

评欧亚晚新生代生物地层对比

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内 容 摘 要

随着人们对欧亚地区广泛分布的陆相沉积物研究的不断深入,不少地区性的陆相生物年代表(主要是哺乳动物生物年代表)相继问世(1853—1985)。随之出现了许多进行洲内和洲际间生物年代对比的文章。新近的两篇文章(李、吴、邱,1984;薛祥煦,1984)建立并概述了中国晚新生代的陆相生物年代,并与欧洲地区作了对比。与此同时,本文作者发表了数篇讨论欧洲晚新生代哺乳动物生物年代及其对比的文章(Kretzoi, 1983a, 1983b, 1984, 1985a, 1985b; Kretzoi-Pécsi, 1982)。其中一篇讨论了欧洲与中国晚新生代生物年代对比的可能性(Kretzoi, 1985b)。许多殊途同归的观点是很令人满意的,但也有一些看法尚需探讨。这篇短文旨在促进双方观点的进一步交流。

作者通过对比中国和欧洲晚新生代动物群进化阶段,认为下述问题尚需探讨或做更详尽的工作。

1. 谢家期,作为一个时代的特征性的化石材料似太少,与欧洲进行生物年代对比尚有困难。

2. 山旺期尽管有丰富的动物群为代表,但其中从早中新世至晚中新世的属种都有,恐怕不能直接与欧洲的奥尔良期(Orléanien)相比,需进一步作工作。

3. 就目前所知,通古尔期在时间上较欧洲的阿斯塔拉期短,或仅相当于 Post-Astaracian = Monacian。

4. 灞河期建期地点的哺乳动物并不是典型森林型的。相反,河南和山西等省的一些地点的哺乳动物的森林性质较欧洲的 Eppelsheim 期更明显。在中国,有希望将该期作进一步的划分。

5. 保德期的材料是新第三纪所有动物群中最丰富的。无论从动物群或是分类单元的数量来说,都很有希望对东亚这一时间跨度作更详细的确定。并为解决新旧大陆之间最大的哺乳动物群的迁徙问题提供资料。

6. 静乐期;这一时期是具特征性的。如果把一些含有真马的动物群从中排除,那么这个时期与西伯利亚—欧洲者是很不相同的。

7. 游河期和更晚些的第四纪的“真马”动物群的时代的确定是令人满意的。这在整个欧亚大陆都是可以对比的,与北美的动物群的时代对比也是有希望的,而与热带地区动物

群的比较仅在放射性绝对年龄的基础上才有可能。

8. 新生代, 尤其是晚新生代真兽类进化和动物群动力学主要受两个因素控制: 中亚的辐射中心和白令海峡“气候筛”。前者取决于古亚洲区的生境演化。中国古脊椎动物学的新成果将有效地推动人们去揭示这一广大地区上生命的进化过程, 确信旧大陆陆地上生命历史的许多问题将通过中国同行们的工作得到澄清。

(吴文裕 摘译)

REMARKS ON THE CORRELATION BETWEEN EUROPEAN AND ASIAN LATE CENOZOIC LOCAL BIOSTRATIGRAPHIES

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Key words Eurasia; Late Cenozoic; biostratigraphy correlation

Increasing interest in the geohistory of vast continental sedimentary regions both in Europe and Asia led to local terrestrial (primarily mammalian) biochronological systems (1853—1985). The multiplicity of local chronologies or stratigraphies necessitated the correlations between these local systems. This is the reason of the many papers dealing with the correlation of continental to intercontinental size. Two recent papers establishing and summarizing the local terrestrial chronology of the Late Cenozoic in China made also correlations with that of Europe (Li Chuankui, Wu Wenyu, Qiu Zhuding, 1984; Xue Xiangxu, 1984). At the same time the present author published some articles discussing the European Late Cenozoic mammal chronology and its correlations (Kretzoi 1983a, 1983b, 1984, 1985a, 1985b; Kretzoi, Pécsi 1982), one of which deals with the possibility of correlation of European and Chinese local chronology (Kretzoi 1985b). Many parallel conclusions are very satisfying, but some points need a more detailed explanation or even comparison. This short note is devoted to the better understanding in our correlational work.

Xiejiaan-Agenian correlation

The 14 mammalian taxa of the biostratotype locality Xiejia are mostly Late Oligocene or transitional to Miocene forms, as *Sinolagomys*, *Tataromys*, *Plesiosminhus* and *Tachyoryctoides* and *Eucricetodon* too. One genus, *Brachypotherium* is a form appearing in Europe only with the Middle Burdigalian or Middle Orleanian. Another genus, *Oioceros* is a member of the *Hipparion* faunae in the Middle East. Its appearance in the Agenian of China could burst all of our ideas on the monophyly of the Bovidae. These very important discrepancies greatly weaken both the correlation between the two mentioned local ages and the concept of the Xiejia age.

Shanwangian-Orléanian correlation

The 9 faunae (Fangshan, Puzhen, Xiacaowan = Hsiatsaohwan, Shanwang, Jiulongkou,

Dongshapo, Lengshuigou, Zhangbei, Danshuilu) given under the heading Shanwangian and correlated with the European Orléanian are much less controversial in composition than the foregoing, though not without problems.

The most striking differences from the European Orléanian are the followings: First of all the appearance of the ovine *Oioceros* in the faunae, as noted under the Xiejiaan, too. The same could be told on the unusually early appearance of a "*Chilotherium*" species, a highly specialized pliopithecine (*Dionysopithecus*) and a very primitive shaped proconsuline type (*Platodontopithecus*) represented by a very nearstanding, if not identical form (*Ataxopithecus*, Kretzoi 1984b) in the Hungarian Middle Eppelsheimian (Lower Vallesian) *Hipparion* fauna of Rudabánya. The very early appearance of giraffids in China is also remarkable, if we consider the African origin of the group. The mixture of Early Miocene to Late Miocene forms (in European scale) in the Shanwangian faunal age suggests further refining of our knowledge in respect of the faunal composition of this time-unit and to wait for more data to ascertain the differences in the appearance of some taxa as real chronological (or ecological) markers of probable heterochronities.

Tunggurian-Astaracian correlations

The most sharp-cut boundary in the Late Cenozoic Chinese sequence in mammal faunae is the so called "Hipparion-datum"

In E. Asia, where the dominant role of hipparions is weakened by the rhinos, this boundary is only acceptable, if the faunal sample is rich enough. The other weakness of this Hipparion-datum is that it is only acceptable if other faunal elements confirm it, i. e. if they represent an entirely Miocene fauna, but accompanied by a *Hipparion* species (Kretzoi 1985b). In other words: the earliest fauna with *Hipparion* will be the Hipparion-datum, until a much earlier form is found. Therefore all the faunae without *Hipparion* must be classified as of prae-*Hipparion*, or Astaracian age. In the chronological table of Li, Wu, Qiu (1984) 15 faunae (Xiaolongtan, Zhongxiang, Erlanggang, Koujiacun, Tunggur, Tongxin, Qinan, Xianshuihe = Hsien-shuiho, Lierpu, Diaogou, Shennongjia, Ledu, Chaidamu = Tsaidam, Hsishui-Taben buluk, Pingliang, Jining) are placed in the Tunggurian or Astaracian of which only one, namely Tunggur show a broader taxonal sample (27 taxons), the others remain under 8 taxa. Therefore only Tunggur is evaluable chronologically, a fauna differing from early *Hipparion*-faunae only in the absence of *Hipparion*. In this respect it remembers on the European Early Eppelsheimian or Monacian faunae without *Hipparion*. Crucial for the migration of the dryopithecines from E. Africa to E. Asia is the age of the fauna of Xiaolongtan with only 7 taxa, partly not characteristic for aging and partly controversial in composition: *Hexaprotodon* is unknown in Asia (both Siwaliks and Indonesia) before Villafranchian, hardly in consistence with some other forms mentioned from the locality, as especially *Palaeochoerus*. The other localities arranged under the Tunggurian are too poor for aging. In sum, the otherwise colourful age (called Astaracian in Europe) needs a broader sample to be subdivided in China. The Tunggur assemblage represents only the Tunggurian s. str., equally broadly the date to post-Astaracian in European sense.

Bahean-Eppelsheimian-Vallesian

As shown in the old sample collected by the Sino-Swedish, Sino-French and other ex-

peditions, the old *Hipparion*-faunae are rarer in China than the Baltavárians (=“Turolians”) in the northern and NE regions (Kretzoi 1985b). This is reflected in the faunal samples of the new Chinese excavations (Li, Wu, Qiu, 1984).

The three faunae assigned to the Bahean or Eppelsheimian are difficult to characterize, even the type fauna, Bahe is too small to be fixed in the “Old Hipparion age”. Much better in this respect are the numerous and partly abundant faunae of Honan and Hopei, or an important number of the *Hipparion*-faunae of Shanxi and some of Shaanxi/Liuhe, Bahe, Bulong, ?Chai-Chang-kou, Chen-Kou-wan, Chiao-Chia-kou, ?Chia-Yü-tsun, Chili loc. 66., Chingko-Hsien loc. 48, Chü-Tse-Wa. Characteristic for this faunal complex, representing the Bahean as an age name it would be perhaps more significant for example Honanian, are primarily (as discussed by the present author some months ago, Kretzoi 1985b): presence of only small forms of agriotheres (*Galeotherium*=“*Ursavus*”), rarity or lack of ictitheres and hyaenines, and true machairodonts among carnivores, increasing number of rhinocerotid taxa (*Brachypotherium*, *Stephanorhinus*, *Acerorhinus*, first true *Chilotherium*) appearance of chalicotheres, diversified and dominant presence of hipparionines, ?last appearance of anchitheres, early suid types as *Korinchoerus*, *Chleuastochoerus* and lack of characteristic forms of the *Hipparion*-assemblages as *Microstonyx*, dominant in the Baodean, poor giraffid fauna, rich representation of primitive cervids (*Cervavitus*, *Eostyloceros* etc.), low number of bovid taxa, all belonging to primitive types, as tragocerines and brachyodont gazells (*Procapra*). Browsing rhinos, frequent Cervids in contrast to grazing forms argument for a bushforest vegetation of the regions represented by the localities of this age. The forest dwelling character of this faunal complex was first underlined by M. Schlosser (1903) and worked out in details by B. Kurtén (1952), a feature characterizing the European Eppelsheimian *Hipparion* faunae, contrasting the later (Baltavárian) ones. The uniformly primitive character of this “gaudryi”-faunae ensure their chronological distinction from the “dorcadoides”-faunae of Baltavárian correlations.

Baodean-Baltavárian = Turolian correlation

The rich sample of the “late” *Hipparion*-faunae both in older and later collections (Zanda, Gyirong, Nyalam, Lufeng, Balouhe, Xinan, Lantian, Wudu, Jingchuan, Qingyang, Huoxian, Tuchengzi, Ertemte, Yushe “Zone I”, Dalai Nor, Chaidamu-Tsaidam p. p., Manas, Urho, Wenquan, Duodaoshi, Chi-Chia-Kou, Chi-Tsu-Kou, Chiton Gol, Fu-ku-Hsien loc. 51, Ho-chü-Hsien loc. 114, Houliang, Hsiao-Hung-Chü, Hsiao-Szu-Chia-Ling, Hung-Chiao-Ni-Ke-Tan, King-Yang Hsien loc. 115, 116, Malang, Mancusun, Olan Chorea, Pao-Te-Hsien = Baode loc. 30, 31, 44, 108, 111, 112, 113, Pei-Hou-Kou, San-Ta-Kou, Shia-Shiang loc. 22, Wa-Yao-Po-Kou-Nei) ensure not only their distinction from the older. Bahean-ones, but their correlations with the European Baltavarian faunas too. The only problem in a broad correlation is the great diversity between the faunae of this age, showing a much more varied composition in taxonal list and dominance rates changing with time and range. A more detailed subdivision of the Chinese Baodean *Hipparion*-faunae in subages is needed, but taxonal revision of some important groups such as carnivores, rhinocerotids, hipparions, suids, cervids and antelopes must precede this work. Until them we will be satisfied with the well founded chronological parallelization of the Chinese Baodean with the European Baltavárian (“Turolian”). The increasing aridisation after the more forested Eppelsheimian-Bahean must be the consequence of the disappearance of the Inner Asian-North Chinese “Lake belt” corresponding the disappearing Paratethys in Europe. The difference between the two parallel processes is to be explained by the more

gradual desiccations of the Chinese Lake-belt than that of the Paratethys ("Messinian salinity crisis") in the European Mediterranean, or the continentalization in the Carpathian Basin. This is the one cause of the less sharp-cut correlation of the upper boundary of the Baodean, whilst the other is simply the basically different origin of the post-Baltavarian, i.e. Ruscinian faunal type embracing practically new forms invading to Europe from the south of Asia, very unlike to the slow transformation of the Baodean fauna to a Jinglean type assemblage.

Jinglean-Ruscinian correlations

The faunal assemblages of the post-"red bed" or post-*Hipparion* faunae are very difficult to characterize; from one side they are the stratigraphically most confused and uncertain materials in the old excavations, from the other side the difficulties are caused by the slow transition mentioned above and manifested in the survival of the rhino genera *Chilotherium* and *Shansirhinus*, primitive Castorids (*Dipoides*, "Eucastor") and some antelopes ancestral for this taxonal complex. Not better than the lower, the upper boundary of the age can be demarcated by the (for the moment) rather artificial argument of the lack of equines and elephantines, arriving-supposedly-with the beginning of the Quaternary. But even this more theoretical boundary marked by the first *Equus* s. l. and *Elephas* s. l. is the weak point of the characterization of the age fauna and remains so until more local faunae make possible to determine it sharper. But even the less humid character of the Chinese Jinglean is the basis of a new difficulty in separating the Jinglean from the Quaternary: in Europe the warm wet Ruscinian has a "Subhimalayan" type fauna sharply differing from both the Baltavarian and the succeeding Villafranchina-Villányian, whilst in the Chinese area this three ages show ecologically, and therefore taxonally, only small differences, giving only a tentative boundary both on the bottom and on the top of the Jinglean.

Comparing the fauna of an European and a Chinese Ruscinian or Jinglean locality we can understand the deep difference between the two areas with a basically different zoogeographic history: spatial Kaspian-NW siberian transgression and radical shrinking and disappearing of the Paratethys barrier and parallel changes in the Tethys belt caused an abrupt end of Sino-Siberia connection and opened a Subhimalayan one, resulting in a wave of southeastern immigrations, reaching as NW-boundary Southern England and replacing the *Hipparion*-grassland ecosystem with Subhimalayan forest to wet savanna conditions. meantime in China the bush-steppe conditions of the *Hipparion*-faunae prevailed during the whole time of this three ages and remained over the non-glacial parts of the whole Quaternary more or less semiarid in climatic conditions. But it is to mention that the climatic differences between North and South China became, as shown on the basis of a comparison of the faunae deeper only during the Pleistocene, namely between territories approximately N and S of the Yangtseline. The difference in the ecological conditions between Europe and Asia, primarily E. Asia could cause the differences between East and South Asia, too, because S. Asia remained with Europe in a more intimate connection, not only in the Ruscinian or Jinglean, but partly in later periods too, whilst E. Asian and S. Asia remained mainly separated until the end of the Quaternary, When the great Ganges-Tsangpo or Brahmaputra alluvium overbridged this barrier (Kretzoi 1938, 1956). This is the cause of the late dissolving of the Late Neozoic Sinomalayan zoogeographical province and the very late, practically only recent confluence of India and the Malayan region to an "Indomalayan" unit.

Youhean-Nihewanian/Villafranchian-Villányian relations

The time span between 2.4 or 2.5 My and 0.7 My is a matter of discussion both in Chinese and European stratigraphy. Less disputed is its aging in the biochronologic sequence of faunae. In Europe it can be divided in three well separable faunal types: the first is characterized by the presence of primitive arvicolids and "arvicoloid" cricetids such as *Baranomys*, *Trilophomys* and by *Dolomys* a. o., escorted by Ruscinian type macromammal forms, but without the rich murid elements, both in number of taxons and in dominant number over the cricetid-arvicolid elements. In the latest practice (Reppening, Fejfar, 1977) this period is the Villafranchian in restricted sense. The second faunal phase is that of the *Mimomys*-explosion (Kretzoi 1969), with a very diversified *Mimomys*-fauna and the first rootless arvicolids (*Lagurodon*, *Prolagurus*, *Allophaiomys*). This faunal type ends with a general restriction of the taxonal latitude and some indications of a general cooling. This faunal complex is called in the latest publications Villányian s. str. The third faunal complex is well characterized by the extinction of practically all Ruscinian remnants of the Villafranchian-Villányian accompanied by the *Microtus*-explosion in the arvicolid-fauna, beginning with the dominance of *Allophaiomys* (accompanied by the last survivals of *Mimomys*), and the sudden emerging of the different *Microtus*-branches, becoming dominant in the Quaternary and extant micromammal fauna of the Holarctica. This is the Early Biharian fauna, followed by the first arctic impact (Mindel-Elster) in the Upper Biharian.

The weakness of this three-grade succession is that it is not accompanied by equally detailed aging in the macromammal fauna. This is the reason of our hesitation in correlating and *Equus*-datum or an *Elephas* s. l. -datum with the detailed micromammal chronology ("vole chronology"). The only well correlable point in the micro-macromammal aging is the coincidence of the extinction of practically all macromammal types, not reaching the end of the Pleistocene with the Villányian/Biharian boundary of the micromammal chronology.

If we compare the Chinese biochronology of this time span with that of the European, we can clearly find the great similarity in the problems: first of all not to mention the problem of the Jinglean-Youhean boundary discussed above, the mixture of Choukoutienian and Nihewanian forms in the "Nihewan complex" and then (as not less difficult problem) the distinction between the pre-Nihewan and Nihewan part of the faunal complex of the Youhean, or more precisely the time span between Youhean and Choukoutienian.

Later faunal ages, following the Choukoutienian are complicated by increasing problems of glaciations and, perhaps in greater extent, by the increasing difference between South and North China in climatic-ecologic conditions. In other words: South China is too much influenced by the Malayan-Indonesian faunal area, or North China became more and more distinct from the Sino-Malayan faunal character. Both mean the same.

Overlooking the problems arisen from a comparison of Chinese and European local faunal evolution and biochronology, some questions emerge, not to be answered on the basis of a simple comparison of faunal lists, but much more as questions to be answered as results of deepened work on actual fossil materials. The number of this question is selfevidently great; some of them will be mentioned in the following:

Insectivores are less complicated in the extant European fauna; not so in the East Asian one, with a series of survivors of the Late Tertiary. Therefore, Chinese Late Tertiary to Early Pleistocene insectivores, primarily soricids and in some respects also talpids are promising for

the study of refined taxonomical-phylogenetical studies, because sorcid evolutionary trends are poorly known. Archaic E. Asian living representants and Chinese fossil relatives can surely help to a better understanding of this "difficult" group and his expansion to four continents.

Tertiary sciurid sample is insufficient to overbridge the gap in our European-North American Knowledge concerning historical dynamics of the family. Surely, the Chinese materials will support a great deal to a more diversified picture of this family. Marmotines are the most important group having Inner to Eastern Asian backgrounds and a rather intimate connection with North America's sciurid evolution.

Though more isolated in the Chinese sample, eomyids are very useful elements of a more precise European-Chinese biochronological correlation.

Basic importance is to attach to a more detailed and primarily careful comparison of European and Chinese cricetids, which are in Europe index forms of the most local terrestrial chronologies.

Special importance is to measure to the detailed study of the myospalacids in China (Teilhard de Chardin 1942, Kretzoi 1961), being the best "common language" between Chinese and Northeast Asian terrestrial local chronological sequences. Starting point must be the careful distinction of parallel evolutionary trends (*Prosiphneus*, *Mesosiphneus*, *Episiphneus*, *Eospalax*, *Myospalax*, *Allosiphneus*) running through more or less the same grades in overall evolution, but at different time levels and thus diminishing the chronological value of most evolutionary levels in the evolution of the myospalacid sample, if not carefully collected.

Arvicolids are basis of Quaternary mammal microchronology in Europe, the same could be evolved in Eastern Asia, but with some restrictions. They are also important for a closer correlation with North America. Restricted is the importance of arvicolids for the Chinese Late Quaternary, whilst a careful comparison of European and Chinese *Mimomys*-forms could be of greatest importance not only for the European-Chinese faunal exchanges in the Earlier Quaternary, or even in the Latest Pliocene, but perhaps with greater weight in the study of Mimomyne evolutionary dynamics expanding between Europe-East Asia-North America.

Histricid sample is important for the migration of this family, arriving in Europe on the boundary of the lower/upper *Hipparion*-faunae, not earlier.

Beside *Hipparion*-faunae *Primates* are the most eminent fossil record of China, at least for the Cenozoic. Their discussion needs much more place than possible in this short review. Therefore only the very early appearance of higher Primates in South China, postulating a separate migration way from East Africa far before the Siwalian immigration and the World's biggest one-locality sample of ramapithecines-sivapithecines (Shihuiiba) or the equally eminent sample of gigantopithecies and hominines from Middle and North China must be mentioned here.

Lagomorph remains are important for many reasons: all are early forms of the faunal exchange between North America and Eastern Asia practically in the whole Holarctica. True Ochotonids arrive Europe not before the end of the Early *Hipparion*-faunae (Eppelsheimian-Baltavarian boundary), i.e. they are contemporaneous with the second exchange between American and European *Hipparion*-faunae, enriching the North American fauna with many typically Eurasian or European types. Exactly the same time is the date of immigration of leporids to Eurasia (except *Hypolagus*, arriving in Europe not before the Ruscinian).

No data are available to fix the time of arrival of Proboscidea in the Chinese area, appearing in Barstovian times in North America. No more is known of the intrusion of elephantids

in the same area, Proboscideans seem to play only a secondary role in Eastern Asia, or at least this region seems to be a secondary scenery of Proboscidean evolutionary dynamism.

Perissodactyls are practically the most important members of the Upper Tertiary faunae in East Asia, contrasting the Artiodactyl dominance (except *Hippation*) in Europe. The most characteristic perissodactyl members of this faunae are the rhinos, matching with hipparions for the dominance. The most important problem is the great number of taxa. The improbably great number of species, living in a given age and territory (for example 22 taxa in the Chinese Turolian) needs revision and drastic reduction of specific-subspecific taxonal names to be real. They will partly represent forms related to European ones, or they are partly if not in majority, Asian, even East Asian endemisms. They produced over the time span Miocene-Pliocene at least evolutionary lines, represented by different generic-subgeneric successions such as *Brachypotherium*, *Acerorhinus* (=Lower-Middle Miocene "*Chilotherium*"), *Stephanorhinus* (=Miocene-Pliocene "*Dicerorhinus*"), *Plesiaceratherium*, ?*Hispanotherium*, *Aceratherium*, *Indotherium* ("*Beliajevina*", *Chilotherium*, *Shansirhinus*, *Sinootherium*, i. e. at least 10 genera-subgenera. Growing size, developing hypselodonty, cement deposition in the valleys and islands of the molars, or some times increasing molarisation of the premolars are all important data for a better knowledge of evolutionary grades and chronological position of the individual taxa composing the Chinese rhinocerotid sample. Their importance is extended both in direction of local biochronology and Chinese-European correlation. Siwalian relations are also to be examined in any genera (*Indotherium*, *Acerorhinus*). North American correlations are absent or importable.

Chalicotheres are present in the Chinese sample in both lines (chalicotheres and schizotheres) but not as frequent as to use for parallelizations. The same is true for Tapirs.

Hipparions, the theoretically most important forms of the Bahean-Baodean faunae, are for the moment of little usefulness both for local chronology and intercontinental correlations, caused by the crisis ruling in the taxonomy of this group, otherwise one of the most important and famous members in Tertiary mammal sample. If we risk a sentence based on this group it is restricted to two more or less recognized statements: one is the probability of the arrival of the *Hipparion*-invasion in China at the same date as the European "*Hipparion datum*", on the bottom of the Bodvaium/Middle Eppelsheimium=Lower "*Vallesium*", the second is the high probability of a second immigration of hipparions from North America (*Neohipparion*) in the Upper *Hipparion*-age (Baodean-Baltavarian). Uncertain is the date of arrival of *Equus* s. l. (*Allohippus*, *Asinus*, *Equus* s. str.) from North America, therefore the "*Equus datum*" is also to determine in the future. The only stating point based on *Equus* is: no faunae with *Equus* s. l. can be older than Early Pleistocene. The chronological insertion of some of the Chinese faunae has to be revised on this basis. The sporadic appearance of *Anchitherium* in a post-Tunggurian fauna side by side with the dominant hipparions, is typical for the *Baodean/Eppelsheimian*, whilst no data for the survival of this group is known from a post-Bahean (Baodean or later) fauna. Therefore, its provenance is a good argument for the prae=Baodean, i. e. Bahean, if accompanied by hipparions. The only problem is the time of the extinction of *Anchitherium* in Eastern Asia. In Europe this is the end of the Eppelshimian (more precisely the end of the Rhenohassian).

Artiodactyls are very different in chronological value, partly caused by the regional difference between Asian and European evolution of the families involved, partly as a result of the many local evolutions of the richer Central Asian Artiodactyl life, except perhaps some

antelope groups. Suid evolution looks to be less many-sided than in South and West Eurasia. Cervid branching in the Late Cenozoic is too complicated to be available for evolutionary zoogeographic speculations.

More in details, suids are scarcely represented in the Miocene, together with tayassuids, they are rare in higher parts of the earlier Miocene (*Conohyus*, *Bunolistriodon*, *Hyootherium*, *Listriodon*), local (*Chlemastchoerus*) or archaic (*Listriodon*, *Conohyus*, *Karynochoerus*) in Bahean, restricted to *Miocrostonyx* and *Propotamochoerus-Potamochoerus* in the Baodean, or to the last and *Sus* in the Jinglean or Ruscinan. Were there any difference between Eastern Asia and Europe, then it would be the more dominant role of listriodonts and the relatively weak participation of bunodont suids in the faunae, compared with locally dominant provenance of the family in European assemblages, speaking for a dominantly more bush forest to dry forest environment in Eastern Asian.

Giraffids are more diversified and complicated group, with a distribution in time and space producing much more questions than data. First of all, their very early appearance in Eastern Asia is a little in discordance with the much later arrival of this family in the European Miocene sample. This fact involves the possibility of an early (Orléanian) direct connection between Africa and not only India, but Chinese territories too. If so, then many other groups could arrive through this direct route to Eastern Asia from Africa and mutual connections are also possible, for example an earlier immigration of Proboscideans via Africa-Subhimalayan Asia-Eastern Asia etc. The later history of the giraffids in Eastern Asia is more correlated with that in Europe; the richer and more diversified sample in the Baodean contrasts that of the poorer representation of this family in the Bahean exactly as the simple *Palaeotragus*-fauna of the Eppelsheimian compared with the diversified giraffid assemblage of the Baktavarian in Europe. At the same time the local differences are also important: *Honanotherium* dominance in Chinese old *Hipparion*-faunae contemporary with *Paleotragus* as the only giraffid in Europe, whilst a *Palaeotragus-Samotherium* dominance in Chinese late *Hipparion*-faunae contrasts evidently the *Samotherium-Helladotherium* representation in Europe.

Practically the same is the case with the bovide as with the cervids. The only parallel between Europe and China is the richer diversification in the gazelles and other antelopes in the late *Hipparion*-faunae (Baodean), and the impoverishment of the antelope-fauna during the post-*Hipparion*-faunae, with increasing number of ovines-ovibovines. Striking difference in bovid evolution is the very early appearance of the prolific evolutionary center of Palasia, far being well known.

Summing the short comparison of Late Cenozoic faunal evolution of China and Europe, I have found the following results and problems to discuss or to be completed:

1. The Xiejiaan sample is too weak to be characteristic for this age and to be compared with any European time unit.
2. The Shanwangian is richer represented by faunae, but too diversified to compared with the European Orléanian, or to parallel the boundaries, which are uncertain even in Europe.
3. The Tunggurian, as known for the moment, is narrower in time than the European Astaracian, or p. p. post-Astaracian (Monacian) what is itself controversial enough to insert and delimit it.
4. The splendid sample of the Bahean is clear than the European Eppelsheimian; a subdivision in subages is promising task of Chinese paleontology.
5. The Baodean is the richest sample of this time unit, richer than any other faunal

group in the Neogene. The imposing number of faunae and individual taxons is highly promising for a more detailed aging of this time span in Eastern Asia and for informing about the greatest migration of mammal faunae between the Old and New World.

6. Jinglean age is well characterized; if some Equus-faunae are excluded from this very characteristic and in its evolution very special time unit of East Asian faunal dynamics, very distinct from Siberian-European processes.

7. Youhean and later Quaternary ("Equus") faunae are satisfactorily dated and correlated in the whole Eurasian sample. Correlation with North American faunal ages is also promising. Correlations with tropical regions is possible only on the basis of radiometric dating, at least for the time given.

8. Cenozoic, eminently Late Cenozoic Eutherian evolution and faunal dynamics are primarily controlled by two factors: the Central Asian radiation center and the Beringian "climatic" sieve. The first depends on the evolution of biota in the Palasian region. Brilliant new results of Chinese vertebrate paleontology promote efficiently in unveiling of the evolutionary processes of the life in this vast region. Many of the questions of the history of the terrestrial life of the Old World surely will be clarified during this activity of our Chinese colleagues.

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