

The earliest fossil evidence for sexual dimorphism in primates

(*Notharctus* / paleontology / Eocene / primate evolution)

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ABSTRACT Recently obtained material of the early Eocene primate *Notharctus venticolus*, including two partial skulls from a single stratigraphic horizon, provides the geologically earliest evidence of sexual dimorphism in canine size and shape in primates and the only unequivocal evidence for such dimorphism in strepsirrhines. By analogy with living platyrrhines, these data suggest that *Notharctus venticolus* may have lived in polygynous social groups characterized by a relatively high level of intermale competition for mates and other limited resources. The anatomy of the upper incisors and related evidence imply that *Notharctus* is not as closely related to extant lemuriform primates as has been recently proposed. The early Eocene evidence for canine sexual dimorphism reported here, and its occurrence in a nonanthropoid, indicates that in the order Primates such a condition is either primitive or evolved independently more than once.

The fossil record of early Cenozoic primates grows richer each year, providing evidence that bears uniquely on the initial differentiation of the order and the phylogenetic relationships of living and extinct taxa. When the fossil remains are sufficiently complete and well preserved, additional critical paleobiological issues can be studied and inferred, such as mode of locomotion, dietary adaptations, and social organization. Although a number of studies have assessed the mode of locomotion (1-3) and dietary adaptations (3, 4) of early Cenozoic primates, little is known concerning the social organization of these animals. Here, we report recently obtained material, the most complete yet recovered, of the early Eocene primate *Notharctus venticolus*, which sheds light on the probable form of its social organization and the phylogenetic position of the genus with respect to other living and fossil primates.

MATERIALS AND METHODS

The new fossils of *Notharctus* were excavated from Quarry 6 in the Buck Spring area of the Wind River Basin, Natrona County, Wyoming (5). The quarry is one of several extremely fossiliferous concentrations found in the B-2 stratigraphic horizon in the type area of the Lost Cabin Member of the Wind River Formation (5-8). Fossil mammals associated with these specimens include the primate *Shoshonius cooperi*, the perissodactyl *Lambdaotherium popoagense*, and 62 other species that indicate a late early Eocene age (Lostcabinian; late Wasatchian) (see ref. 9). Analyses of quarry and surrounding sediments reveal that the fossils accumulated in a periodically drained freshwater pond adjacent to a major perennial stream (5).

During the time that the strata at the Buck Spring Quarries were deposited, only one large species of notharctine primate is known to have lived (8). Remains of this species, *N.*

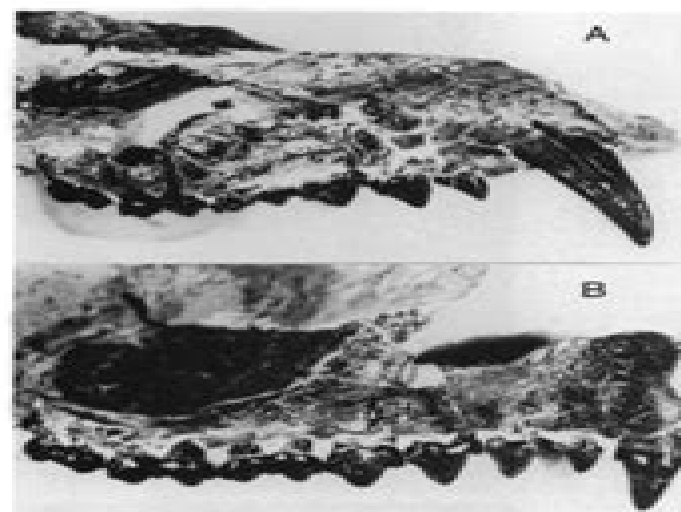


FIG. 1. Lateral view of upper deciduous of *N. venticolus*. (A) Male, CM 60497. (B) Female, CM 62006. (Scale is in cm units.)

venticolus, are easily distinguished from those of lithosympatric *Notharctus maximus* on the basis of its larger size and different molar morphology (10-12). Extensive comparisons between the new sample of *Notharctus* from the Buck Spring Quarries and known material of *N. venticolus* and *N. maximus* (including the type specimens, both of which were also collected from the Lost Cabin Member of the Wind River Formation) leave no doubt that all of the specimens discussed here represent *N. venticolus*.

Measurements of the upper and lower canines in the new sample of *N. venticolus*, including maximum mesiodistal length (L) and maximum labiolingual width (W) (measured perpendicular to L), were obtained using Fowler Max-Cal electronic digital calipers. From these data we calculated several indices of canine dimorphism following the method of Kay *et al.* (13).

RESULTS AND DISCUSSION

Four of the new fossils of *N. venticolus* preserve the upper canines. Although the cheek teeth in these specimens are

Abbreviation: CM, Carnegie Museum.

Sexual Dimorphism In Living Fossil Pri

Karen B. Strier



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American Journal of Physical Anthropology, 1995 AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY. VOL. 103, NO. 1, MAY 1997. EMOKE SZATHMARY, 1997 The Evolution of Hominin Diets Jean-Jacques Hublin, Michael P. Richards, 2009-05-15 Michael P Richards and Jean Jacques Hublin The study of hominin diets and especially how they have primates modern humans 2 faunal and plant studies 3 evolved throughout time has long been a core research archaeology and paleoanthropology and 4 isotopic studies area in archaeology and paleoanthropology but it is also This volume therefore presents research articles by most of becoming an important research area in other fields such as these participants that are mainly based on their presentations primatology nutrition science and evolutionary medicine at the symposium As can hopefully be seen in the volume Although this is a fundamental research topic much of the these papers provide important reviews of the current research research continues to be undertaken by specialists and there in these areas as well as often present new research on dietary is with some notable exceptions e g Stanford and Bunn evolution 2001 Ungar and Teaford 2002 Ungar 2007 relatively lit In the section on modern studies Hohmann provides a tle interaction with other researchers in other fields This is review of the diets of non human primates including an unfortunate as recently it has appeared that different lines interesting discussion of the role of food sharing amongst of evidence are causing similar conclusions about the major these primates Snodgrass Leonard and Roberston provide issues of hominid dietary evolution i e *Comparative Dental Morphology* Thomas Koppe, Georg Meyer, Kurt W. Alt, 2009-01-01 Teeth and their surrounding structures are exceptional sources for addressing significant questions in numerous disciplines In this publication an international multidisciplinary team of researchers addresses important issues on current aspects of dental morphology research from evolutionary anatomical clinical and archaeological perspectives In combining leading edge methods of data acquisition and analyses such as molecular analyses and highly advanced non destructive imaging technologies the book demonstrates how information about various aspects of dental morphology can be used to explore the evolution of vertebrate life histories a subject most relevant to our own species The chapters provide profound discussions on dental evolution dental morphology dental tissues dental growth and development as well as on clinical aspects of dental morphology As a special feature the publication provides new information about the role of teeth as tools in reconstructing the nature and behaviour of past populations This book will serve as an important reference for researchers of dental sciences anatomy evolutionary biology paleoanthropology paleontology archaeology prehistoric anthropology comparative anatomy genetics embryology and forensic medicine *Handbook of Paleoanthropology* Winfried Henke, Ian Tattersall, 2007-05-10 This 3 volume handbook brings together contributions by the world s leading specialists that reflect the broad spectrum of modern palaeoanthropology thus presenting an indispensable resource for professionals and students alike Vol 1 reviews principles methods and approaches recounting recent advances and state of the art knowledge in phylogenetic analysis palaeoecology

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American Journal of Physical Anthropology American association of physical anthropologists,1998 **Species, Species Concepts and Primate Evolution** William H. Kimbel, Lawrence B. Martin, 2013-12-18 A world of categories devoid of spirit waits for life to return Saul Bellow Humboldt's Gift The stock in trade of communicating hypotheses about the historical path of evolution is a graphical representation called a phylogenetic tree In most such graphics pairs of branches diverge from other branches successively marching across abstract time toward the present To each branch is tied a tag with a name a binominal symbol that functions as does the name given to an individual human being On phylogenetic trees the names symbolize species What exactly do these names signify What kind of information is communicated when we claim to have knowledge of the following types Tetonia mathewzi was ancestral to Pseudotetonia ambiguus The sample of fossils attributed to Homo habilis is too variable to contain only one species Interbreeding populations of savanna baboons all belong to Papio anubis Hylobates lar and H pileatus interbreed in zones of geographic overlap While there is nearly universal agreement that the notion of the species is fundamental to our understanding of how evolution works there is a very wide range of opinion on the conceptual content and meaning of such particular statements regarding species This is because oddly enough evolutionary biologists are quite far from agreement on what a species is how it attains this status and what role it plays in evolution over the long term **Interpreting the Past** Daniel Lieberman, Richard W. Smith, Jay Kelley, 2005-11-01 This volume published in honor of the occasion of David Pilbeam's 65th birthday covers major topics in human primate and mammalian evolution mostly from the Miocene to the present The papers emphasize novel interpretations of several key areas of longstanding interest and importance including Miocene biogeography and hominoid evolution the origins of hominids and new interpretations of the hominid fossil record In terms of content most of the papers tackle key issues in the evolution of hominoids and hominids in terms of systematic paleoenvironmental and behavioral questions More broadly however the papers explore the epistemological problems of how one interprets the past from the available data **Wiley-Blackwell Student Dictionary of Human Evolution** Bernard Wood, 2015-05-04 Not so long ago all a student studying human evolution needed was a familiarity with the relatively sparse fossil record and what limited information there was about the context of the sites a basic knowledge of gross anatomy and archeology and an understanding of simple analytical methods Times have changed The fossil record has grown exponentially imaging techniques have advanced dramatically quantitative methods have burgeoned and molecular biology has revolutionized our understanding of genetics evolutionary history and development Added to this are advances in the archeological biological and earth sciences that help interpret the context of the fossil evidence and reconstruct behavior But presently there is

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Primate Behavioral Ecology Karen B. Strier, 2015-07-22 Primate Behavioral Ecology described as an engaging cutting edge exposition incorporates exciting new discoveries and the most up to date approaches in its introduction to the field and its applications of behavioral ecology to primate conservation This unique comprehensive single authored text integrates the basics of evolutionary ecological and demographic perspectives with contemporary noninvasive molecular and hormonal techniques to understand how different primates behave and the significance of these insights for primate conservation Examples are drawn from the classic primate field studies and more recent studies on previously neglected species from across the primate order illustrating the vast behavioral variation that we now know exists and the gaps in our knowledge that future studies will fill

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Monitoring the Future, 2003 Questionnaire responses from the nation's high school seniors

Primate Locomotion Elizabeth Strasser, John Fleagle, Alfred L. Rosenberger, Henry McHenry, 2013-06-29 The study of primate locomotion is a unique discipline that by its nature is interdisciplinary drawing on and integrating research from ethology ecology comparative anatomy physiology biomechanics paleontology etc When combined and focused on particular problems this diversity of approaches permits unparalleled insight into critical aspects of our evolutionary past and into a major component of the behavioral repertoire of all animals Unfortunately because of the structure of academia integration of these different approaches is a rare phenomenon For instance papers on primate behavior tend to be published in separate specialist journals and read by subgroups of anthropologists and zoologists thus precluding critical syntheses In the spring of 1995 we overcame this compartmentalization by organizing a conference that brought together experts with many different perspectives on primate locomotion to address the current state of the field and to consider where we go from here The conference Primate Locomotion 1995 took place thirty years after the pioneering

conference on the same topic that was convened by the late Warren G Kinzey at Davis in 1965

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