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Hominid Phylogeny As Seen in the Dentition

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This paper will examine to what extent the study of the dentition can help us to elucidate two types of questions regarding hominid phylogeny. The first type has to do with hominid origins, the second with the degree of relationship obtaining between contemporary hominid taxa in early Pleistocene.

1. Dental evidence and hominid origins

1. How far back can we trace the origin of the hominid phylum? The answer to that question depends of course on the way the term 'hominid' is defined. It used to be thought that the hominid grade of evolution could be defined by either one of the following characteristics: erect posture, small canine tooth, and tool making. No problem arose as long as these three features seemed to appear together (v.g. the Australopithecine material found up to the late 50's). Problems began to arise when it became likely that some erect primates did not make tools (v.g. Australopithecus robustus). These mistakes were compounded when it appeared that primates with small canines may neither have walked erect nor have been making tools (Gigantopithecus, Oreopithecus, possibly also Ramapithecus).

In other words, to identify the time of origin of the hominid phylum it is first necessary to answer the question: is a small canine a sufficient condition to qualify as hominid?

For a long time it was nearly universally accepted that the hominid type of dentition derived from dentitions with a 'canine complex' as seen in pongids. This conviction was based on both indirect and direct evidence. Overlapping tips of upper and lower canine in perfect occlusion, long roots of the canines in man, large size of the deciduous canine, relative length of P3 and P4, and late eruption of the canine made up the indirect evidence. Direct evidence was found in the relatively large size of the canine in Neanderthal Man and Homo erectus.

This way of thinking made it easy to identify hominid forms as soon as they appeared, since a small canine was considered to be sufficient evidence. In recent years, however, this view has been questioned on several grounds pertaining to both the indirect and direct evidence mentioned above. Indirect evidence has been shown recently to be much less clear than was commonly believed (Kinsey, 1971).

Direct evidence, which has been accumulating at an accelerating rate during the last ten years, suggests today a different interpretation. It has been established, for instance, that as long as 3.10⁸ years ago the mandibular and dental mechanism of Australopithecus was about as unlike that of apes as in present-day man. Simons (1969) concludes after reviewing the evidence: "the living habits typical of Australopithecus arose long before the late Pliocene." In other words, there is no indication whatever in the fossil record that Australopithecus derived from a form with large canines.

The discovery of new specimens of Ramapithecus and the restudy of the formerly known material confirm the preceding conclusion. What is now designated as the "Rama-Australopithecus dental complex" (Simons, 1969) comprises, among other traits, very small canines and is known to have been in existence for over 10 million years (perhaps as many as 20). However, and this is most important to note, in spite of the short canine, this complex has been shown (Andrews, 1971) to include several pongid traits. Thus, direct evidence indicates that a short canine is not necessarily associated with an entirely hominid-like dental complex. On the other hand, the finds of forms like Gigantopithecus and Oreopithecus show that the observation of Andrews holds also for genera other than Ramapithecus.

2. The questions raised by the evidence considered above can be formulated as follows: a. it is not enough to show that a form had a short canine in order to establish its hominid status, since undoubted hominids (Australopithecine) are now known to have derived from forms that had already short canines and since forms with short canines appear to have shared also a number of characters with the pongids; b. it may thus become necessary to redefine 'hominid' in a more comprehensive way. Pilbeam (1968) has attempted to include in that definition a number of features covering the entire dentition, including occlusal pattern, mode of implantation of the roots, and disposition of the tooth rows. On the basis of these characteristics he states that it is difficult to tell whether Ramapithecus should be classified as a hominid or as a man-like pongid, and he expresses the view that this question may well be "a matter of semantics." c. the borderline between hominids and pongids having thus become more and more arbitrary, the time of origin of the hominid phylum is thus likely to be pushed back in time much more than was thought...
possible until recently (v.g. L.S.B. Leakey (1967) 

wants to recognize as hominids some of the East 
African lower Miocene fossils).

3. If any lesson can be drawn from this first 
section of our inquiry, it is that teeth are far from 
being a convenient basis for distinguishing the 
first appearance of hominids. The latter is perhaps 
best identified by traces of the new behavior that 
characterized it, such as learning, cooperation, etc. 
Dental evidence will be most important where it 
helps to identify the presence of such types of 
behavior.

II. Dental evidence and Australopithecine 
taxonomy

In the original find published by Dart in 1925 the 
dentition figured already among the features which 
drew the attention, particularly the shape of the 
dental arch and the small size of the deciduous 
canine. Dart's deductions, much discussed at the 
time, were confirmed by later finds of adult speci-
mens. The Australopithecine dentition may thus be 
said to have been the first piece of evidence to 
suggest that Australopithecus belonged to the 
hominid line of evolution, and not to the pongid 
line (Gregory, 1939). From a methodological point 
of view it is interesting to note why, in spite of so 
many hominid characters in the dentition, many 
experienced anthropologists were so slow in recog-
nizing the phyletic status of Australopithecus. As 
noted by Le Gros Clark (1967), “inadequate and 
erroneous statistical results” purported to demon-
strate no difference in size or shape between some 
of the fossil teeth and those of modern anthropoid 
apes.

Today, few anthropologists would hesitate to 
recognize Australopithecus' dentition as that of a 
hominid. The remaining moot point is whether it 
can be regarded ancestral to Homo. Von Koenigs- 
wald (1967) for instance believes the anterior den-
tition to be too much reduced to be that of an 
ancestor of Homo erectus. Similarly, P₃ is more 
molarized than in the later hominids from South-
east Asia.

Just as dentition played an important role in the 
éarly controversy on the hominid status of the 
Transvaal finds, so today it forms the major topic 
of discussion when discussing the relative taxono-
mic status of the two forms that coexisted in early 
Pleistocene Africa: Australopithecus and Paranth-
ropus. Those holding for a generic distinction 
(Robinson) as well as those believing that the dis-
tinction is at most specific (Tobias, Simons, 
Frisch), both rely heavily on an analysis of the 
dentition. This by itself would suffice to show that 
the dentition, taken alone, cannot be expected to 
yield an adequate criterion for deciding this point 
of taxonomy. The latter conclusion becomes even 
more evident when it is realized that the differences 
observed between Australopithecus and Paranthro-
pus are much better marked in the dentition than in 
the cranial capacity or in the locomotor system.

In the last ten years one more find by L.S.B. 
Leakey has become the object of heated discussion: 
the fossil hominid christened by him Homo habilis. 
Here again it is the dentition which forms the focal 
point of the controversy regarding the inclusion of 
this specimen in the genus Homo or Australopithecus.

Those who exclude Homo habilis from Austral-
opithecus stress the relative narrowness of the post-
canine teeth, especially in the mandible. The op-
ponents (v.g. Robinson, 1968) point out that such a 
distinction is possible only because only a very 
small sample of Australopithecine teeth has been 
considered. With larger samples, it is argued, Homo 
habilis' teeth are seen to fall mostly toward the 
upper end of the range of variation at present 
known in the Australopithecine material and not outside 
this range. Moreover, Robinson shows the 
length/breadth index used by Leakey et al. to have 
extremely low phyletic valence so far as hominids 
are concerned, since this index shows wide overlap 
in its ranges for Australopithecus, Paranthropus and 
Homo erectus. To this criticism of Leakey's po-
tion, Robinson adds an interesting observation: 
if one bases one's judgement not on the relative 
narrowness of the postcanine teeth but on the re-
relative size of the lower canine to the anterior lower 
premolar, the specimen designated as Homo habilis 
is seen to resemble Australopithecus, while the 
latter appears to differ significantly from Paranthro-
opus.

The lesson taught by the second part of our 
study undertaken in order to answer the 
question formulated at the beginning of this paper 
has resulted chiefly in identifying more closely the 
problems to be faced by the student of the den-
tition of early hominids. While recognizing the 
necessity of relying on dental evidence, both be-
cause of the nature of the preserved evidence and 
because of the reliability of many of the features 
apparent on the dentition, it is important to be clear 
on the limitations of this evidence, especially of the 
metric features.

These limitations are seen to result chiefly from 
the variability characteristic of the hominid—and 
of the primate—dentition and from the personal 
coefficient inherent in the techniques of measure-
ment. Ways to make up for these limitations would
霊長類の系統進化からみた hominization

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はじめに

hominization すなわちヒト化の成立を考えるに当っている、それを単にその時点における変革の諸要素から考察するのみでなく、広く、その成立前に至るまでの歴史的状況についても、適切な把握を行うことが必要である。ここでは後者の必要性に添って霊長類の系統進化を踏まえ、hominization 考察の基したい。もともと、ヒト化の考察に近づく以前に、霊長類に属する諸祖先が、系統進化上、互いにどういう関係にあるかについて、必ずしも一般的見解は定まっていない現状である。むしろ、従来の見解を再検討すべきとの意見も、少なくないというべきであろう。したがって、論述の内容が、大なり小なり仮定、想像に頼るところをえないことを、あらかじめお断りしておきたい。本稿は研究会記録として草されたものであるが、論説内容に若干手を加えてまとめることとした。

生活様式としての樹上性

まず、原猿の段階について考察する。出発点に相当するとされるツバメ（類）が、それに近縁で、かつての原始食虫類とともに、現生食虫類一般ほどに生活に、地上・地下生活であると考えにくい（岩本，1971を参照）。むしろ、既に、順調に樹上にもすすむ習性をもっている。このことが、とりも直さず、大きな特徴化を欠すことと関連している。ツバメ、あるいはツバメ集団なもの、長い間にかけさまざまな原猿が分化した。他方では、分化の多くが環境の変化の中で、絶えている。ことで一言つけ加えるならば、それら始端が、いわゆる competition のイメージの中にある敗北で律されるものは思われない。competition に「おかなかった」ものが「適者、として生活をつづけ、あとの進化的基幹となることすら、ありえないことではない。

さて、高等霊長類、たとえば旧世界ザルにおける、枝をとり、食物をとる手、あるいは新世界ザルにおける、枝をとり（？）尾などをもって、樹上性への適応と考えるならば、原猿一般にそのような特徴は不完全であり、樹上性への適応に徹していないことになる。しかし、現実に原猿が樹上生活者であることは疑いない事実である。しばしば、前述の意味において、原猿は樹上生活に適応してはいても、適応しきってはいないといえた感じの表現をみることがあるが、もともと、樹上性とい、地上性といい、単にそれそれぞれ、そのような生活様式を表現する以上に、身近上の適応内容を表現しうるものとは思われない。

言いかえれば、原猿は原猿なりに樹上に適応しきったものとして、原猿の総体を見てみる必要がある。多くの原猿、あるいは手足の指における平掌の発達は、だからが食虫類大から大化する傾向と、夜行性は昆虫食と。立体視は樹上における昆虫食および鼻孔部の退縮と、それぞれ互いに関連をもって、樹上性との矛盾を生じていないと見るべきであり、それぞれ特徴を、ばらばらに分離