大型鼩鼱 *Beremendia*（食虫目,鼩鼱科）在江南的首次发现及其古气候学意义[1]

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摘要:记述了在现代东洋界发现的鼩鼱类一新种:江南贝列门德鼩 *Beremendia jiangnanensis* sp. nov.。化石产自长江以南安徽繁昌早更新世早期人字洞古人类遗址。新种的体型比该属已知种大;形态特征比我国渤海种 *B. pohaiensis* 原始,但比欧洲早上新世的 *B. fissidens* 进步。贝列门德鼩是喜湿耐冷的北方型动物,最早发现于欧洲北部上新统,曾广泛分布于欧洲和中亚高纬度地区,种群密度大,中更新世完全绝灭;它在东亚出现较晚,零星发现于华北早更新世地层中,其起源尚不清楚。新种乃是人字洞动物群的主要成员之一,该动物群由 70 多种哺乳动物组成。动物群的生态类型分析和分类统计表明,它与以往发现的早更新世南、北动物群及当地现代动物群截然不同,具有东洋界和古北界交错带动物群的特色,但动物组合特征为北方动物稍占优势,北方色彩较浓。贝列门德鼩和三门马(*Equus sanmeniensis*)、次兔(*Hypolagus*)、科氏仓鼠(*Kowalskia*)、模鼠(*Mimomys*)等大量北方型动物在我国东洋界的出现,足以说明第四纪早期有一次明显的降温事件。寒冷气候促使北方动物大规模南迁,古北区动物地理区系的界线在早更新世时要比目前更靠南;而且在古北界与东洋界之间确实存在南、北动物过渡带,其界线大致南移至现在的长江以南。贝列门德鼩在我国现代东洋界地区的首次发现,为研究该属的系统演化,探讨上新世—更新世气候转型时期鼩鼱类扩散事件及我国第四纪动物地理区系的演变将提供重要的信息。

关键词:安徽繁昌,早更新世早期,贝列门德鼩,气候事件

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FIRST DISCOVERY OF THE LARGE SHREW, *BEREMENDIA* (INSECTIVORA, SORICIDAE), FROM THE LOWER PLEISTOCENE OF SOUTH CHINA AND ITS PALEOCLIMATIC IMPLICATIONS

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Abstract　A new species of the large shrew, *Beremendia jiangnanensis* sp. nov., is described here. The materials were excavated from the Early Pleistocene deposits of Renzidong Cave located on the south bank of the lower reaches of the Yangtze River, near Fanchang County, Anhui Province, South China. The new species is the largest in the genus. It is morphologically more primitive than *B. pohaiensis* from China, but more advanced than the type species, *B. fissidens*, from the lower Pliocene of Europe. *Beremendia* was initially reported from the Pliocene of northern Europe. It had been widely distributed in the high latitude regions of Europe and central Asia with a high population density, and became extinct by the end of the Middle Pleistocene. In East Asia, however, it appeared later, and was only rarely reported from the Early Pleistocene of North China. The origin of the genus is still unclear. The new species is a typical member of Renzidong fauna which is composed of more than 70 mammals. The analyses of ecological and taxonomic composition of the fauna show that it is noticeably distinct from the known Early Pleistocene faunas from northern and southern China and the modern local fauna for the reason that it is characterized by the coexistence of both Palearctic and Oriental faunal elements. But the Palearctic elements are somewhat predominate. The occurrence of the Palearctic element, *Beremendia*, as well as *Equus sanmeniensis*, *Hypolagus*, *Kowalskia*, and *Mimomys*, in the present-day Oriental Region strongly indicates that there was a cooling event during the Early Pleistocene, which drove the Palearctic elements to migrate southwards to the south of Yangtze River. So the southern boundary of the Palearctic Realm was more southernly located than present then. The first discovery of the hygrophilous and cryophylactic large shrew, *Beremendia*, in the present-day Oriental Region of East China will be helpful to the study of the evolution of *Beremendia*, and will provide significant information on the shrew's dispersal events during the Plio-Pleistocene climatic transition and the faunistic development of China during Pleistocene.

Key words　Fanchang County, Anhui Province; early Early Pleistocene; *Beremendia*; climatic event

Beremendia (Beremendiini, Soricidae, Insectivora) is a group of extinct, large-sized shrews with heavily pigmented teeth, which was first reported from the Late Neogene of Villány, south Hungary (Kormos, 1934). It was a very common member of the micromammalian faunas in northern Europe from Early Pliocene to Middle Pleistocene; however, it was rarely reported within East Asia, only from the Early Pleistocene deposits of Dalian, Liaoning Province and Tangshan, Hebei Province in North China (Kowalski and Li, 1963; Jin and Kawamura, 1996). The geographic distribution of *Beremendia* was restricted to the Old World.

Recently, *Beremendia* fossils were unearthed from the Early Pleistocene Paleolithic Renzidong Site on the south bank of Yangtze River, near Suncun Town, Fanchang County, Anhui Province (E118°5′46″, N31°5′23″). Renzidong Site is a cave developed in the Triassic limestone, the deposits of which, with an exposed thickness of about 30 meters, can be divided into two units and eight layers from the top down. The upper unit (layer 1 to 7) comprises primarily of red-brown sandy clay with breccia, from layer 2 to 6 of which the fossils and human relics were mainly unearthed. The lower unit (layer 8) is composed of gray sandy clay, sand and sandy gravel. After six times of systematic excavations during the years from 1998 to 2001, besides artifacts, more than 70 species of mammalian fossils, including Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora, Proboscidea, Perissodactyla, Artiodactyla and Primates, had been acquired. Faunal comparison with other Early Pleistocene faunas of China showed that the age of Renzidong fauna should be the early Early Pleistocene (MN17 equivalent) (Jin et al., 2000).

Insectivora of Renzidong fauna is represented by 14 species, belonging to 11 genera and 2 families, most of which retain primitive characteristics compared with those of the other known Early Pleistocene Insectivora assemblages of China. The Insectivora assemblage of Renzidong fauna could be regarded as the most characteristic one among the Early Pleistocene micromammalian faunas of China so far, because it is characterized by the coexistence of both northern- and southern-type of shrews. But the northern-type species are dominant in the species diversity and population density.

Beremendia was usually thought to be distributed in the high latitude area of Eurasia, and

had never been found in the present-day Oriental region before. Therefore, *Beremendia*'s appearance along lower reaches of the Yangtze River can not only imply the climatic transition during the Early Pleistocene. Moreover, it is important for the discussion of the origin and systematic position of *Beremendia*, which have been issues for paleomammalogists all along, and will also provide significant paleoclimatic information.

Nomenclature and measurements for skull, mandible and teeth follow Reumer (1984).

1   Systematic palaeontology

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Order Insectivora Bowdich, 1821
Family Soricidae Gray, 1821
Subfamily Soricinae Fischer von Waldheim, 1817
Tribe Beremendiini Reumer, 1984
Genus *Beremendia* Kormos, 1934
***Beremendia jiangnanensis* sp. nov.**
(Figs. 1–3; Table 1)

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Holotype   IVPP V 13961.1, an incomplete and crushed skull with left I1−A2, right A1−M2, premaxillae, nasals, right lacrimal and right maxilla. V 13961.2, left ramus of mandible belonging to the same individual with i1−m2, incomplete coronoid and condyle.

Other materials   V 13961.3−4, 2 incomplete skulls; V 13961.5−14, 10 left maxillary fragments; V 13961.15−96, 82 mandibles; V 13961.97−168, 72 isolated teeth.

Horizon   Layers 3−6 of Renzidong Cave section, Fanchang, Anhui Province.

Age   Early Pleistocene.

Etymology   The prefix Jiangnan refers to the south side of the Yangtze River, where the specimens were excavated.

Diagnosis   Large-sized; A1 and A2 with similar size, and both have parastyle; A4 usually lacking; P4 with distinct protocone and hypocone; lower facet of condyle shifting far anteriorlly and medially; m1 and m2 with developed entoconid crests; and entoconid and entoconid crest present on m3.

Measurements   See Table 1.

Description   Skull: the rostrum is slightly short, on the lateral wall of which there is a roughly triangular depression above A1−A3. The infraorbital foramen is ovate, and positioned above the parastyles of P4−M1. The lacrimal bone is relatively robust and short; the lacrimal foramen is small, round, and positioned above the trigon of M1. The zygomatic process originates from above the parastyle of M3. The anterior palatal foramina are large, and situated at the medial side of A1. The posterior palatal foramina are small, situated at the medial side of M1.

The dentition is stained in dark red or dark brown pigmentation.

Upper dentition: upper incisor (Ⅰ) is robust, and strongly curves downwards. The upper incisor is fissident, because there is a small but distinct medial cuspule on it. The talon is nearly rectangle-shaped. A well-developed buccal cingulum runs along the buccal posterior edge of the talon.

The A1 and A2 are similar in size and morphology, with a roughly right-angled triangle outline in occlusal view. The parastyle is small, extending anteriorly as a ridge. The labial cingulum is well developed. A3, about half of A1 in size, is unicuspid and small, with distinct labial and lingual cingulums. A4 is usually absent, only present in two specimens (V13961.5−6). If present, it is small, unicuspid, and not visible in labial view.
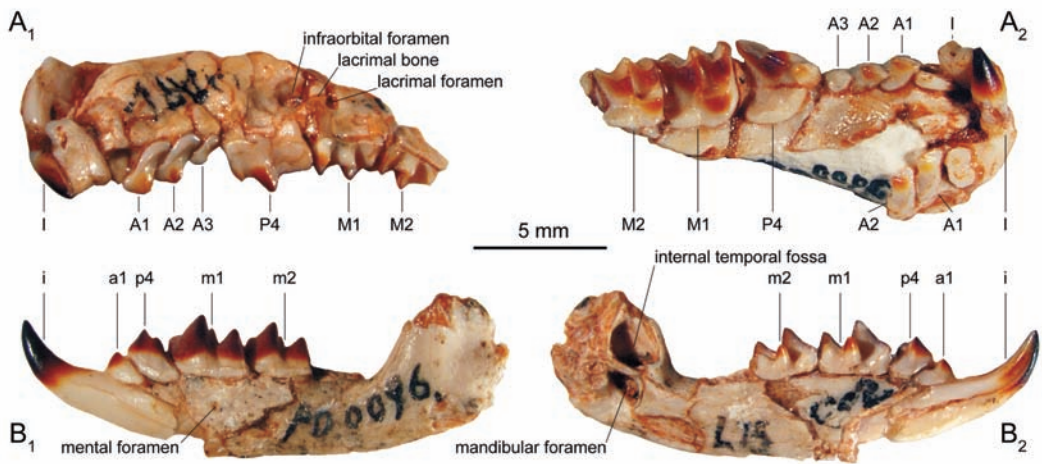
Fig. 1 Holotype of *Beremendia jiangnanensis* sp. nov.
A. skull（V 13961.1）：A1. buccal view（inverse），A2. ventral view；B. left mandible（V 13961.2）：
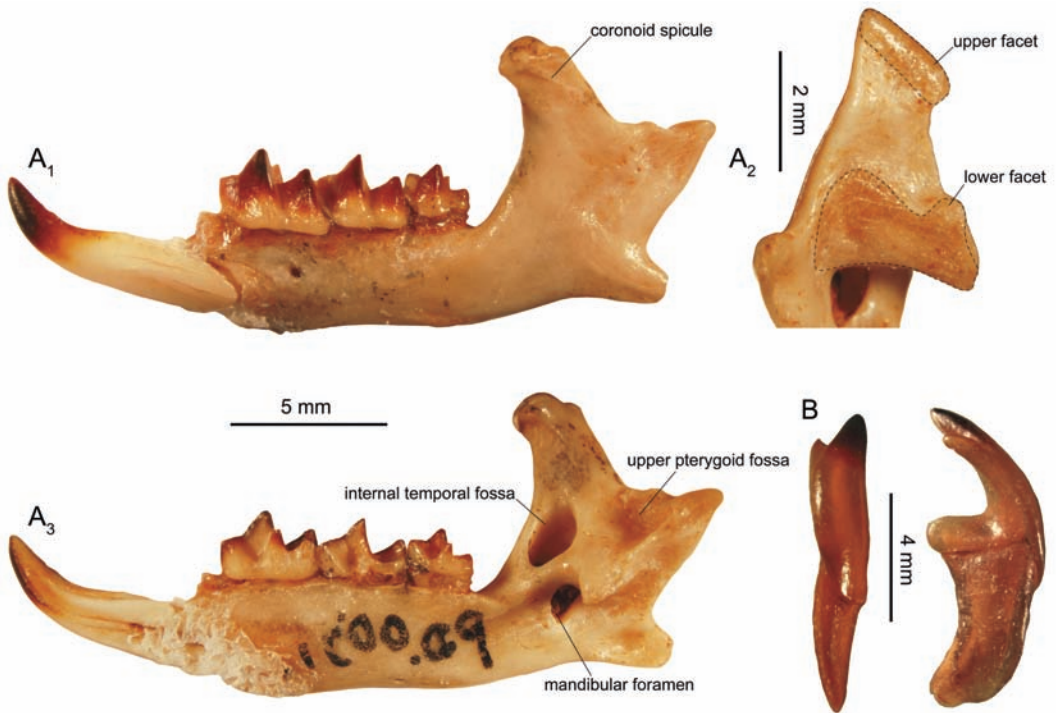B1. buccal view，B2. lingual view

Fig. 2 *Beremendia jiangnanensis* sp. nov.
A. left mandible（V 13961.21）：A1. buccal view，A2. ventral view of the condyle，A3. lingual view
（inverse）；B. right upper incisor（V 13961.158），dorsal and lingual views

Table 1   Measurements of dentitions and mandibles of *Beremendia jiangnanensis* sp. nov.　　（mm）

Item	parameter	n	min	X	max	sd
I	L	20	3.15	3.63	3.86	0.20
	H	20	2.32	2.57	2.80	0.14
	LT	20	1.25	1.58	1.80	0.14
A1	L	2	1.17	1.42	1.67	—
	W	2	1.17	1.21	1.25	—
A2	L	2	1.17	1.42	1.67	—
	W	2	1.17	1.42	1.67	—
A3	L	3	0.75	0.89	1.00	—
	W	3	0.92	0.97	1.00	—
P4	BL	8	2.79	3.00	3.17	0.12
	LL	8	1.92	2.14	2.33	0.13
	PE	8	1.83	2.03	2.25	0.12
	W	8	2.50	2.67	2.83	0.11
M1	BL	9	2.58	2.68	2.92	0.11
	LL	10	2.50	2.62	2.75	0.07
	PE	10	2.08	2.26	2.42	0.10
	AW	10	2.58	2.78	3.08	0.15
	PW	9	2.67	2.81	3.08	0.13
M2	BL	7	2.29	2.33	2.42	0.04
	LL	7	2.00	2.25	2.33	0.13
	PE	7	1.92	2.03	2.30	0.12
	AW	7	2.50	2.87	3.00	0.19
	PW	7	2.17	2.31	2.42	0.12
	HC	17	6.04	7.09	7.92	0.44
	LUF	18	1.30	1.88	2.08	0.18
lower dentition	L m1–m2	21	4.69	5.17	5.62	0.19
	L m1–m3	7	6.58	6.90	7.25	0.26
i	L	19	7.25	6.25	6.76	0.29
a1	L	5	1.22	1.43	1.58	—
	W	5	1.08	1.20	1.32	—
p4	L	8	1.41	1.88	2.08	0.22
	W	8	1.42	1.52	1.58	0.07
m1	L	28	2.83	3.01	3.38	0.14
	TRW	28	1.43	1.64	1.87	0.11
	TAW	28	1.49	1.79	2.00	0.13
m2	L	32	2.20	2.53	2.89	0.15
	TRW	31	1.32	1.52	1.79	0.11
	TAW	31	1.30	1.54	1.75	0.11
m3	L	17	1.70	1.89	2.08	0.12
	TRW	17	1.00	1.08	1.25	0.05

　　Abbreviations: n. number of specimens measured; min. minimum value; max. maximum value; X. mean value; sd. mean square deviation; L. length; H. height; LT. length of the talon; W. width; BL. buccal length; LL. lingual length; PE. length to the posterior emargination; AW. anterior width; PW. posterior width; HC. height of the condyle; LUF. length of the condylar upper facet; TRW. trigonid width; TAW. talonid width.

　　The P4 is highly molarized, and nearly rectangular-shaped in occlusal view. The parastyle is developed, conical, and lower than the paracone. It connects to the paracone by the parastylar crest. The paracone is strong, and the centrocrista is well developed, and runs straight nearly

half-length of the tooth. The protocone is weak, roughly ridge-shaped and anteriorly placed. The protocrista is developed and extends anterolabially to the base of parastyle. The hypocone is distinct, ridge-shaped, a little higher than the lingual cingulum, and separated from the protocone by a shallow groove. The posterior emargination is deep. The buccal cingulum is distinct under the parastyle and the paracone, becomes weaker from there on. The lingual and posterior cingulums are also developed.

The M1 is square-shaped in occlusal view, with a moderate posterior emargination. Its W-shaped ectoloph forms a high sharp ridge. The protocone is located on a U-shaped crest, which connects it to both the paracone and the metacone. The hypocone is distinct, and connected to the posterior cingulum, but separated by a groove from the protocone and connected to the metaloph through a faint endoloph (V 13961.6, 10); the lingual and posterior cingulums are developed.

The M2 is generally similar to M1 in construction, but the paracrista and metacrista are nearly equal in length, and the posterior emargination is stronger.

Lower jaw: as in other shrews, the mandible is massive. The horizontal ramus is stoutly built, and attains its maximum height at the posterior root of m1. The ascending ramus is broad anteroposteriorly, and leans markedly anterolabially. The coronoid process is short and narrow, with a smooth and round dorsal facet that bears a posteriorly oriented opening on the posterior part. The mental foramen is small, and situated below the hypoflexid of m1. The coronoid spicule is distinct and directed posteroventrally. The external temporal fossa is shallow. The upper pterygoid fossa is a relatively large depression on the dorsolingual face of the condyle. The internal temporal fossa is ovate and deeply pocketed. The mandibular foramen is very large and elliptic, and connects to the internal temporal fossa by running through the bone bridge that separates them superficially. The condyle is large, with its lower facet strongly shifted antero-medially, and not visible in buccal view. The interarticular area of the condyle is very wide and emarginated lingually, with a long cylinder-like upper face and a wide lower facet strongly concave posteriorly. The angular process is very short, with a lower pterygoid fossa that is small, deep and elliptic in outline.

Lower dentition: the lower incisor is acuspulate, with a smooth cutting edge and a strongly upturned and pointed apex. The symphysial side of the tooth bears a deep longitudinal furrow. The posterior margin reaches the posterior part of a1 in the lingual view, and is positioned below the protoconid of m1 in the buccal view. The posterolabial cingulid is weak.

The a1 is small, single-cusped. It closely lies on the incisor, and the posterior half of it is covered by p4 from the buccal view. The weak posterolingual basin is visible. The buccal and lingual cingulids are developed.

The p4 is roughly triangular-outlined in the occlusal view, with paraconid and metastylid well developed. The posterolingual basin is developed, but usually shallow. The buccal and lingual cingulids are distinct.

The m1 and m2 are similar in morphology, but m1 is larger than m2. The protoconid is the highest and most robust. The trigonid basin is wide and deep because of the posterior position of the metaconid compared with the protoconid. The entoconid is the weakest cusp, and more anteriorly positioned than the hypoconid. The oblique cristid nearly extends to the longitudinal axises of the molars, which makes talonid basin narrow and shallow. The entoconid crest of m1 is short and low, while that of m2 is long and high. The occlusal outline is trapezoidal, with well developed ectocingulids and slightly weak entocingulids.

The m3 bears a reduced talonid, but its entoconid, entocristid and oblique crestid are clear, while its obsolescent postcristid makes hypoconid nearly γ-shaped. The buccal cingulid is developed, while the lingual one is weak.

Comparisons and discussion　The classification of shrews is still open to discussion and

unsettled up to now （Reumer, 1984, 1998；Repenning, 1967；McKenna and Bell, 1997）. Reumer （1998） revised his classification in 1984 based on the morphology of the coronoid process and the interarticular area of condyle, teeth pigmentation, fissidenty of the upper incisor and the development of entoconid crests in lower molars of both fossil and extant shrews. According to his revision, fossil and extant shrews are divided into two families：Heterosoricidae and Soricidae. Furthermore, Soricidae is subdivided into 5 subfamilies, among which Soricinae comprises 46 genera referable to 7 tribes. Here, we follow the classification of Reumer （1998）.

According to Reumer （1998）, the new form of *Beremendia* from Renzidong site can be referred to Soricinae because it has the deeply pocketed internal temporal fossa, the lingually emarginated interarticular area of the mandibular condyle and a p4 with the posterolingual basin. The Renzidong form differs from *Blarina*, *Blarinella*, *Microrex*, *Neomy*, *Petenyia* and *Sorex*

Fig. 3　A right mandible （V 13961. 30）of *Beremendia jiangnanensis* sp. nov.
A. buccal view, B. occlusal view, C. lingual view （inverse）

in having a larger size；from *Anourosorex*, *Crocidura* and *Paranourosorex* in having a broad interarticular area, antero-shifted lower facet of the condyle and heavy teeth pigmentation；from *Blarinoides* in having postero-lingual basin on p4 and developed entoconid crest on lower molars；from *Lunansorex* and *Shikamainosorex* in having fissident upper incisors. These differences indicate that the new species should be undoubtfully referred to the tribe Beremendiini, and more specifically to the genus *Beremendia*.

There have been 6 species of *Beremendia* reported so far：*B. fissidens*, *B. minor*, “*B. ucrainica*”, *B. pohaiensis*, “*B. sinensis*”, and ? *Beremendia* sp., among which, “*B. ucrainica* Pidoplichko, 1956” was treated as the synonymous of *B. fissidens* （Petényi, 1864）（Reumer, 1984；Rzebik-Kowalska, 1976）. As for the controversial “*B.（Neomys）sinensis*”（Zdansky, 1928）, Kowalski and Li （1963） already clarified that it was improper to put this small-sized form with unpigmented teeth and weak cingulids in lower molars into *Beremendia*. Besides, the locality of this form was unclear, and it was impossible that the materials came from Zhoukoudian, Beijing. ? *Beremendia* sp. from the Late Pliocene Daodi Formation, Nihewan Basin, Hebei Province （Cai, 1987） is only represented by three isolated teeth, which makes it difficult to determine which genus on earth among *Beremendia*, *Lunansorex* and *Blarinoides* should the material be referred to. For these reasons, we mainly compare the new speices, *B. jiangnanensis*, with *B. fissidens*, *B. minor* and *B. pohaiensis*.

B. fissidens is the type species of *Beremendia* from the Early Pliocene （MN15） of southern Villány, Hungary. Even though its size variation is remarkable （Reumer, 1984；Rzebik-Kowalska, 1976；Sulimski, 1962）, it is smaller than the new species from Renzidong, because its largest specimen is just as large as the smallest one of the latter. In addition, it also differs from *B. jiangnanensis* sp. nov. in A4 usually present, no parastyle on A1 and A2, a more developed coronoid spicule, and lower entoconid crests on m1 and m2.
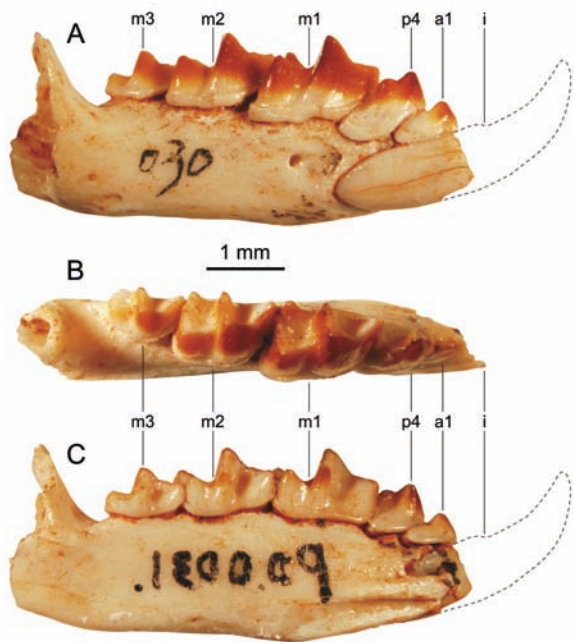
B. minor usually coexisted with *B. fissidens* in the Pliocene of Europe (Reumer, 1984; Rzebik-Kowalska, 1976). It differs from the Renzidong form in having a distinctly smaller size.

Kowalski and Li (1963) established a new genus, *Peisorex*, based on "*P. pohaiensis*". Jin and Kawamura (1996) thought *Peisorex* was a synonymous of *Beremendia* after they compared "*P. pohaiensis*" with the known species of *Beremendia* and treated *Peisorex* as a subgenus of *Beremendia*. *B. (Peisorex) pohaiensis* differs from *B. jiangnanensis* sp. nov. in having a smaller size, the complete absence of A4, the indistinct coronoid spicule, the undulated cingulids in the lower molars and a more reduced talonid in the m3.

Due to the differences mentioned above, and more importantly, the larger size (Fig. 4), this form should represent a previously unknown species of this genus, which is named here as *Beremendia jiangnanensis* sp. nov.
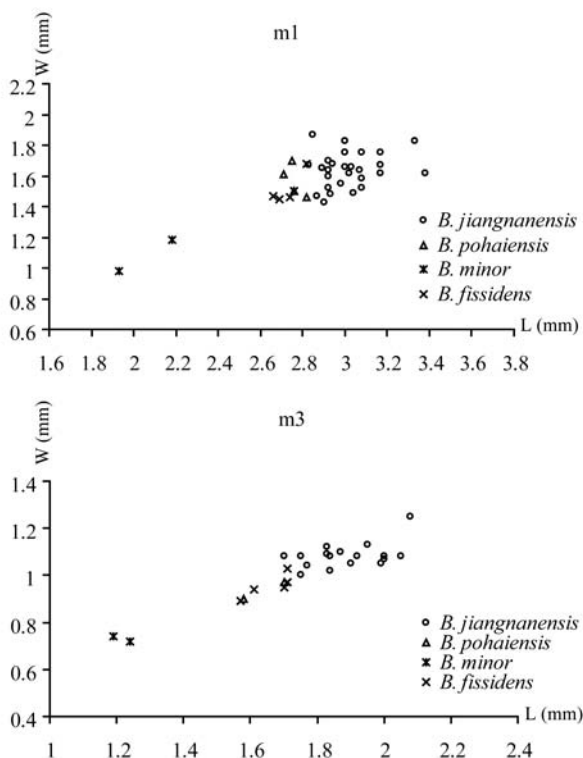

Fig. 4　Scatter graph of the length and width (trigonid) of m1 and m3 in *Beremendia*

Beremendia first appeared in Europe during Early Ruscinian (MN14) (Rzebik-Kowalska, 2003). The reliable ancestral form of this genus has not been discovered so far. The occurrences of the small-sized species *B. minor* are restricted to Europe geographically, and Pliocene chronologically. However, large-sized *Beremendia* species are discovered from both Europe and Asia, and they have a longer chronological distribution (Pliocene – Middle Pleistocene). So these species, *B. fissidens* – *B. jiangnanensis* – *B. pohaiensis*, should represent the main evolutionary lineage of the genus. This lineage probably originated from Europe. The occurrences of Asian species likely resulted from the dispersal of the genus from Europe. The evolutionary trend of the lineage seems to be the gradual reduction to disappearance of A4; reduction of the coronoid spicule and the talonid of m3; increasing development of the entoconid crests.

2　Geographic and chronologic distributions of *Beremendia* and the paleoclimatic implications

With over 300 species in 23 genera, extant shrews can be found throughout the world, with the exceptions of the Polar Regions, Australia, and southern South America. Like their ancestors, most of extant shrews keep a small body size. Large shrews, especially those with pigmented teeth, are rarely seen now, but they, such as *Beremendia*, were once widely distributed in the north of Eurasia during prehistoric age, even in the area around 31°N.

Based on the fossil records up to now, there are 35 *Beremendia* bearing localities in Europe, intensively located near 50°N and covering the latitude form 45°N to 52°N; 8 in West

Asia from 50°N to 55°N; 3 in Central Asia from 48°N to 51°N; and 4 in East Asia, including Haimao, Tangshan, Fanchang and the Nihewan basin (with a questionable *Beremendia* species), covering the latitude from 31°N to 40°N (Fig. 5). These data indicate that the northern limit to the latitude distribution of *Beremendia* can reach 55°N, and the southern limit can reach 31°N; longitudinally, its distribution covers the range from Sugwoth near Oxford, England (Stuart, 1980) to Renzidong site, Fanchang, Anhui, China (1°W–120°E). Looking at the distribution of *Beremendia* in the whole Eurasia, we can notice that it shows a zonal distribution extending transmeridionally with all the localities situated in the plain area of Eurasia and the steady increase of population density from East Asia to Europe.

　　The earliest record of *Beremendia* in Europe is the Early Pliocene (MN14) (Rzebik-Kowalska, 1998, 2003); the Middle Pliocene (MN15 equivalent) in West Asia (Storch et al., 1998); the Late Pliocene (MN16 equivalent) in Central Asia (Storch et al., 1998), and the early Early Pleistocene (MN17 Equivalent) in East Asia (Jin et al., 2000). Apparently, the chronologic distribution of *Beremendia* is longer in Europe than that in East Asia (Early Pliocene-Middle Pleistocene in Europe, while only early Early Pleistocene-Late Pleistocene in East Asia). At the same time, the first appearances of it tend to be gradually earlier from East Asia to Europe.
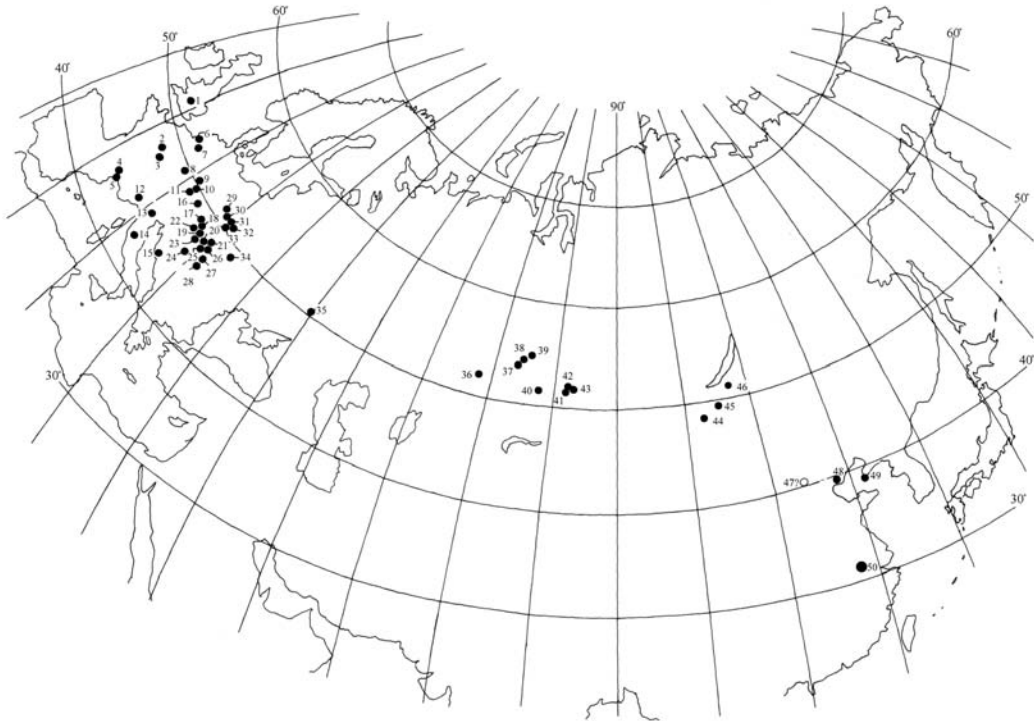

Fig. 5　Geographic distribution of *Beremendia*
1–35 see Jin and Kawamura (1996); 36. Beteke; 37. Andreyevka and Novaya Stanitsa; 38. Livenka; 39. Kartasshovo; 40. Lebyazhye; 41. Kizikha; 42. Razdolye (36–42, Storch et al., 1998); 43. Razdol′e (Zazhigin, 1980); 44. Orkhon; 45. Shamar and Bural-Obo; 46. Beregovaya (44–46, Devyatkin and Zazhigin, 1974); 47. ?Nihewan (Cai, 1987); 48. Jiajiashan (Kowalski and Li, 1963); 49. Haimao (Jin and Kawamura, 1996); 50. Renzidong (Jin et al., 2000)

From the integrated view of both the geographic and the chronologic distribution of *Beremendia*, it can be revealed that this genus probably originated from Europe and then dispersed

towards East Asia. There were probably four main dispersal events for *Beremendia* to step across more than 120° longitudes transmeridionally and then 20° latitudes meridionally from Europe to East Asia. The first event happened in the Early Pliocene and it traveled from Europe, the center of origin, to the west of Central Asia. The second and third events took place at the beginning of the Late Pliocene and around the end of the Late Pliocene respectively, and it dispersed from the west of Central Asia to Central Asia, then to East Asia. During these three dispersal events, *Beremendia* only traveled transmeridionally from the west to the east. Different from the former three events, the fourth event happened in the early Early Pleistocene, during which *Beremendia* traveled meridionally southwards nearly 20° latitudes and reached the present-day Oriental Region. This event during the Plio-Pleistocene is a very important dispersal event of *Beremendia*.

From the Middle Oligocene, shrews began to thrive in the humid temperate climate with a great diversity. After going through the repeated climatic fluctuations that happened during late Cenozoic, they successfully adapted themselves to a variety of climates. The discontinuous zonal distribution of *Beremendia* mentioned above (Fig. 5) reflected the dramatic influence of the climatic fluctuations since the Early Pliocene on it. During the transition from Miocene to Pliocene, there happened an important cooling event, and the sea level dropped remarkably, which led to the more notable differentiation between the northern- and the southern-type faunas and their faunistic distributions became more evident (Qiu, 1988; Wang et al., 2003). The first appearance of *Beremendia* in East Asia was probably related to the cooling event, too (Rzebik-Kowalska, 2002). *Beremendia*, which belongs to the northern-type hygrophilous and cryophylactic animals, was mainly zonally distributed in the high latitude area of Eurasia, where belongs to the monsoon region at the same time, and deeply relied on climatic conditions of these regions. The monsoon region of Palaearctic region is characterized by lesser temperature difference in summer, but greater in winter. That *Beremendia*, originally inhabiting high latitude area, dispersed southwards within China and reached the present-day Oriental Region at 31°N latitude can sufficiently reveal a remarkable cooling event happened during the early Early Pleistocene. At that time, the cold climate impelled the northern-type animals moved southwards. As a result, the southern boundary of Palaearctic region during the Early Pleistocene was more southward extended to the south of Yangtze River at about 31°N.

3　Conclusions

1) *Beremendia jiangnanensis* sp. nov. is the largest and the most southward distributed Early Pleistocene shrew so far. The occurrence of this hygrophilous and cryophylactic shrew in the modern Oriental Region of South China is closely related to the global cooling during the Late Cenozoic. The cold climate drove the shrew to migrate southward and evolve into a new species.

2) *Beremendia* has a zonal distribution pattern in Eurasia (1°W ~ 120°E, 31°N ~ 55°N). The more westward, the higher density of *Beremendia* bearing localities with, and the older its first appearance is, which may imply that *Beremendia* originated from Europe rather than East Asia.

3) *Beremendia* has a longer chronologic distribution in Europe (Early Pliocene-Middle Pleistocene) than in East Asia, but it hadn't morphologically changed in Europe as noticeably as in East Asia, where it became extinct by the late Early Pleistocene. This probably results from the different influence on the climate of East Asia and Europe caused by the rapid uplift of the Qinghai-Tibet Plateau since Pliocene, which is still open to discussion though.

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