Olbitherium millenariusum **gen. et sp. nov.**
（　　　　　　　“　；　　　　　　”）[1]

1　　　　　　　　1　　　　　　　　2

(1　　　　　　　　　　　　　　　　　　　　　　　　　　　　100044)
(2　　　　　　　　　　　　　　　　　10024)

:　　　　　　　　　　　　　　　　　　　　　　　“　　　　　”　:　　　　　　（ *Olbither-*
ium millenariusum gen. et sp. nov.）　　　　　　　　　　　　　　　　　,
, m1　2　　　　　　　　　　　　　　　　　　　　　　　　　　　　M3
, 　　　　　　　　　　　　　*Seggeurius*　　　　　　,　　　　　　　　　,
McKenna (1975)　　　“　　　　　”（" Mirorder Phenacodonta"）
(phenacodontids)　　　　　,

:　　　　　,　　　　　“　　　　”
: Q915. 873　　　　　　:A　　　　　　:1000 - 3118(2004)01 - 0027 - 12

,　　　　　　　　（Equidae）　　（Tapiridae）　　（Rhinocerotidae）
100　　　　　,Cope (1881a)　　“　　　”（" Condylar-
thra"）　　　　　　　Radinsky (1966 ,1969)　　　　　　　　　,
, 　　　　　　　　*Tetraclaenodon*（　　　　　　）
20　　　,　　　　　　　　　　（*Radinskya yupingae*）　　　,
(arsinoithere)
(Domning et al. , 1986 ;McKenna et al. , 1989 ; Prothero and Schoch , 1989) ,
(tethytherians)　　　　　　　　　　　　　,　　　　　　　,
phenacodontids　　　　　　,　　　phenacodontids　　　(outgroup) ,
phenacodontids　　　　　　　　　　（Prothero and Schoch , 1989 ; Court ,
1992 ; Thewissen , 1990 ; Thewissen and Domning , 1992 ; Hooker , 1989 , 1994 ; Froehlich , 1999 ,
2001 , 2002 ; Holbrook , 2001 ; Ekdale , 2002)
Olbitherium millenariusum gen. et sp. nov. ,　　　　　　　*R. yupingae*
m1　2　　　　　phenacodontids ,　　　phenacodontids
,

(Tong and Wang , 1998) , *O. millenariu-*
sum   ,   Bayan Ulan
(Meng et al. , 1998)

"   ""**Mirorder Phenacodonta**" **Mc Kenna , 1975** (sensu **Mc Kenna , 1975)**
Order incertae sedis
(   ) Olbitherium **gen. nov.**
Olbitherium millenariusum gen. et sp. nov.

Olbi ,   ,olbios ,   ,   ;therium ,

(   ) Olbitherium millenariusum **gen**. **et sp**. **nov**.
(1 , 2)
p1   m3   (IVPP V 10758. 1)
P2   M1   P1   C   (V10758. 2)   p2   p4
p1   (V 10758. 3) ,   M1 (V 10758. 4) ,   P2 (V 10758. 5)   P4
(V 10758. 6)   M2 (V 10758. 7) ,   M3 (V 10758. 8) ,   p4   m3   (V 10758. 9) ,
dp2   m2   (V 10758. 10)   dp4   m2   (V 10758. 11)
;   ,
: ?. 1. 4. 3/ ?. 1. 4. 3   C   P1   ;P4   ;   ,
,   ;M1   2   ,   ,
;   ,   ;   ;M3   ,
p1   ,p2   ,p4   ,   ;m1   2
,   ,   ,   ,
,   ;m3   ,   ,   ,

millenariusum ,   ,   ,
V 10758. 2   3   ,
,   ,
,   V 10758. 2   ,   7 mm ,
,   13. 4 mm   P1   ,   ,P1   ,P1   P2
P2   ,   ,   ,2   ,   V 10758. 2
,   V 10758. 5   P2
P2   ,   ,
(V 10758. 2)   (V 10758. 5)   (V 10758. 2)
(V 10758. 5)
P3   3   ,   ,   ,
,   V 10758. 2   P3   4   ,   P3
,   ,   ,

, V 10758. 2 , ,

V 10758. 2 V 10758. 6 P4 ,V 10758. 6 P4

, , ,

, , ,

M1 M2 ,M2 (1 ,D F) ,

, ,

, , , ,

, ,

, , ,

Hooker (1989) (premetaconule crista) ,

M2 , ,

(sublophoid) ,

M3 , , ,

, , V , (1)

V 10758. 3 p1 , p1

,p1 p2 (10. 4 mm) (1 ,G) p1

(1 ,A) , , , ,

, (p1 :4. 3 mm) p2 , p1 ,

p3 , , (V 10758. 1)

, , , ,

, , ,

, (V 10758. 3) ,p3

p4 , , ,

, ,

, , ,

表 1 颊齿测量数据 (单位 : 毫米)
Table 1 Measurements of cheek teeth of Olbitherium millenariusum **gen. et sp. nov.** (mm)

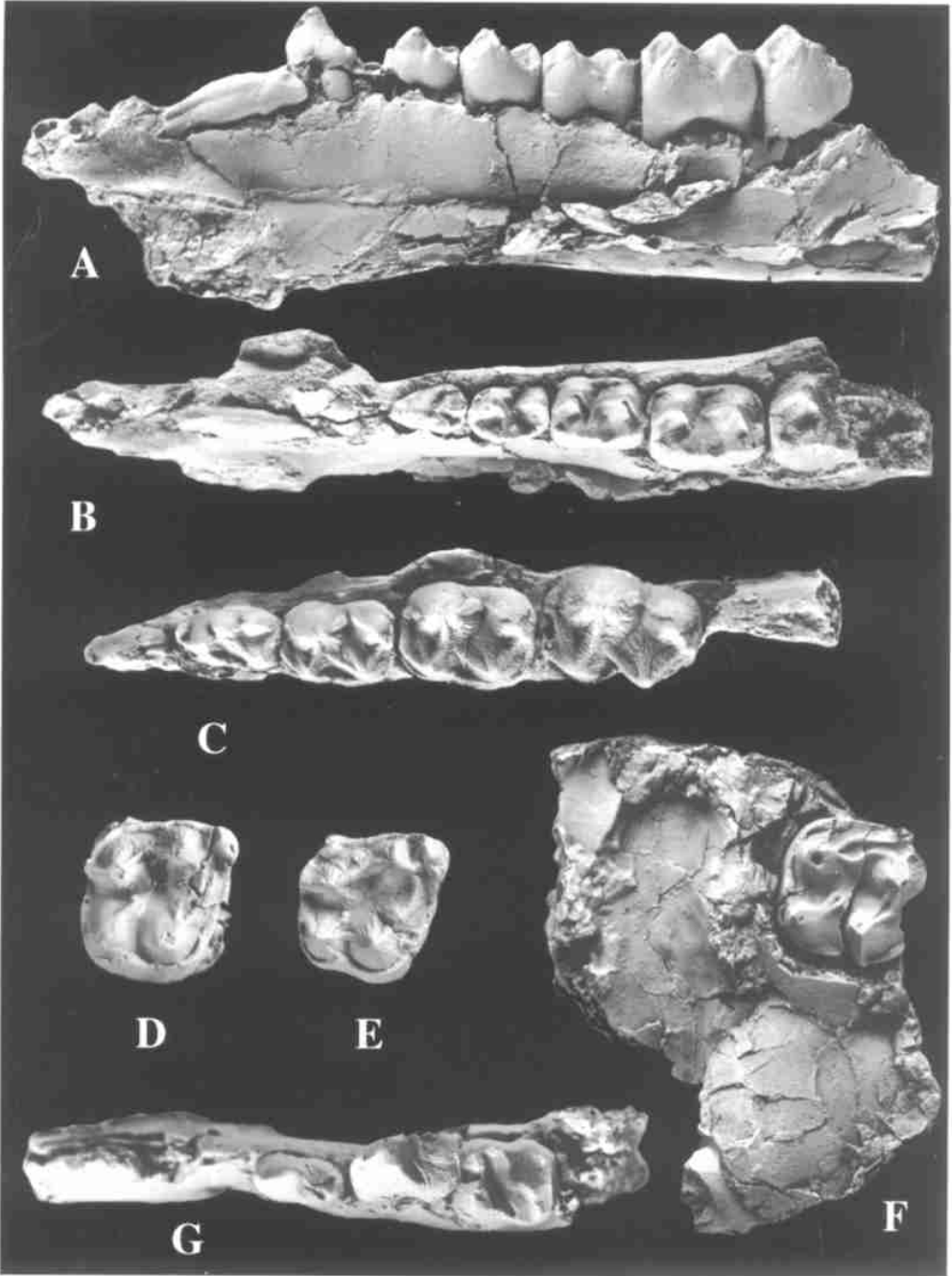|	P2		P3		P4		M1		M2		M3	
	L	W	L	W	L	W	L	W	L	W	L	W
V 10758. 2	7. 25	5. 4	8. 15	9. 0	8. 7	11. 3						
V 10758. 4 7	8. 75	6. 95			> 10. 0	11. 5	> 12. 1		12. 9	13. 5		
V 10758. 8											11. 7	12. 85
	p2		p3		p4		m1		m2		m3	
	L	W	L	W	L	W	L	W	L	W	L	W
V 10758. 1	7. 8	4. 0	8. 8	5. 6	9. 5	6. 2	11. 4	7. 9	13. 5	9. 75		
V 10758. 3	7. 6	3. 95	9. 25	6. 0	9. 35	7. 15						
V 10758. 9					8. 75	6. 7	8. 75	> 7. 6	12. 05	9. 1	16. 85	10. 45
V 10758. 10							12. 2	8. 7	14. 1	10. 3		

Fig. 1　Upper and lower cheek teeth of *Olbitherium millenariusum* gen. et sp. nov. , occlusal and lateral views
A , B. right mandible with p1　m3 (V 10758. 1) , lateral and occlusal views , ×1.3 ; C. left mandible with
dp2　m2 (V 10758. 10) , occlusal view , ×1.6 ; D. right M2 (V 10758. 7) , occlusal view , ×1.6 ; E. right M3
(V 10758. 8) , occlusal view , ×1.6 ; F. fragmentary left maxilla with M1 (V 10758. 4) , occlusal view , ×1.6 ;
G. left mandible with p2　4 (V 10758. 3) , occlusal view , ×1.6

1cm

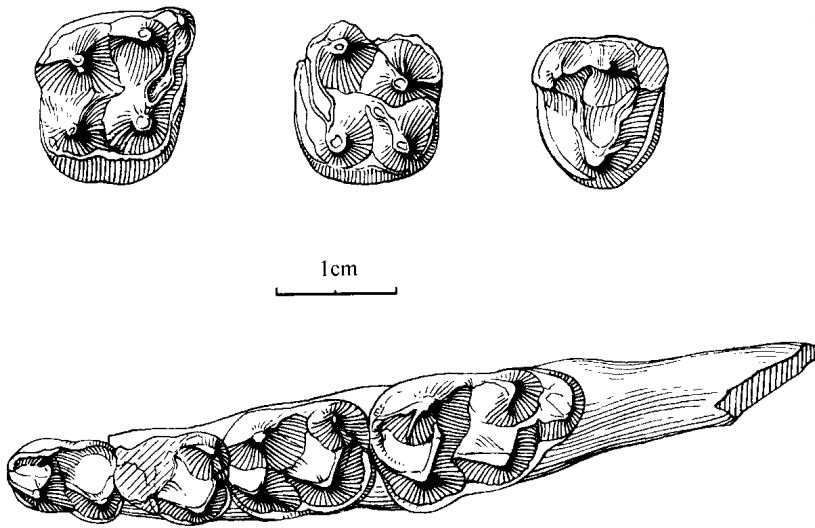2　　　　　　　（　　　　　　），　M2（V 10758. 7）　M1（V 10758. 4）
P4（V 10758. 6）　　p4　m3（V 10758. 9），

Fig. 2　*Olbitherium millenariusum* gen. et sp. nov. , right M2 , left M1 ,
right P4 , and left p4　m3 , occlusal view

　　　　　　　　　　　　，　　V 10758. 10　　m1　　m2　　　　　　　，V 10758. 9　　m1
　　　　　，　　　　　　　　V 10758. 10　　　　　m1　　m1

　　　　，　　　　　　　，　　　　　　　　　，
　　，　　　　　　，　　　　　　，　　　　　　　　　　，
　　　　（　　）　　　　　，
　（V 10758. 10）（　1 ,C）　，　　　　　　　　　　　（buccal postcristid branch ,*sen-*
su Hooker , 1989)　　　　　　　，　　　　　，　　　　，
　（lingual postcristid branch , *sensu* Hooker , 1989)　　　　　　　　（V 10758. 1)
（　1 , B)　，　　　　　　　　　，　　，　　　—
　　—　　　　　　　　　，
　　m2　m1 ,　　　　，
　　m3　　　　　　，　　　　　　　　，
　，　　　，　　，　　　　　　　，
　　，　　　，　　　　　　　　　　，

　　　V 10758. 10　　　　　dp2　dp4（　1 , C) dp2　　，
　，　　　　，　　　　　　，　　　　　　（dp2　:7. 3
mm ,　:3. 4 mm) dp2　　　　　　*Tetraclaenodon puercensis*　dp2（Butler , 1952),
　　　　P3 ,　　　　dp3　　　，　　　，
　　　　，　　　　，
　　　　，　　　　　　　　，

, , (dp3 :9. 45 mm, :5. 45 mm)
dp3 Butler (1952) *Plagiolophus annectens* dp3 ,
, , , ,
dp4 m1 , (dp4 :9. 9 mm, :7. 2 mm)
Hooker (1989) , phenacodontids
; , ;
2A (facet 2A) ; ; ,
, ;M3 ,
,
, phenacodonts , , ,
, , ,
, M3 , ,
, V , , *Hyracotherium* , *Cym‐*
balophus , *Cardiolophus* *Homogalax* M3
(*Radinskya yupingae*)
, (Phenacolophidae) (Mc Kenna et al. , 1989) ,
(Mirorder Altungulata *s. s.*) (Mckenna and Bell , 1997)
, *Olbitherium millenariusum* *R. yupingae*
McKenna et al. (1989) *R. yupingae* ,
, , ,
R. yupingae ,*O. millenariusum* :
, , ,
, *O. millenariusum*
R. yupingae *O. millenariusum* C P1 (*R. yupingae*
) ,P1 P2 (*R. yupingae*) ,P4 (*R. yupingae*
) , (*R. yupingae* M1) , (*R. yupingae*
) , (*R. yupingae*) ,M3 (*R. yupingae*
,) , *R. yupingae* phenacolophids M3
, , ,
,
, m1 2 , phenacodontids m1 2 *O. millenariusum* m1 2
, ,
, , , ,
m1 2 , ,
, , phenacodontids m1 2
O. millenariusum , *Ectocion* *Phenacodus* *Copecion* , ,
, ,
O. millenariusum *O. millenariusum* m1 2 phenacodontids , m3
phenacodontids , phenacodontids m3 ,

,   ,   *O. millenar-*
iusum   ,m3   ,   ,   ,   ,
O. millenariusum   m3   ,   ,   ,

,*Olbitherium millenariusum*   M1   2   *Radinskya yupingae*
,   m1   2   phenacodontids   ,
（Hyracoidea）   ,   *O. millenariusum*   M3   V   ,   ,
Seggeurius (Mahboubi et al. , 1986)   M3
(Sudre , 1979) ,   ,
O. millenariusum   ,*Seggeurius*   M3   V

,   ,
(Fischer , 1989 ; Fischer and Tassy , 1993 ; Prothero and Schoch , 1989) ,
Proboscidea , Sirenia , Tubulidentata , Macroscelidea   Afrosoricida
(Superorder Afrotheria) (Hedges , 2001 ; Madsen et al. , 2001 ; Helgen , 2003   )
O. millenariusum   M3   V   ,
,   *O. millenariusum*

,Maas et al. (2001)   "   "   *Hi-*
lalia ,   "   "(" Condylarthra")   (brontoth-
eres)   (chalicotherioidea) ,   ,   W   ,   ,
,   ,
,m1   3   ,m3
Hilalia   *Meniscotherium*   *Pleuraspi-*
dotherium   Orthaspidotherium   ,   "   "   ,
(1995)   (*Danjiangia*)   ,   *Danjiangia*
Hilalia   *Olbitherium*   ,
W   ,   ,   ,
,m3

Gheerbrant et al. (2001)   Ouled Abdoun
,*Abdounodus hamdii*   Miocleanidae   ,
Ouled Abdoun   *Ocepeia*
daouiensis ,   Taxeopoda (Archibald , 1998) ,   " Phenacodonta"
" Phenacodonta"   McKenna (1975)   ,   Thewissen   Domr
ning (1992)   Archibald (1998)   "; Phenacodonta"   (Phenacodon-
tidae) (Meniscotheriinae)   *O. daouiensis*   (entolophid) ,
(mesoconid) ,m3   ,p4   ,   ,
Olbitherium millenariusum   ,
,   ,
Olbitherium millenariusum

,   Owen   1848   (*Hyrax*)
(Fischer , 1989) ,Cope（1881b）   (Condylarthra)
(subunit)   McKenna（1975）   "   "
"   "（" Mirorder Phenacodonta"）,   "   "
:   (Mirorder Eparctocyona McKenna , 1975)
(Mirorder Altungulata s. s.) (McKenna and Bell , 1997)   Thewissen   Domning（1992）
" Phenacodonta"   ,   Phenacodontidae   Meniscotheriidae
, *Olbitherium millenariusum*

,   ,   McKenna（1975）
"   "

(Ting , 1993 ; Bowen et al. , 2002
) ,   ,

,   ,
" Condylarthra"   phenacodontids (Cope , 1881a ; Radinsky , 1966 , 1969 ; Prothero et al. ,
1988   ) ,   ,   Hooker（1989），
Rose（1996）   ,   *Radinskya yupingae*   ,

R. yupingae

,   *R. yupingae*   (phenacolophids)   (McKenna
et al. , 1989)   Phenacolophidae   tethytherians   (McKenna and Manning , 1977 ;
Domnig et al. , 1986)   ,   *Phenacolophus*（Phe-
nacolophidae)   *Arsinoitherium*   *Crivadiatherium*
mackennai ,   p4 m2   m3   Russell et al.（1982）   ,
C. mackennai   ,   *Phenacolophus-Crivadiatherum-Arsinoi-*
therium   (morphocline)   , *C. mackennai*
,   ,   *Phenacolophus*   *Radinskya*
tethytherians   ,   ,   *Olbitherium millenariu-*
sum ,   phenacodontids   ,
phenacodontids   ,
(Maas et al. , 2001 ; Gheerbrant et al. , 2001) ,
phenacodontid   , *O. millenariusum*

(,   ) ,
(Bowen et al. , 2002 ;Ting et al. , 2003)   /   ,
,
,   (neoplagiaulacid
multituberculate) ,   (epoicotherid palaeanodont) ,
(carpolestid and paromomyid plesiadapiformes) ,   (asti-
galid and pseudictopid anagalidans) ,   "   "(hyopsodontid and phe-
nacodontid" condylarths") (Tong and Wang , 1998) ,   *Olbitherium millenariusum*

Meng et al.（1998）

Bayan Ulan　　　　　　　　　　*Olbitherium millenariusum*　　　　，

（IVPP V 11149. 2　　V 11149. 5)　　　　　　　　　　　　　　，

　，

　　　　　　　　　　，*Olbitherium millenariusum*

phenacodontids　phenacodontid　　　　　　　，　　*Olbitherium millenariusum*　　　　　phe-
nacodontid

　　　　　　　　　　　　　　　，　　　　　　　，

OLBITHERIUM MILLENARIUSUM, A NEW PERISSODACTYL-LIKE ARCHAIC UNGULATE (MAMMALIA) FROM THE EARLY EOCENE WUTU FORMATION, SHANDONG

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Key words　Wutu, Shandong, Early Eocene,“ Phenacodonta”

Summary

A unique mammal was found from the Early Eocene of the Wutu Basin, Shandong Province, China. The upper molars of the species are similar to those of early perissodactyls in general morphology, but the m1　2 are much like those of phenacodontids in having an incomplete hypolophids, and the M3 has a hypocone with prehypocrista and posthypocrista, which is similar to that of primitive hyraxes. It is difficult to assign the new species to the order Perissodactyla or other definite orders. It seems advisable to refer the new species to“ Mirorder Phenacodonta”, including Condylarthra, Perissodactyla and Hyracoidea (*sensu* McKenna, 1975).

“ **Mirorder Phenacodonta” McKenna, 1975 (** sensu **McKenna, 1975)**

Order incertae sedis

Olbitherium millenariusum **gen. et sp. nov.**

(Fig. 1, 2)

Holotype　A right mandible with p1　m3（IVPP V 10758. 1).

Referred specimens　A fragmentary left maxilla with P2　M1 and alveoli of C and P1 (V 10758. 2), and associated left mandible with p2　p4 and alveolus of p1 (V 10758. 3); isolated left M1(V 10758. 4), and right P2(V 10758. 5), P4(V 10758. 6), and M2 (V 10758. 7); a right M3 (V 10758. 8); a fragmentary left mandible with p4　m3 (V 10758. 9); and left dp2　m2(V 10758. 10), and right dp4 trigonid and m2 trigonid (V 10758. 11).

Locality and age   Early Eocene Wutu Formation , the coal mine of Changle County , Shang-dong Province , China .

Diagnosis   Dental formula : ?. 1. 4. 3/ ?. 1. 4. 3 ; diastema significant between C and P1 ; P4 without metaconule ; upper molar with three roots , long protoloph connecting to the paracrista ; M1   2 metaconule small , anterolateral to the hypocone , and connecting to the metacone by a posterolaterally oriented ridge ; parastyle large ; mesostyle absent ; lingual cingulum surrounding protocone and hypocone ; M3 metaconule greatly reduced , hypocone bearing anterior and posterior crests ; talonid absent on p1 and small on p2 ; p4 metastylid distinct , and entoconid absent ; m1   2 hypoconulid more lingually positioned and close to entoconid ; and connecting to the hypoconid by buccal postcristid branch (Hooker , 1989) , metastylid weak , no hypolophid connecting the hypoconid and entoconid ; m3 elongated , entoconid nearly isolated , hypoconulid large and formed third lobe .

Remarks   *Radinskya yupingae* from the Late Paleocene of the Nanxiong basin , Guangdong Province , China , is similar to early perissodactyls in the upper cheek tooth morphology (McKenna et al. , 1989) and was called as a " Chinese Paleocene perissodactyl " (see Froehlich , 1999) . The lower cheek teeth of *R. yupingae* are unknown . As recognized by McKenna et al. (1989) , *R. yupingae* differs from the primitive perissodactyls in having a large protoconule , a strong metaconule , strong and short protoloph and metaloph , alignment of the hypocone , metaconule , and metacone in a line , and lacking lingual cingulum surrounding the protocone and hypocone . In comparison , *Olbitherium millenariusum* shares more derived features with early perissodactyls , such as a relatively small paraconule , the metaconule being considerably smaller than the metacone and hypocone , the metaconule anterior to both the metacone and hypocone so that the three cusps are not aligned in a line , and the well-developed lingual cingulum surrounding the protocone and hypocone . *O. millenariusum* further differs from *R. yupingae* in having a longer diastema between the canine and the P1 but lacking gap between the P1 and P2 , absence of P4 metaconule (small metaconule in *R. yupingae*) , upper molars with three roots (M1 with four roots in *R. yupingae*) , absence of the mesostyle (an extremely weak mesostyle in *R. yupingae*) , presence of the postmetaconule crista (lacking both pre- and postmetaconule cristae in *R. yupingae*) , the M3 metaconule reduced (distinct , isolated metaconule in *R. yupingae*) , and having hypocone cristae . Moreover , in *R. yupingae* and related phenacolophids the M3 is little reduced and have the hypocone but lack cristae of the hypocone , which are also distinctive from *O. millenariusum.*

In contrast , the lower cheek teeth of *O. millenariusum* , particularly the m1 and m2 , are hardly comparable with those of perissodactyls . Instead , they show more similarities with those of phenacodontids . *O. millenariusum* differs from early perissodactyls in the following features : the trigonid and talonid basins are shallow ; the hypoconulid is more lingually positioned and is closer to the entoconid ; and the hypoconulid connects to both the entoconid and hypoconid by the lingual postcristid branch and the buccal postcristid brach , respectively . In primitive perissodactyls , the trigonid and talonid of basins of the m1 and m2 are deep ; the hypoconulid rides on the posterior cingulid , and is usually at the longitudinal axis of the tooth ; the entoconid directly connects the hypoconid by the hypolophid ; the hypoconulid lacks the lingual and the buccal postcristid branches (*sensu* Hooker , 1989) . The lower cheek teeth , particularly the m1 and m2 , of *O. millenariusum* are similar to those of some phenacodontids , such as *Ectocion* , *Phenacodus* , and *Copecion* in the following characters : the trigonid and talonid basins are shallow ; the hypoconulid in some cases is closer to the entoconid ; and the hypoconulid connects to both the entoconid and hypoconid , although these taxa differ from *O. millenariusum* in having less developed lophids . However , the m3 of phenacodontids is different from that of *O. millenariusum* in being shorter , and lacking the hypoconulid lobe . In phenacodontids , the m3 is relatively shorter , has a talonid formed by the hypoconid , hypoconulid , and entoconid , and lacks a hypoconulid lobe . Similar to primitive perissodactyls , the m3 of *O. millenariusum* is relatively long and has the hypoconulid lobe . The m3 entoconid of *O. millenariusum* is nearly isolated and is not connected by the hypolophid to the hypoconid , which

differs from the condition in perissodactyls. In sum , *O*. *millenariusum* is more similar to primitive perissodactyls than is *R*. *yupingae* in the upper molar morphology , but the m1 and m2 are more comparable to those of phenacodontids.

 O. *millenariusum* is also comparable to early hyracoids in some features. For instance , the V-shaped hypocone on the M3 and reduction of the hypoconule in *O*. *millenariusum* are similar to those of the hyracoid *Seggeurius* (Mahboubi et al. , 1986) .

 Cope (1881a) first proposed that the Condylarthra are the ancestral type of the known perisso-dactyls ; the proposal has been influential since then. Based on his study on structures of the masti-cation and locomotion , Radinsky (1966 , 1969) specifically pointed out that perissodactyls originat-ed from the phenacodont genus *Tetraclaenodon*. McKenna (1975) further grouped the orders Condy-larthra , Perissodactyla , and Hyracoidea to the" Mirorder Phenacodonta" , although Hyracoidea is transferred to the Superorder Afrotheria based on molecular data (Hedges , 2001 ; Madsen et al. , 2001 ; Helgen , 2003) . The cheek teeth of *O*. *millenariusum* concurrently possess some characters of perissodactyls , phenacodontids and hyracoids , and make it difficult to assign a definite order. Therefore , the new taxon from the Early Eocene of Wutu Basin is tentatively referred to the " Mirorder Phenacodonta" (McKenna , 1975) .

 The similarity of *O*. *millenariusum* to the primitive perissodactyls and phenacodontids suggests that perissodactyls derived from phenacodonts or *Phenacodus*-like archaic ungualates. And the new taxon , *Olbitherium millenariusum* , represents an offshoot when the Paleocene *Phenacodus*-like archaic ungulates evolved to perissodactyl-like mammals.

 Some archaic ungulates were reported recently , *Abdounodu hamdii* (Miocleanidae) , *Ocepeia daouiensis* (cf." Phenacodonta") , and *Hilalia* (" Condylarthra") were found from the early Paleo-gene of Morocco and Turkey (Mass et al. , 2001 ; Gheerbrant et al. , 2001) . These suggest that origin of perissodactyls is possibly related to Asian and North African archaic ungulates.

 Olbitherium millenariusum is probably one of many Eocene relic forms of archaic mammals in the Wutu fauna (Tong and Wang , 1998) . Fossils similar to *O*. *millenariusum* were also found in the latest Paleocene Bayan Ulan fauna (Meng et al. , 1998) .

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