine problem, the question has already been raised whether the presence of a diastema can be taken to be an indication of there having existed originally a large canine in the preceding state of human evolution. Within this chapter it was shown that a diastema had not been present in the lower dentition of *Sinanthropus*, but what the conditions were in the upper jaw could not be ascertained, due to lack of material. Since the writing of that statement the upper jaw of Locus O I was found, which demonstrates that there is not the slightest indication of the presence of diastema. Nevertheless, as has already been pointed out, it is impossible to draw any conclusions with regard to the conditions of canines in preceding stages, for even in recent anthropoids, diastema in upper and lower jaws may be completely absent, despite the really tusk-like canines. The fact that such an occurrence is rather common, especially in orang, is proved by Selenka's (1898-99) statement. He found that in the upper jaws of female orangs a diastema was missing in 30 per cent, and lower jaws in 34 per cent. The percentage derived for the male orang is smaller, but nevertheless was found to be missing in 18 per cent."

43. "The quotation is given at length since Weidenreich is clearly minimizing the value of a diastema as an ancestral trait. He stresses the fact that in quite a substantial percentage of anthropoids there is no diastema even in the maxilla. In the limited number of ape crania that the writer has had the opportunity of handling, not one was without a marked maxillary diastema. The cooperation by letter of the Museums in Sydney, Melbourne and Adelaide was enlisted in testing the truth of the statement

attributed to Selenka. Thirteen adult orang skulls disclose marked maxillary diastemata in every instance. There is no trace of support here to the statement attributed to Selenka.

44. "Turning our attention once more to the examination of the human primary dentition, in order to see if there is any indication of a diastema which may serve as a guide in the search for such a primitive feature, let us examine the models which we have already found helpful and instructive in the discussion on canines.

45. "There can be not the slightest doubt that on both sides there is a maxillary diastema for accommodating the lower canines. On the left side this diastema is 1.9 mm mesiodistally, on the right, 1.8 mm. These diastema obviously are associated with the mode of occlusion of the upper and lower canines. The combination of features here, though not identical with the simian condition, is obviously somewhat akin. Nor are these diastema as large as can be seen in other youthful patients who present themselves at times.

46. "The writer feels confident that there will yet be found in fossil form a primate ancestor of man with a permanent dentition containing relatively much larger canines than are seen today, similar to those of the deciduous dentition in shape and mode of occlusion, fitting into diastema of the same type. At least, certain intermediate stages should present themselves.

47. "Before leaving the discussion on canines and diastema and the evidence of primary dentition, we must note one very fundamental difference between man and the anthropoid apes. In the former the secondary canines are relatively smaller than the primary canines; in the latter they are relatively larger.

48. "Last, brief reference must be made to the fossil "man-apes" of South Africa. Gregory and Hellman ('39) had just completed their work on the teeth of these forms when the work described in these pages was being finalized. Since then it has been my privilege to receive some beautiful casts from Dr. Broom (Transvaal Museum, Pretoria, S. Africa) of the dental tissues and surrounding bony structures of

Plesianthropus and Paranthropus and they are undoubtedly an astonishing combination of features. Dr. Broom was also good enough to send the May and June issues of the *Annals of the Transvaal Museum* (1939). The former contains Dr. Broom's description of the dentition of Plesianthropus and Paranthropus; the latter, the work of Gregory and Hellman and these Primates.

49. "Plate 4 is a reproduction of the upper dental arch of Plesianthropus transvaalensis. Certain traits are clear and are pointed out by Gregory and Hellman.

50. "The upper canine "is actually smaller in its transverse diameter than the first premolar, whereas, even in female apes, it is normally larger than that tooth. Moreover, its crown, although somewhat worn off at the tip, is not dagger-like as it is in typical modern female apes, but altogether more like the human canine."

51. "There is not the slightest trace of a diastema, and the strong similarity in certain regards to the human dentition is obvious from the illustration.

52. "Gregory and Hellman state ('39, p. 560) that Plesianthropus presented such an astonishing mixture of ape and human characters, that for a long time they were in doubt whether to call it a very progressive ape or a very primitive man. The conclusion drawn by these scientists is that the South African Pleistocene man-apes were in both a structural and a genetic sense the conservative cousins of the contemporary human branch.

53. "This finding in no sense militates against the writer's convictions concerning the ancestral canines. But it does indicate that the older acceptance of the anthropoid ape type as the ancestral human form has been rather too rigid in its application."

The preceding observations and data by Hector Jones, in my opinion, are of extreme importance to dental science. The very first sentence of the first paragraph graphically portrays the expectation that we may find an ancestral form of man in which the canines differ from those now known in man and which will approximate the condition seen in the anthropoid apes—*interlocking canines*. References to Keith and Cu-

vier concerning such a development and relationship of the canines assumes that they were primarily intended for offensive and defensive purposes. Jones' work on the deciduous dentition may or may not have some significance as far as anatomical changes in the size of the canines are concerned. Such changes, however, would not necessarily have any bearing in the functional position and relation in the opposing arches. There is no doubt that all of man's teeth have undergone changes in size and form and, likewise, that some changes in position in the arch have taken place due to developmental changes in the facial bones, particularly the maxillae and mandible.

In paragraph 15, (Modes of Mastication) Jones graphically portrays the functional relationship of what we in dentistry describe as the 'working side' and 'balancing side'. In the 'working side' the action is a shearing action of the buccal cusps of upper and lower posteriors, the mandible moving medially and upward to centric. The posterior teeth on the balancing side *do not make contact* until centric position has been reached. Such a movement of the mandible can only be seen in cases where the upper canine overlaps the lower. The overlapping canine guides the mandible into centric in quite the same manner as movements seen in the anthropoids, man still possessing a wide translatory movement which he has undoubtedly inherited from primitive man.

The lateral or translatory movement of the mandible of primitive man is made possible only after attrition of the cusps of the molars, premolars and canines has taken place. Jones describes this movement as being not unlike that of the ruminant or herbivore, but without the compensating mechanism found in them. Jones also believes that this functional relation of the opposing teeth of prehistoric and recent primitive type specimens of man is not natural to man. He is trying to prove that man originally had an interlocking relation of the canines as seen in other primates, particularly the apes. In doing so, he attempts to place some significance on the size and interlocking position of the deciduous ca-

nines in certain Western Europeans of today. Also, that this is precisely what he sees in the Australian aboriginal children of today living in the same manner as the Western European. This relationship is quite different in what he has seen studying the crania of the Australian aboriginal, for in the "primitive" specimens, he sees attrition of the opposing dentitions, and the edge-to-edge bite of incisors and canines as seen in all other primitive specimens of man. (Again I repeat, with the exception of *Pithicanthropus robustus*.) Fig. 13.

The writer does not agree with Jones as to the reasons and causes which resulted in the edge-to-edge bite and the functional elimination of the canines. For instance, in paragraph 32 he suggests that "primitive man needed powerful incision for the dismemberment of tough food, in particular, meat, which played so large a part in the aboriginal diet. Meat held firmly in the incisor teeth was dragged forward by hand and in this manner divided. Against the force forward and slightly downward im-

parted by hand, a corresponding force backward must be applied by the mandible; so that the anterior teeth of the mandible would tend to move slightly forward as a result of this applied force." Jones has overlooked the fact that the upper anterior teeth would function in a like manner and would move forward also. If this were true, primitive man would have developed a diastema between the canines and first premolars in both upper and lower arches, or a diastema between the lateral incisors and canines. And this is the distinguishing feature between primitive man and anthropoids, that primitive man did not have a diastema.

(Continued in April Issue)

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