

Biostratigraphical Correlations (Mammals) of Quaternary Continental Deposits of Europe and the Far East¹⁾

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Abstractum

On the basis of biostratigraphical data (large mammals) attempts are made to correlate the Quaternary faunistic sequence of Europe and the Far East.

Auf der Grundlage biostratigraphischer Daten (Großsäuger) werden Versuche diskutiert, die quartären Faunenfolgen Europas und die des Fernen Osten zu korrelieren.

На основе биостратиграфических данных по крупным млекопитающим делается попытка корреляции последовательности четвертичных фаун Европы и Дальнего Востока.

1. Palaeogeographical and Palaeozoological Background

In the Late Neogene and Quaternary the palaeofaunistic picture of the Eurasian continent was highly influenced by two landbridges: a composite one in the far west, connecting Africa with Europe and Asia perhaps along a western (Afro-Iberian), a central (Afro-Sicilian), and an East Mediterranean (Afro-Arabian) landbridge, and another in the far north-east, Beringia, connecting Siberia with the Nearctic.

Already in Late Neogene times there was a world-wide interchange of faunistic elements between Africa, Europe, Asia, and North America along these highways distributing biostratigraphic marker-taxa in both directions. With the progress of world-wide climatic deterioration in the Pleistocene, leading to the glaciation of wide areas in the Holarctic, this mainly west-east or east-west directed faunistic exchange was finally overlain by a fluctuating north-south migration of faunistic elements in glacial times, or a south-north migration in interglacial times.

Only against this palaeogeographic-palaeoclimatic background may we understand the different ecological character of Pleistocene association within the same area — in the far west as well as in the far east — and finally the present zoogeographical state of Eurasia.

2. Biostratigraphical Sequences of Terrestrial Deposits of Europe and Continental East Asia

In Europe, in general, we have to distinguish in the Quaternary two different faunistic complexes or facies: an East European faunistic complex of Asian affinities, and a West European faunistic complex of Mediterranean/African affinities (KAHLKE 1961; RUTTE 1967). In the Pleistocene the boundary between both complexes was marked by the easternmost distribution of the genus *Hippopotamus*, a typical Mediterranean/African element.

The Early Pleistocene (Neogene/Quaternary boundary; XIth INQUA Congress, Moscow 1982, and 27th International Geological Congress, Moscow 1984, INQUA- and IGCP-Working Groups: Locus typicus: Vrica, Calabria, Italy; Stratum typicum: basal plane of the claystone overlying bed "e", ≈1.6 Mill. yrs.) fauna of Europe is characterized by Late Villafranchian associations of Olivola faunal unit type (AZZAROLI 1983) following the Saint Vallier faunal unit type of uppermost Pliocene age according to the recently adopted N/Q boundary.

In the Far East, continental China, Indochina, and South-East Asia as far as Java, we meet with a similar picture. In general we have to distinguish here two faunistic complexes as well: a North-Tsinling complex of Siberian affinities north of the Tsinling range, and a South-Tsinling complex of Malayan affinities south of the Tsinling range (PEI 1957; KAHLKE 1968) extending southwards as far as Java. In palaeofaunistic respects the South-Tsinling faunistic complex was characterized by the large Pongidae and other taxa of Late Neogene Indo-Malayan affinities (*Gigantopithecus*, *Pongo*).

In continental China, in the Pliocene/Pleistocene intramontane basins — Yangyuan (Nihewan) basin, Yuanmou basin — the Lower Pleistocene continental deposits are characterized by fossil associations of late "Yellow Nihewan" type. According to palaeomagnetic research (CHENG et al.

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1978; LIU 1982) the boundary between the Lower and the Upper ("Yellow") Nihewan is more or less coincident with the Matuyama/Gauss boundary (≈ 2.5 Mill. yrs.). The fauna of the Lower Yellow Nihewan (TEILHARD DE CHARDIN and PIVETEAU 1930) is correlated with the Saint Vallier faunal unit, now uppermost Pliocene according to the recently adopted N/Q boundary. In southern China the Lower Pleistocene is represented by deposits (cave deposits) with Leng-chai-shan faunal unit associations.

Up to the present day there has been no general agreement about where to place the boundary between the Lower and the Middle Pleistocene. Moreover in accordance with geological principles this boundary has to be determined in a marine environment. Against a palaeoclimatic background we can see this boundary as coincident with the progressive climatic deteriorations within the Pleistocene ("Glacial Pleistocene"). In the area of the unstable Palaearctic ice shields we have an important turning-point in the glacial sequence with the beginning of the Anglian/Elsterian/Mindelian/Oka/Dagu period, causing fundamental changes in environment and fauna in vast areas of the Holarctic.

In the far west, in Europe, we have to record, that with the beginning of the so called "Glacial Pleistocene" — Anglian/Elsterian/Mindelian/Oka — large mammals of North Asiatic/Beringian affinities: *Praeovibos*, *Ovibos*, and *Rangifer*, elements of steppe and cold steppe environment, were enabled for the first time to reach Central Europe and finally Western Europe as shown by the fossil faunae of the well known localities of Süssenborn, Bad Frankenhäusen, Mosbach, and Tautavel, to name only a few localities. At the same time faunistic elements of "praeglacial" European character and of Mediterranean/African affinities (*Hippopotamus*) were retreating to the south.

A similar picture is met with in the Far East, continental China, Dagu period. At this time the distribution of southern elements of Late Neogene Indo-Malayan affinities retreated more and more to the south, indicating the very end of the Late Neogene Indo-Malayan faunistic predominance in continental South-East Asia, and foreshadowing the extinction of the large Pongidae *Gigantopithecus* and *Pongo* on the continent in the Pleistocene and Holocene.

At the same time faunistic elements of northern affinities: Sino-Siberian faunistic complex (North-Tsinling complex) were extending far to the south, intermingling with elements of the Sino-Malayan complex (South-Tsinling complex) in a relatively southern location as is shown by the recently discovered Long-tan cave fauna (HUANG et al. 1982) with *Sinomegaceros* and *Bison* of northern, *Ailuropoda*, *Stegodon*, *Tapirus*, and *Megatapirus* of southern affinities. A similar picture is found at Tautavel, South-West France, where elements of northern character (*Praeovibos*, *Rangifer*) are mixed in a southern geographical location with a local fauna of West European/Mediterranean character (CRÉGUT 1979; KAHLKE 1981).

The following interglacial period of Europe, the Holsteinian, is characterized in biostratigraphical respects by the retreat of continental/northern faunistic elements and a corresponding immigration of faunistic elements of southern/Mediterranean affinities: the early *Palaeoloxodon antiquus*/*Dicerorhinus kirchbergensis* associations, enriched by *Bubalus* of South Asiatic affinities, extending as far as Central Europe: Schönebeck (SCHERTZ 1937), Steinheim an der Murr (BERCKHEMER

1927), and perhaps the northern part of the Rhine valley-graben (FRANZEN and VON KOENIGSWALD 1979).

Again we find the same picture in the Far East, continental China, where faunistic elements of southern origin, the Sino-Malayan faunistic complex, including *Palaeoloxodon*, the merckoid *Dicerorhinus choukoutiensis* as well as *Bubalus* reached in this interglacial the area around Beijing as recorded in the famous Zhoukoudian deposits, *Homo erectus pekinensis* too is a southern element in a northerly geographical position at this time.

Up to this geological horizon the biostratigraphical correlation of the Pleistocene sequences seems to be fairly well recorded in both areas under discussion. After this time, however, a problematical gap follows in the continental Far Eastern fossil record.

In Europe, the following glacial period, the Saalian/Rissian/Dnepr-Moscow glaciation, is characterized by a new invasion of continental- northern faunistic associations, the early *Mammuthus primigenius*/*Coelodonta antiquitatis* fauna, extending finally over nearly all Europe.

Knowing of the Late Pleistocene (Tali glacial) invasion by Siberian faunistic elements into Central China, we have to expect a similar invasion in the Chinese equivalent of the far western Saalian (Lushan) as in the Tali glaciation. But this faunistic horizon is not known, perhaps not identified in the Far East. In the most recent papers on this question (ZHOU and GUO 1980; ZHOU 1982) the fossil association for example of Tingsun (PEI et al. 1958) has been quoted to be correlated with the Lushan or western Saalian/Rissian glacial period. But this correlation seems to be quite impossible because we have here — Tingsun — a mixed fossil association including southern ("interglacial") elements like Indian elephant, *Dicerorhinus* sp., and *Bubalus* (WOO 1980) in a relatively northern geographical position. This association is — in western terms — an association of the Eemian, perhaps Late Eemian, last Pleistocene interglacial period.

The only possible explanation for this problem, the apparent lack of a faunistic complex in the continental Far East (North and Central China) correlated in ecological respects to the far western Saalian/Rissian glacial period is, that it was not possible to distinguish within the Pleistocene *Mammuthus primigenius*/*Coelodonta antiquitatis* faunistic complex between an earlier one — in western terms a Saalian/Rissian — and a later one — in western terms a Weichselian/Würmian — association. In Europe, in the extra-glacial area it is sometimes a problem too, especially if the fossil record is poor and no other stratigraphical data are available.

In Europe, the next interglacial period, the Eemian, is characterized by the late *Palaeoloxodon antiquus*/*Dicerorhinus kirchbergensis*-associations as known from different classical localities of Europe.

In China there are also Late Pleistocene faunistic associations of large mammals — for example the already mentioned association of Tingsun, Shanxi — with southern types in a relatively northern geographical position. According to the present state of knowledge no other interpretation is possible than to see in these associations fossil faunae of the last interglacial period of China, when southern elements again reached a more northerly geographical distribution.

As in Europe, the continental deposits of the last glacial period in China (Tali glaciation) were characterized by a more or less uniform faunistic block — differentiated by endemic

elements in both areas only — extending from Western Europe as far as Southern Central China: the Late Pleistocene *Mammuthus primigenius/Coelodonta antiquitatis*-associations known from numerous fossil localities of this vast region.

To conclude we may say, that an intensive study of the ecological and evolutionary character of Quaternary fossil associations will provide more and more details leading towards a synthesis of biostratigraphical correlations of the continental deposits of both Europe and the Far East, proving or disproving the hypothesis of glacial events and corresponding faunal movements, occurring simultaneously in the Palaearctic.

Summary

Biostratigraphical correlations of Quaternary continental deposits of Europe and the Far East have a long history. Tracing the question of European/Far Eastern Quaternary correlations by means of biostratigraphy we may point out, that during the Pleistocene in Europe as well as in the Far East a north-south, and a south-north fluctuation of faunistic elements is known, documented by alternating mixed fossil associations in the contact zones s.l. of both areas. The changing direction of these migrations is unquestionably the result of changing climatic conditions. Other factors are to be excluded. On the basis of these faunistic migrations recorded by mixed fossil associations of southern affinities in northerly geographical positions, or of northern affinities in southerly geographical positions respectively, and in connection with the evolutionary status of the different fossil associations, it seems possible to add further details to the study of European-Far Eastern biostratigraphical correlations.

Zusammenfassung

Biostratigraphische Korrelationen quartärer Kontinentalablagerungen zwischen Europa und dem Fernen Osten haben eine lange Geschichte. Verfolgt man die Frage solcher Korrelationsversuche so kann man aufzeigen, daß während des Pleistozäns in Europa wie auch im Fernen Osten eine Nord-Süd- und eine Süd-Nord-Fluktuation von Faunenelementen bekannt ist, die sich durch einander abwechselnde Mischfaunen in den Kontaktzonen s.l. beider Räume belegen lassen. Die jeweils wechselnde Richtung dieser Faunenbewegungen ist zweifellos das Ergebnis wechselnder klimatischer Bedingungen; andere Faktoren scheiden offensichtlich aus.

Auf der Basis dieser Faunenbewegungen, die durch Mischfaunen südlicher Affinität in einer relativ weit nördlichen geographischen Position oder aber nördlicher Affinität in einer relativ weit südlichen geographischen Position angetroffen werden, und in Verbindung mit dem evolutionären Status der verschiedenen fossilen Assoziationen erscheint es möglich, weitere Details zur Frage biostratigraphischer Korrelationen zwischen Europa und dem Fernen Osten aufzuzeigen.

Резюме

Попытки биостратиграфических сопоставлений четвертичных континентальных отложений Европы и Дальнего Востока предпринимались давно. Анализируя проблему корреляции четвертичных отложений Европы и Дальнего Востока методами биостратиграфии, можно подчеркнуть, что как в Европе, так и на Дальнем Востоке на протяжении плейстоцена известны смены северных фаунистических элементов на южные и южных на северные. Эти смены документированы чередующимися смешанными фаунистическими ассоциациями, существовавшими в контактных (в широком смысле) зонах обеих областей. Изменение направлений этих миграций не-

сомненно является результатом изменений климатических условий. Прочие факторы следует исключить. На основе этих фаунистических миграций, устанавливаемых по смешанным ассоциациям ископаемых форм южной принадлежности, найденных в географически более северных местонахождениях, или северной принадлежности, найденных в географически более южных местонахождениях, а также на основе эволюционного положения различных ассоциаций ископаемых форм, представляется возможным детализировать биостратиграфические корреляции между Европой и Дальним Востоком.

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