GEOLOGICKÝ ZBORNÍK — GEOLOGICA CARPATHICA, 32, 4, BRATISLAVA, SEPTEMBER 1981, Pp. 427—447

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OCCURRENCES OF HIPPARION PRIMIGENIUM (H. v. MEYER, 1829) (MAMMALIA, EQUIDAE) REMNANTS IN THE NEOGENE OF THE WEST CARPATHIANS (SLOVAKIA, CZECHOSLOVAKIA)

(Figs. 6, PL. 6, Tab. 5)

Abstract: Remnants of the species *Hipparion primigenium* (H. v. Meyer, 1829) are described from three localities in Slovakia — Slepčany, Topoľčany and Pezinok. All remnants were found in Upper Miocene sediments.

Резюме: В статье описаны остатки вида Hipparion primigenium (Г. в. Меер, 1829) из трех местонахождений Словакии — из городов Слепчаны, Топольчаны и Пезинок. Все остатки нашлись в седиментах верхнего миоцена.

Introduction

The first find of Hipparion remnants comes from the locality Slepčany, where in the local sand-pit situated about 1500 m ESE of the village remnants of bones and teeth of big vertebrates[1] were found. The second find is from Topoľčany, where in Pontian sands remnants of Hipparion were found with digging of foundations of living house. The locality is situated at the SW margin of the town, in the part called „Kalvária".[2] The last finding is from the loam pit of the brick-kiln in Pezinok.[3] Besides that there is still one occurrence of Hipparion remnant from Kinek near Nitra, which I had not the possibility to study. At the locality Pezinok remnants of vertebrates were found first.

Brief geological survey of the areas of localities

Slepčany — sand pit. The locality is situated in the area of the Žitavská tabuľa tableland about 1500 m SE of the village (Fig. 1). At the Žitavská tabuľa tableland in the northern part of the Hronská tabuľa tableland the Pontian is in sandy — gravelous sandy development, in which layers of sandy clays are found subordinately only. In Nemčiňany — a village situated about 8 km east of Slepčany, layers of psephites and psammites with well worked up pebbles are uncovered. Poorly preserved remnants of molluscs of

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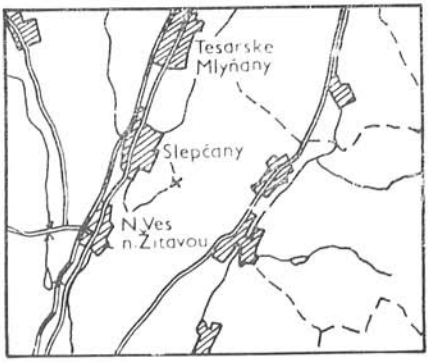
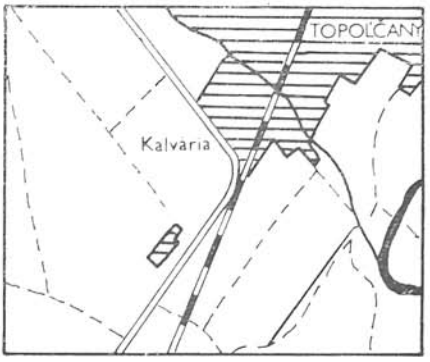
[1] They were deposited in the y. 1959 by J. Balko in the municipal museum in Zlaté Moravce and determined by Dr. O. Fejfar. In this place I express my thanks to the director of the museum Dr. Š. Rakovský for willing lending of the fossil material as well as to Dr. O. Fejfar from the Central Geological Institute (ÚÚG) Prague for lending of professional literature and consultation.

[2] They were found by Prof. Oplušťil and are deposited in the Home Country Scientific Museum in Topoľčany under rev. no. P-186. For kind lending of this material I thank Dr. Gergeľ.

[3] For help in field works I thank to Dr. E. Halásová, who found Mc III Hipparion.





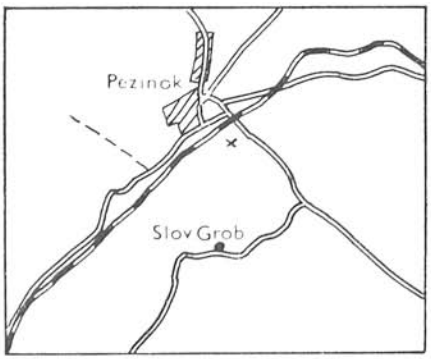


Fig. 1. Sketch map of the area of the locality Slepčany — sand pit. The position of the locality is designated with cross. Scale 1:50 000.

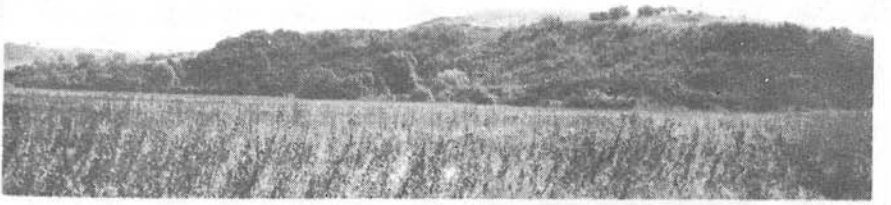
Fig. 2. Sketch map of the area of the locality Topoľčany—Kalvária.

Fig. 3. Sketch map of the position of the loam pit of brick-kiln in Pezinok. The locality is designated with cross. Scale 1 : 50 000.

the genera *Melanopsis* and *Congeria* were also found here. At the locality Slepčany grey psammites of various grain size are exposed (see Pl. 1, Figs. 1—3), in which remnants of big mammals — *Hipparion primigenium* (H. v. Meyer), *Aceratherium bavaricum* and *Tetralophodon longirostris* (Kaup) were found. The find of these species testifies to an Upper miocene age of the sediments. The occurrence of the species *Tetralophodon longirostris* confirms a Pontian age of the psammites. Neither associated microfauna, nor macrofauna of vertebrates has been found here.

Topoľčany. The locality is situated at the SW margin of the town in the part called „Kalvária" (Fig. 2). During digging of foundations of a living house fragments of Hipparion mandibula were found at depth about 150 cm in the year 1967 in coarse-grained psammites underlying the Quaternary covering formations. These sands are of Upper Miocene — Pontian age (E. Brestenská, 1961). At other place of this locality molars of mastodont *Tetralophodon grandincisivus* (Schlesinger) were found, reported by K. Silnický, 1931. Near Topoľčany, by about 3 km airline WNW from the town is located the locality Kuzmice, where from sediments of equal age Z. Schmidt, 1963 described an incompletely preserved skull with tusks of the species *Tetralophodon grandincisivus* (Schlesinger).

Pezinok — loam pit of the brick-kiln (Fig. 3, Pl. 2, Fig. 1). The locality is situated in the WNW part of the Danube lowland below the SE foothills of the Little Carpathians . The sequence uncovered in the brick-kiln of the Pezinok loam-pit is formed by fine-pelitic clays, grey to greenish sandy



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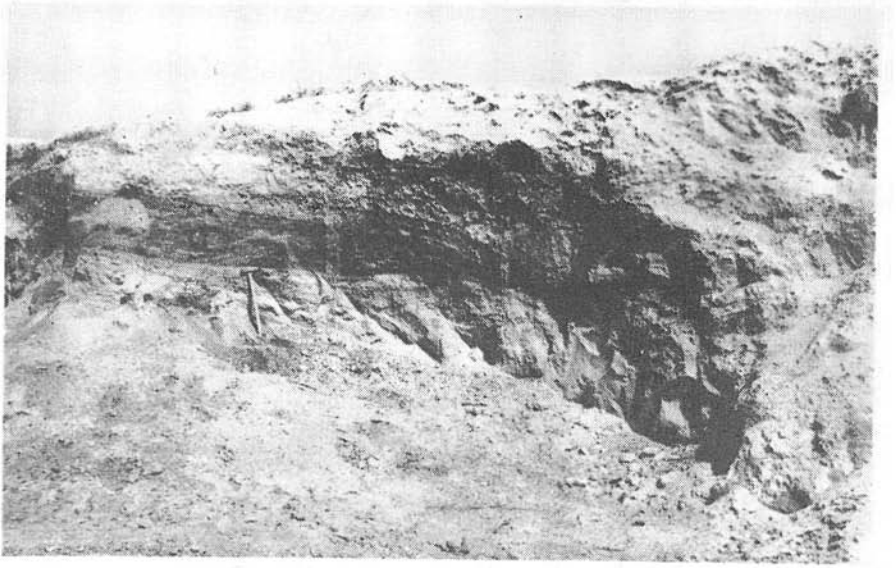

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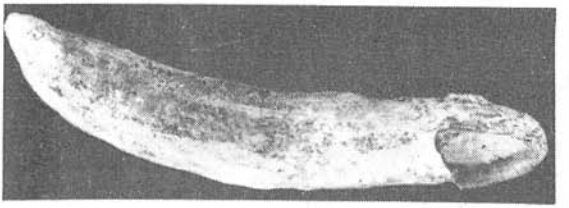

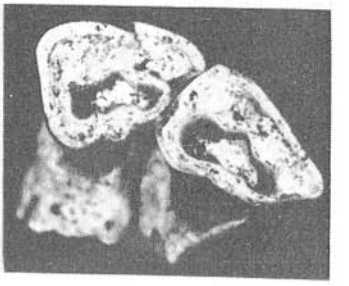

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Plate 1

Locality Slepčany — sand pit. 1 — general view, 2 — more detailed view, 3 — fossil remnants incisors of Hipparion found at the locality. Photo by O. Fejfar, copy prepared by L. Osvald.

clays and fine-grained sands. In clays also lignite seams, in places of thickness up to 10 cm, are found (see profile Fig. 5). From this locality a rich fauna of bivalves and gastropods is known. The genera *Congeria* and *Melanopsis* are predominating. Significant species are *Congeria ungula caprae, C. neumayeri, Dreisensia auricularis, Unio atavus, Limmocardium conjungens, Valvata variabilis, Melanopsis vindobonensis, M. sturi, M. pygmaea* and *M. entzi.*

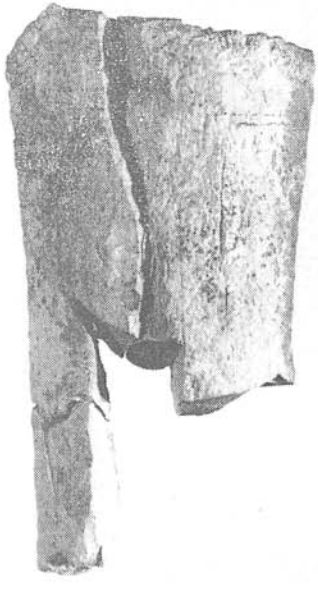
Fig. 4. Schematic lithological profile of the loam pit of brick-kiln in Pezinok.

1. 0,00—0,40(0,40) — rusty-brown earth with many of quartz pebbles, little to-medium worked up, of profile 5—15 cm.
2. 0,40—1,10(0,70) — dark rusty-brown fine-sandy earth
3. 1,10—2,85(1,75) — light-grey to rusty-grey very fine sand
4. 2,85—3,20(0,35) — dark greyishgreen clay enriched in $CaCO_3$ colouring white the bed
5. 3,20—5,80(2,60) — dark-grey very clayey sand, in places with rusty thin beds. In the lower part the share of clay increases and many calcareous concretions occur.
6. 5,80—6,60(0,80) — bed of very fine light-coloured to dark-grey clays with sporadical $CaCO_3$ concretions (find of Hipparion)
7. 6,60—7,90(1,30) — light-greyishbrown fine clayey sands
8. 7,90—8,10(0,20) — bed of clay sands overfilled with $CaCO_3$ concretions, in the lower part clay predominates
9. 8,10—11,50(3,40) — light-brown to rusty fine-grained clay sand
10. 11,50—13,80(2,30) — light-grey bluish clay, in the lower part bituminous
11. 13,80—15,70(1,90) — greyishbrown fine clay sand
12. 15,70—17,10(1,40) — light-grey bluish clay, in the lower part in places up to 10 cm lignite bed. Occurrence of macrofauna — molluscs — bivalves (Congeria)
13. 17,10—18,00(0,90) — grey fine-grained clay sand
14. 18,00—18.70 (0,70) — light-coloured brownish-yellow sand with macrofauna, molluscs — gastropods (Melanopsis)
15. 18,70 and more (2,00) — dark greyish-green clay

From microfauna (ostracodes) is in these beds mainly *Candona unguiculus* (in T. Buday—B. Cambel — M. Mahel', 1962). According to the fauna of molluscs and ostracodes the sequence in the loam pit of Pezinok belongs to the upper part of Zone E in the sense of A. Papp, 1951, which we range into the Pannonian, to the boundary with the Pontian at present. Our find of Hipparion is from beds of light — to dark-grey clays with $CaCO_3$ concretions. This bed is lying 9,1 m above the bed with mollusc fauna (see Fig. 4).

Paleontological part

Classis: *Mammalia*
Ordo: *Perissodactyla* Owen, 1848
Familia: *Equidae Gray*, 1821
Genus: Hipparion de Christol, 1832



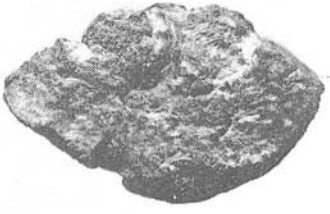


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Plate 2

Fig. 1. — Locality Pezinok — loam pit of brick-kiln, view from SW, photo by the author, prepared by L. Osvald. Fig. 2. — *Hipparion primigenium* (H. v. Meyer), proximal part of Mc III in view of the dorsal and in Fig. 3. — proximal joint surface. Locality Pezinok — loam pit of brick-kiln, 1 x. Photo L. Osvald.

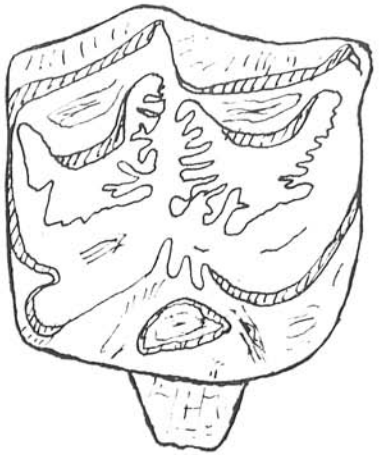


Fig. 5. Hipparion primigenium (H. v. Meyer) — view of occlusal surface of tooth $P^{3,4}$ dext. Locality Pezinok — loam pit of brick-kiln. The scale indicates length 5 cm.

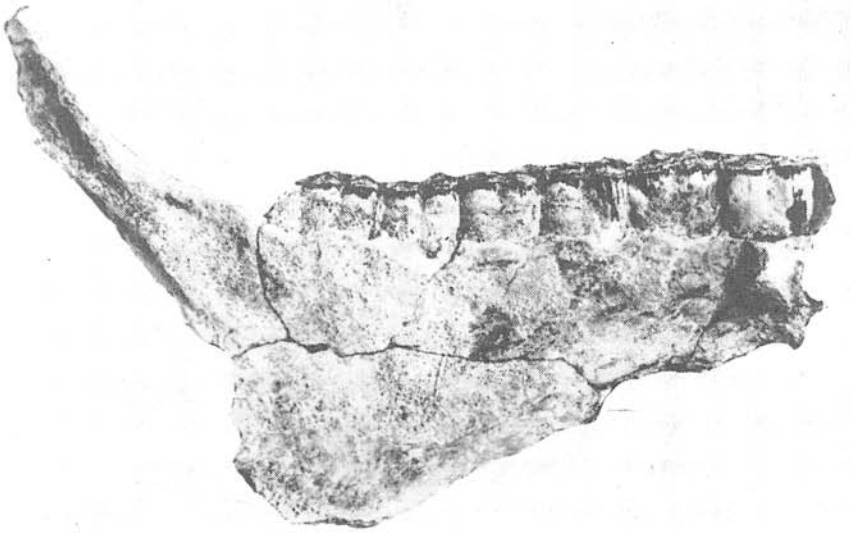
Hipparion primigenium (H. v. Meyer, 1829)

Tab. 2, Figs. 2, 3, Tab. 3, Figs. 1—3, Tab. 4, Figs. 1—3, Tab. 5, Figs. 1,2, Tab. 6, Figs. 1—3.

1952 *Hipparion platygenys* sp. n. — V. Gromova: The Hipparions, p. 3—475, Tab. 4, Figs. 1, 2.
1952 *Hipparion giganteum* sp. n. — V. Gromova, ibidem, Tab. 12, Fig. 1—4.
1954 *Hipparion gracile* (Kaup.) A. Papp — E. Thenius: Vösendorf — eine Lebensbild etc., p. 73, Tab. 9, Figs. 1. 1a, 8, 9, 15—18.
1954 *Hipparion gracile* Kaup. — M. Mottl: Hipparion-Funde der Steiermark, p. 43—71, Tab. 1, Figs. 1, 2.
1959 *Hipparion primigenium* Meyer — L. K. Gabunia: K istorii gipparionov, p. 2—538, text. Fig. 19.
1961 *Hipparion truyolsi*, nov. sp. — P. Sondaar: Les Hipparion de l'Aragón meridional, p. 209—305, Tab. 2, Fig. D, Tab. 3, Fig. D, Fig. 20 c.
1961 *Hipparion königswaldi*, nov. sp. — P. Sondaar: Ibidem, p. 247, Fig. 21 c, Tab. 1, Fig. B, Tab. 2, Fig. A, Tab. 3, Fig. A.
1968 *Hipparion primigenius* (H. v. Meyer, 1829) — A. M. Forstén: Revision of the Palearctic Hipparion, p. 3—134, Tab. 1 (cum syn.).
1971 *Hipparion strymoniensis* sp. n. — I. Nikolov: Novye predstaviteli etc., P. 116, Tab. 2, Figs. 1—3.
1971 *Hipparion praesulcatum* sp. n. — I. Nikolov: Ibidem, p. 114—122, Tab. 1, Figs. 1—2a, Tab. 3, Figs. 3—6.
1972 *Hipparion primigenium* (H. v. Meyer, 1829) — A. M. Forstén: *Hipparion primigenium* from Southern Tunisia, P. 7—28, Fig. 2.
1975 *Hipparion gracile* (Kaup) 1833 — G. Piccoli —F. Franco — O. Bertolotti — M. Bimbatti — P. Buja — L. Cesca — M. Grandenigo: I resti di mammiferi etc., P. 3—39, Tab. 3, Fig. 3.

Plate 3

Fig. 1. — *Hipparion primigenium* (H. v. Meyer), fragment of the right lower jaw with P_2 — M_3 dext. In view of their buccae and Fig. 2. — occlusal surface of the teeth. Fig. 3 — fragment of left lower jaw with P_2 — M_1 sin. in view of the occlusal surface of teeth. Locality Slepčany — sand pit, 0,5 x. Photo by L. Osvald.



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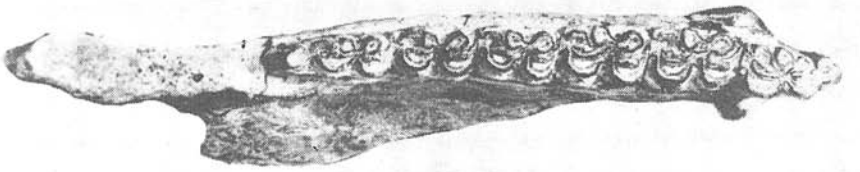

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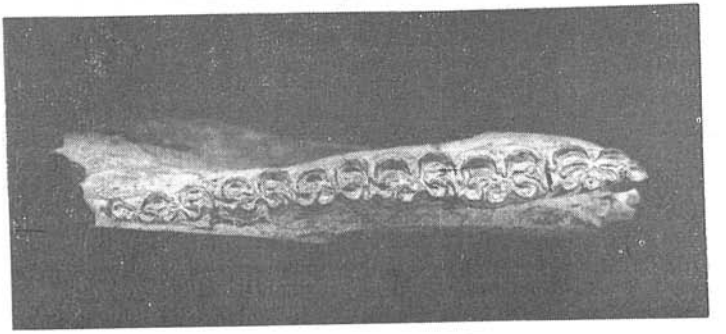

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Lectotype: Fragment of right jaw described by H. v. Meyer 1829, Plates 30—31, Figs. 17, 18, 19 as *Equus primigenius*.
Locus typicus: Eppelshein, Germany.
Stratum typicum: Miocene — Upper Sarmatian.
Material:
Slepčany: 1 fragment of right lower jaw with P_2 — M_3 dext.
1 fragment of left lower jaw with P_2 — M_3 sin.
1 fragment of left upper jaw with P^3 — M^2 sin.
Topoľčany: 1 fragment of right lower jaw with P_2 — M_3 dext.
1 fragment of left lower jaw with P_2 — M_3 sin.
Pezinok: 1 isolated tooth $P^{3,4}$ dext.
1 fragment of proximal part Mc III dext.

Description of material: Fragment of right mandibula with P_2 — M_3 from the locality Slepčany — sand pit (Pl. 3, Figs. 1,2, Text. Tab. 1). A part of the body and a part of the limb of the right mandibula are preserved. Below the anterior root part P_2 dext. the body of the lower jaw is broken. The lower part of the mandibula is preserved below M_1 — M_3 almost to the angulus. This is, however, broken. The limb of the lower jaw has been preserved partly only. The whole posterior and upper parts are missing. The body of the lower jaw is thickest in the alveolar part. Its thickness below P_3 — P_4 is 24 mm, below M_3 17 mm. In upper view the body of the mandibula is slightly S-shaped bent — anteriorly inward, posteriorly outward.
Description of teeth: The teeth are medium to strongly worm in the sense of V. Gromova (1952). P_2 dext. parastylid is damaged on the outer side. The inner valley is smooth, ptychostylid is developed. The cement layer on the anterior inner side is not developed. The enamel on the lingual side of the crown is very finely bent, on the buccal side almost smooth. This feature is at all teeth P_3 dext. It is strongest in the row of teeth. The tooth cement is well developed ,the inner valley is more distinct — it includes almost half the width of the chewing surface of tooth. The ptychostylid is developed, the isthmus leads into the metaconid.
P_4 dext. The inner valley is very wide and reaches roughly half the chewing surface, similarly as in P_3. In the anterior part the protostylid is developed, not reaching the chewing surface.
M_1 dext. The inner valley reaches the isthmus — neck of double knot, extends to the inner half of the chewing surface of the tooth. The ptychostylid is present although indistinct, the protostylid at the anterior outer margin of the tooth is developed and reaches almost the chewing surface of the tooth.
M_2 dext. The outer valley is extraordinarily developed. With its end it touches the enamel connecting the metaconid with the mesostylid. The ptychostylid and protostylid are developed.
M_3 dext. The narrowest tooth of the whole row of teeth. The outer valley reaches even the isthmus but not as deep as in M_2 dext. The cement layer is well developed, the ptychostylid is developed, the protosylid is missing.
Fragment of the left lower jaw with P_2 — M_3 sin. from the locality Slepčany — sand pit (Pl. 3, Fig. 3, Pl. 4, Fig. 3, Text. Tab. 2). The alveolar part of the left mandibula has preserved. In the anterior part it exceeds by about 8 mm before P_2 sin. The body of the lower jaw turns anteriorly inward, posteriorly

Table 1

Hipparion primigenium (H. v. Meyer, 1829). Dimensions and indices of teeth P_2 — M_3 *dext.* of the right lower jaw from the locality Slepčany

	P_2dext.	P_3dext.	P_4dext.	M_1dext.	M_2dext.	M_3dext.
d	28,4	24,6	23,7	21,0	22,0	27,7
š	14,0	17,6	16,6	14,9	14,3	11,9
v	17,9	16,8	18,4	14,4	14,4	13,4
d.mfld	7,0	6,8	6,8	5,7	5,3	6,0
d.enfd	11,7	11,8	12,0	8,2	7,5	7,2
š.ent.	5,6	5,5	5,2	4,4	3,4	3,2
d.ent+T	9,0	8,4	9,0	6,3	7,0	12,6
I.v	63,0	68,2	77,6	68,5	65,5	48,5
I.š	49,4	71,5	70,2	71,0	65,0	43,0
I.enfd	41,2	48,8	50,6	39,0	34,0	26,0
I.mfd	24,3	27,7	28,7	27,2	25,2	21,6
mf/ef	59,5	57,7	56,6	69,5	70,5	83,5
I.end	62,0	65,5	57,7	70,0	48,5	26,0
d.T						6,2
I.d.T						22,4
	1—0—3	1—0,5—5	1—1—4	1—0,5—0	2—0—0,5	1—1—1
	1	1	1	1	1	1

d = length
ef, end, enfd = entoflexid
ent = entoconid
I = index
mf, mfd, mfld = metaflexid
š = width
T = talon(id)
v = height

Table 2

Hipparion primigenium (H. v. Meyer, 1829). Dimensions and indices of teeth P_2 — M_3 sin. of the left lower jaw from the locality Slepčany

	P_2sin	P_3sin	P_4sin	M_1sin	M_2sin	M_3sin
d	27,4	24,9	23,5	20,7	20,6	27,5
š	13,6	17,0	16,8	15,0	12,4	10,7
v	20,0	16,8	19,0	16,0	17,6	15,8
d.mfld	7,0	7,0	6,6	5,5	5,0	5,8
d.enfd	12,2	12,1	11,9	9,4	7,7	9,0
š.ent	5,0	6,3	5,5	4,1	3,8	3,6
d.ent+T	9,6	8,1	8,6	6.2	6,8	12,7
I.v	73,0	67,5	81,0	77,2	85,5	57,5
I.š	49,5	68,2	71,5	72,5	60,2	39,0
I.enfd	44,5	48,7	50,7	45,5	37,4	32,8
I.emfd	25,6	28,1	28,1	26,6	24,3	21,2
mf/ef	57,5	58,0	55,5	58,2	65,0	64,5
I.end	52,0	77,7	64,0	66,0	55,8	28,4
d.T						6,7
I.d.T						24,4
	1—0—4	1—0,5—4	1,5—1—4	2—0,5—0,5	1—0—0	1—1—0,5
	1	1	1	1	1	1

outward in upper view. Thickness of the alveolar part in P_2 and P_3 is 26 mm, in M_3 16 mm. The left limb of the lower is broken 5 mm behind M_3 sin. and its whole posterior part with projections is missing. The height of the lower jaw below M_1 measured on the outer side is 58 mm.

The teeth are medium to strongly worn in the sense of V. Gromova (1952). The enamel is of greyishbrown to dark-brown colour. The cement is white and the bone is white to azure. The whole fragment is silicified. The cement is mainly developed on the outer depression but also between the metaconid and mesostylid.

P_2 sin. The outer hole is shallow with simple bending (ptychostylid) and not reaching the neck of double knot, the isthmus leads into the metaconid.

P_3 sin. is together with P_4 the strongest teeth of the whole row of teeth. The outer hole is deeper than in the preceding tooth and reaching almost half the chewing surface of the tooth. The isthmus is wide and also leads into the metaconid.

P_4 sin. The outer hole is deeper than in P_3 sin. but not reaching the neck of the double knot, the tooth is somewhat smaller than the preceding one. At the anterior outer margin the protostylid is developed, however, not reaching the chewing surface of the crown.

M_1 sin. The outer hole is very deep, reaching the neck of double knot. The protostylid is developed and reaches almost the level of the chewing surface of the crown.

M_2 sin. The outer hole reaches the neck of double knot and almost touches the enamel from inward, which is connecting the metaconid and mesostylid. The protostylid is developed and not reaching the chewing surface of the crown.

M_3 sin. It is the narrowest of the whole row of teeth. The outer hole reaches the isthmus, but not as deep as in M_2 sin. The protostylid is developed, but not reaching the chewing surface of the crown. Fragment of the left upper jaw with P^3 — M^2 sin. from the locality Slepčany — sand pit (Pl. 4, Figs. 1, 2, Text. Tab. 3). A narrow 1,0—1,5 cm strip of jaw bone with well preserved teeth P^3 — M^2 sin has preserved only. The bone is wrapping the root part of teeth. It is of light-grey colour, the tooth enamel is greyishbrown, the tooth cement white to bluish. The fragment is silicified. The teeth are medium to strongly worn, considering from the height of the crown and shape of protocone.

P^3 sin. is in the anterior part of the crown partly damaged by corrosion so that the bends of enamel on prefosette are little distinct. The tooth crown protrudes 10 mm from the preserved jaw bone (measured on the lingual side). The cement is preserved at the lingual surface of tooth only. Above the protocone where the cement is mostly developed, it is preserved in thick-

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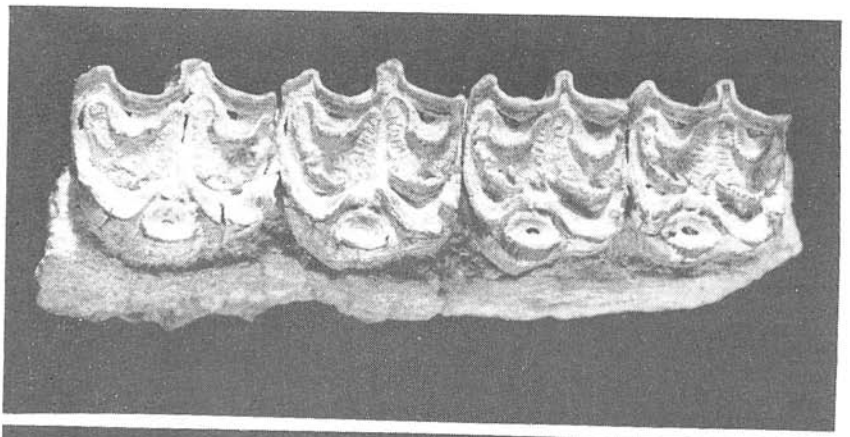
Plate 4

Fig. 1 — *Hipparion primigenium* (H. v. Meyer), fragment of left upper jaw in view of the occlusal and Fig. 2, — buccal surface of teeth P^3 — M^2 sin. Locality Slepčany — sand pit m = 1x, Photo by L. Osvald. Fig. 3. — *Hipparion primigenium* (H. v. Meyer) fragment of left lower jaw with P_2 — M_3 sin. in view of their buccal surface. Locality Slepčany — sand pit, 0,5 x. Photo by L. Osvald.



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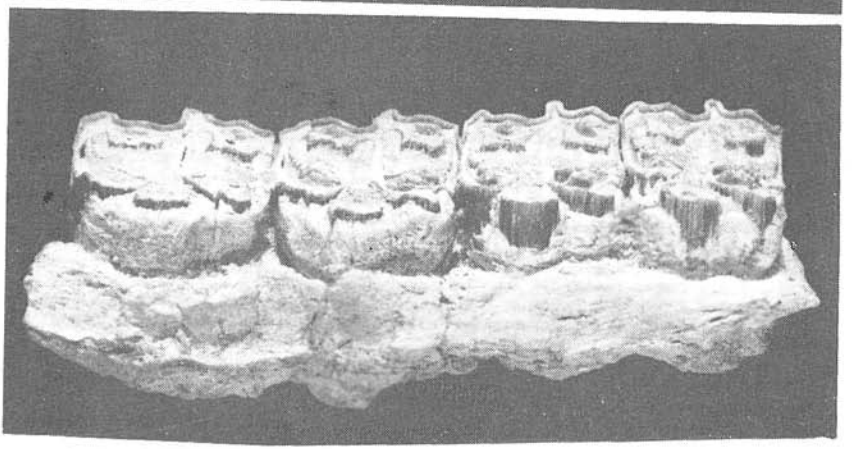

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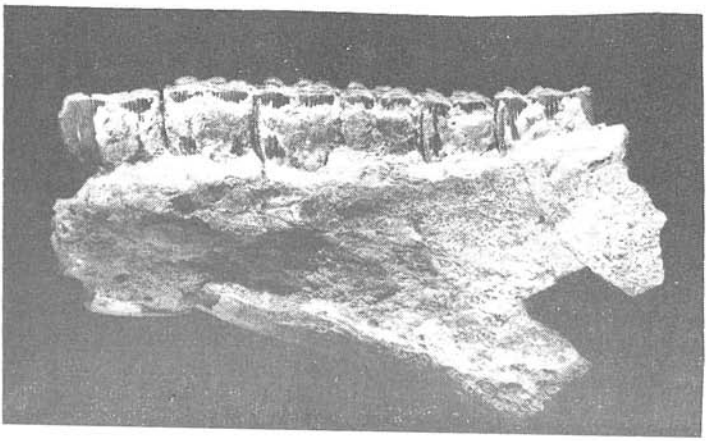


3

ness 1,7 mm (measured laterally from the protoconulus). On the buccal side of the tooth the cement is preserved only as a small spot between the parastyle and mesostyle.

P^4 sin. is the broadest in the preserved row of teeth. The tooth crown protrudes 8 mm from os maxilla (measured on the lingual side). The state of cement is similar as in the preceding tooth P^3 sin. and its maximum thickness is 1,3 mm. The mesostyle forms similarly as in the preceding tooth a relatively free bend of the enamel.

M^1 sin. is distinctly smaller than P^4 sin., the mesostyle forms a relatively narrow bend of the enamel. The cement on the buccal side is missing, on the lingual side it is only in the lower part of the crown, so that the protocone is uncovered more than half. The pli caballin forms 3—4 bends, the tooth crown exceeds about 9 mm above the bone.

M^2 sin. is smallest in the row of teeth. The cement is preserved on the lingual and aboral sides of the crown only. A part of the protocone is uncovered — without cement.

Fragment of lower jaw from the locality Topoľčany—Kalvária (Pl. 5, Figs. 1, 2, Pl. 6, Fig. 1). An incomplete mandibula is preserved in the anterior incisor -part (pars incisiva) broken into two fragments — closer to the left branch. The anterior incisor part is broken as far as the base of incisor alveoles. The left limb of the lower jaw is broken anteriorly about 1,0—1,5 cm before the foramen mentale. In the right limb the fracture is about 2,0—2,5 cm before the foramen mentale. In the left limb of the mandibula the teeth P_2—M_3 sin. are preserved. In the right limb the whole tooth row P_2 — M_3 dext. is preserved. The lower, molar part of the mandibula is broken below P_2 dext. or below P_3 sin. Both rami mandibulae are missing.

The fragments are silicified and of bluishgrey colour. In the alveole after M_3 sin. are several grains of light-grey coarse-grained quartz sand.

Description of teeth of the right branch of the mandibula. (Text. Tab. 4, Pl. 5, Figs. 1, 2, Pl. 6, Fig. 1 top.)

P_2 dext. The metaconid widely communicates with the paraconid. The outer hole does not exceed half the width of tooth crown. The axis connecting the centre of the metaconid and mesostylid it not identical with the longitudinal axis of the tooth crown but is directed buccally in the anterior part and lingually in the posterior part.

P_3 dext. The metaconid communicates with the protoconid and hypoconid through a narrow channel only. The outer hole reaches half the width of tooth crown but not the neck of double knot.

P_4 dext. It has the greatest width og tooth crown of all teeth of this tooth row. The outer hole is wide and reaches half the width of tooth crown, however, not the isthmus.

M_1 dext. The outer hole is narrow, exceeds to the inner half of tooth crown and deeply to the neck of double knot.

M_2 dext. The outer hole reaches deeply the neck of double knot.

M_3 dext. is separated by 3,5 mm hollow from M_2 dext. The outer valley reaches the isthmus. The tooth crown is widening toward the tooth base.

Description of teeth of the left branch of mandibula (Text. Tab. 5, Pl. 5, Figs. 1, 2, Pl. 6, Fig. 1 bottom.)

P_2 sin. The outer hole reaches nearly half the width of tooth crown. The

Table 3

Hipparion primigenium (H. v. Meyer, 1829). Dimensions and indices of teeth P^3 — M^2 sin. of the left upper jaw from the locality Slepčany and isolated $P^{3,4}$ dext. from the same species from the locality Pezinok

	P^3sin	P^4sin	M^1sin	M^2sin	$P^{3,4}$dext
d	26,1	24,0	21,3	21,4	27,2
š	25,4	25,9	23,6	23,4	27,4
v	15,3	18,0	16,4	18,2	26,4
d.p	7,1	7,3	7,8	7,8	7,7
š.p	5,0	5,1	4,6	4,6	4,6
I.d	58,5	75,0	77,0	85,0	97,0
I.š	107,5	108,0	110,0	109,5	100,7
P.d.p	28,1	32,0	36,6	36,6	28,4
I.tv.p	70,5	70,0	59,0	59,0	59,7
	5—11—7—8	5—11—11—5	4—10—11—5	6—11—11—5	4—9—6—0
	6	6	3	2	2

Table 4

Hipparion primigenium (H. v. Meyer, 1829). Dimensions and indices of the teeth P_2 — M_3 dext. of the right lower jaw from the locality Topoľčany

	P_2dext	P_3dext	P_4dext	M_1dext	M_2dext	M_3dext
d	26,6	23,4	21,8	21,0	21,1	28,3
š	12,8	14,8	16,2	13,6	14,1	13,0
v	13,1	12,6	11,3	12,2	13,6	13,0
d.mfd	4,6	6,6	5,9	5,0	5,2	5,4
d.enfd	12,0	11,2	10,8	8,5	8,7	7,9
š.ent	5,0	5,1	4,4	4,2	3,6	3,6
d.ent+T	6,9	6,9	6,2	6,6	6,1	12,5
I.v	49,2	53,7	51,8	58,0	64,5	46,0
I.š	48,0	63,2	44,2	64,8	67,0	46,0
I.enfd	45,0	47,8	49,5	40,5	41,2	28,0
I.mfd	17,3	28,2	27,1	23,8	24,1	19,1
mf/ef	38,4	59,0	54,5	58,7	59,7	68,2
I.end	72,5	74,0	71,0	69,0	59,0	28,8
d.T						6,4
I.d.T						22,6
	0,5-0,5-0,5	1—0,5—2	2—1—2,5	2—1—2	3—2,5—1	0—1—1
	1,5	1,5	1	1	1	1

metaconid widely communicates with the protoconid. The middle of the axis connecting the metaconid and mesostylid disagrees with the longitudinal axis of the crown surface but is directed buccally in the anterior part and lingually in the posterior part.

P_3 sin. The outer hole reaches behind half the width of tooth crown but not

Table 5

Hipparion primigenium (H. v. Meyer, 1929). Dimensions and indices of teeth P_2 — M_2 sin. of the left lower jaw from the locality Topoľčany

	P_2sin	P_3sin	P_4sin	M_1sin	M_2sin
d	26,2	22,7	22,4	21,0	21,3
š	12,8	14,9	15,3	13,9	14,1
v	11,8	13,6	11,5	13,1	14,0
d.mfd	5,2	6,0	5,7	5,3	5,1
d.enfd	10,9	11,0	10,5	7,8	8,7
š.ent	5,4	5,6	5,0	4,3	4,1
d.ent+T	7,6	6,6	6,5	6,8	6,7
I.v	45,5	60,0	51,5	62,5	66,0
I.š	49,2	65,7	68,2	66,2	66,2
I.enfd	42,0	48,5	47,0	37,2	40,9
I.mfd	20,0	26,5	25,5	25,2	23,9
mf/ef	47,7	54,5	54,2	67,7	58,5
I.end	71,0	84,7	77,0	63,2	61,2
d.T					
	1—1—2	1—1—0	2—1—2	3—1—2	3—1—1
	1	2	1,5	1,5	1

the neck of double knot. The protoconid communicates with the metaconid through a narrow channel only.

P_4 sin. It has the largest tooth crown. The outer hole reaches the inner half of crown but not the isthmus.

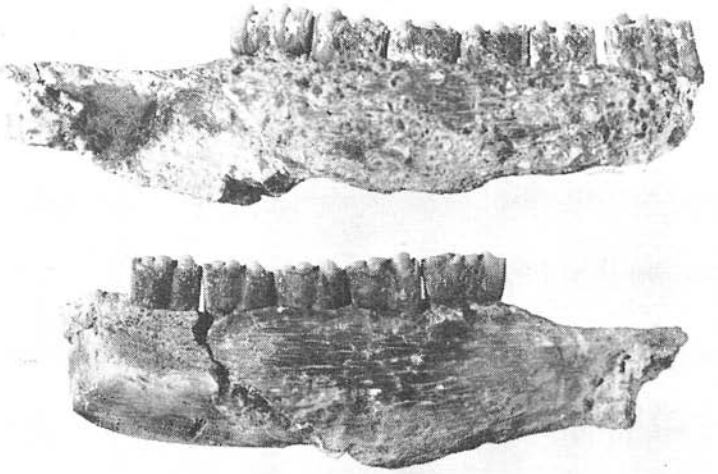
M_1 sin. is conspicuously smaller than P_4 sin. The outer hole reaches deeply the isthmus of double knot and the mesostylid is connected with the hypoconid through a narrow channel only.

M_2 sin. has a structure very similar to M_1 sin. The outer hole reaches deeply the neck of double knot. The posterior margin of the tooth crown is a little split away.

When comparing the lower teeth from Slepčany and Topoľčany we see a great similarity of both finds. In both cases the teeth are strongly worn in the sense of V. Gromova (1952). The length of the row of teeth in the right mandibulae differs only by 2,5 mm in favour of the Topoľčany find. The differences in the dimensions of the individual teeth are minimum (see Text. Tabs. 1, 2, 4, 5). Greater differences are in dissection of enamel, however, also not very important. The dimensions of teeth are within the range of variation for Hipparion primigenium (H. v. Meyer, 1829).[4]

[4] A. Forstén, 1978, p. 300 mentions the following dimensions of teeth of the species *Hipparion primigenium* (H. v. Meyer) from Eppelsheim:

$P^{3,3}$ length = 20,3—25,8
width = 22,2—29,0
$P_{3,4}$ length = 19,8—25,9
width = 13,4—17,4
$M^{1,2}$ length = 18,8—22,8 protoc.. 1=5,7—10,1
width = 21,9—26,7
$M_{1,2}$ length = 19,8—23,5
width = 11,7—16,4



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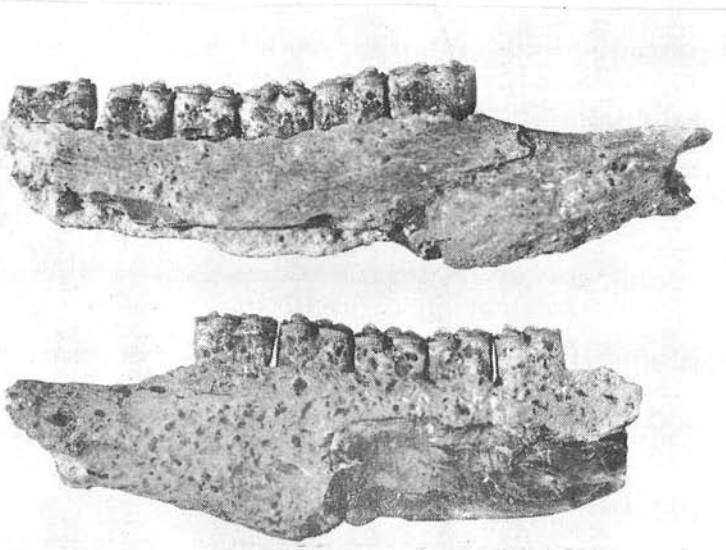

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Plate 5

Fig. 1. *Hipparion primigenium* (H. v. Meyer) fragment of right (top) and left (bottom) lower jaw with P_2 — M_3 dext., or P_2 — M_2 sin. in view of their lingual and Fig. 2 buccal surface. Locality Topoľčany — Kalvária, 0,4 x. Photo by L. Osvald.

Isolated tooth $P^{3,4}$ dext. Pezinok — loam pit of brick-kiln (Pl. 6, Figs. 2,3, Text. Tab. 3, Fig. 5). The tooth is medium worn in the sense of V. Gromova (1952). The roots are broken close below the crown. The tooth is of brown colour (sement), the enamel is almost black. In the cavity on the broken part of the root are small pyrite crystals. Thickness of cement on the buccal (outer) side of the tooth is 2,8 mm (measured laterally from the metacone and paracone). On the lingual side anteriorly from the protocone, measured laterally from the protoconulus, are even 4,8 mm. The height of crown measured in the anterior part of tooth is 26,4 mm. The enamel of the posterior wall of the anterior hole and of the anterior wall of the posterior hole forms bends, some also double, reaching relatively deeply the holes. The anterior outer corner of the posterior hole is very distinct more laterally than the posterior outer corner of the anterior hole. The pli caballin is double.

Comparison of upper teeth of hipparions from Slepčany and Pezinok.

Pezinok:

1. Tooth less worn, close to the limit of medium wear, from younger individual
2. Protocone more elongated
3. Cement strongly developed up to 4,8 mm thick
4. Mesostyle forming a relatively sharp bend of enamel
5. Tooth relatively large dark-drey (cement) to black (enamel)

Slepčany:

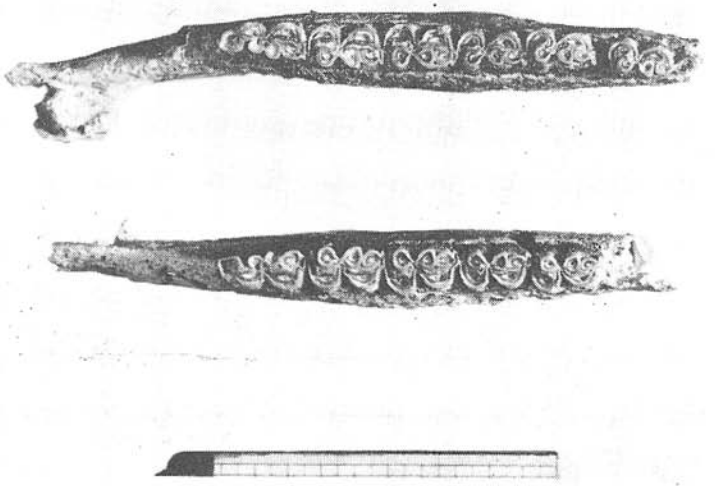
1. Teeth exceeded the limit of medium wear, from older individual.
2. Protocone more circular
3. Cement less developed, only 1,7 mm thick
4. Mesostyle relatively wide
5. Teeth smaller, more tender
6. Colour grey to greyish-brown, cement almost white

The differences, although existing, are not great and I consider them as intraspecific variability.

Fragment of proximal part of metacarpale III dext. Pezinok-loam pit of brick-kiln (Pl. 2, Figs. 2, 3, Fig. 6). The preserved part of the bone body is flattened dorsoventrally. In the place where the body of bone is broken, Mc III is of transversally oval cross section. A part of the ventral surface is broken to 1,0—1,5 cm below the joint surface. Below the joint surface on the dorsal side is the tuberositas metacarpi. In lateral view the base is moderately inclined medianly. The lateral joint surface, because of connection with the base of the lateral bone McIV, is sloping laterally and centrally. With the remaining surface of the base it forms an angle of 233 °.

Plate 6

Fig. 1. — *Hipparion primigenium* (H. v. Meyer) fragment of right (top) and left (bottom) jaw with P_2 — M_3 dext. or P_2 — M_2 sin. in view of the occlusal surface of teeth. The locality Topoľčany — Kalvária, 0,4x. Photo by. L. Osvald. Fig. 2. — *Hipparion primigenium* (H. v. Meyer) isolated tooth $P^{3,4}$ dext. in view of the occlusal and Fig. 3. — mesial- surface of tooth. Locality Pezinok — loam pit of brick-kiln, 1 x. Photo by L. Osvald.



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The whole bone surface is affected by corrosion. It is shown in a way that the bone surface is not smooth but furrowed with fine winding channels and covered with small holes and tubercles. So is also affected the joint surface, mainly its posterior (ventral) part. Dimensions: width 40,5 mm, thickness 26,6 mm, length 73,2 mm.

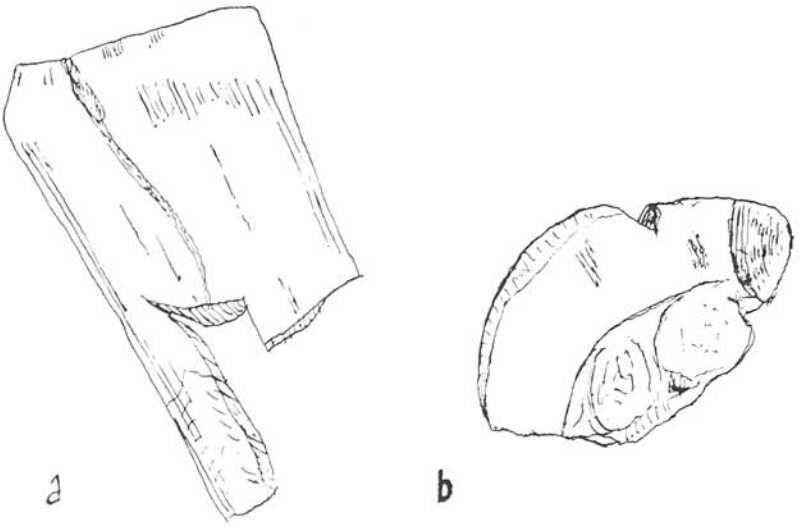

Fig. 6. Hipparion primigenium (H. v. Meyer) — proximal part of Mc III dext. in view of a, dorsal, b, of proximal basal surface. Locality Pezinok, loam pit of brick-kiln. The scale indicates length 5 cm.

Remarks to stratigraphic range and finds of hipparions

The hipparions were living in America, Europe, Asia, also in Africa. Their large areal extension shows that they could have lived in most diverse climatic zones. In this point they agree with the genus Equus, which replaced them in the Pleistocene. From geological view-point it may be considered that the hipparions appeared in all parts of their region in not very different time (V. Gromova, 1952). For this reason the hipparions are very valuable for application in biostratigraphy of terrestrial sediments. In spite of that the views of the stratigraphic range of hipparions are different. There is mainly no uniform view of the first occurrence of the genus Hipparion. It is connected with difficult correlation of continental sediments in large regions. There is no uniform comprehension of definition of the Sarmatian—Pannonian stages and the difference in the views of the boundary between the Miocene and Pliocene is also in connection with it. At last it is the incorrect or not quite precise determination of age of sediments at some localities, mainly because of lacking other fossil remnants.

Among the oldest localities in Europe, from which we know remnants of hipparions, are Eppelsheim and Höwenegg in Germany. In Eppelsheim with Hipparion also remnants of *Anchitherium* sp. and *Listriodon* sp. were found.

H. Tobien (1938) described remnants of Hipparion from Höwenegg in SW Germany from Sarmatian beds. L. Benda and J. E. Meulenkamp (1972) range them to the Lower Pliocene, similarly as A. Papp and E. Thenius (1954) consider. These authors suppose that remnants of hipparions are not known from pre- Pliocene sediments. Contradictory to these views is the find of one lower tooth of Hipparion from „Helvetia" sands thus, of pre-Tortonian age from France. C. Guerin — P. Mein — M. Philippe — G. Truc (1972). As far I know it is the oldest and so far an isolated find of Hipparion from beds of such age. This implies that the boundary between the Miocene and Pliocene cannot be placed on the basis of the occurrence of the genus Hipparion as many authors considered for a long time. I tend to the opinion of P. Mein (1975), who ranges the localities Eppelsheim and Höwenegg into his Zone 9, which corresponds to the Upper Sarmatian of the Central Paratethys or to the base of the Middle Sarmatian of the Eastern Paratethys.

M. Motl (1954) mentions the finds of *Hipparion gracile (H. primigenium)* from several localities in Styria in Austria. The finds are according to the age ranged to the Pannonian, Zones C, D and E according to A. Papp (1951). As to their age, these finds are only a little older than the finds from Slovakia. He mentions that in the Sarmatian of Austria Hipparions have not been so far found. Remnants of hipparions are known also from Hungary from the localities Polgardi, Czakvar and Baltavár (T. Kormos, 1913). Remarkable is that the Hipparion fauna in Czakvár is found in cave sediments. From the locality Baltavár T. Kormos (1914) descrbed a new species, *Hipparion microdon (= H. primigenium)*.

Whereas in Central Europe only a few species of hipparions are described--here is some vacuum, the situation is different in eastern and western Europe. According to V. Gromova (1952) *Hipparion primigenium* is not found in eastern Europe but replaced there by other species of hipparions. N. Macarovici (1967, 1973) also affirms that *H. primigenium* is not even found in Roumania but there are other species. So, for example he mentions from the Upper Sarmatian the species *H. sebastopilitanum,* from the Meotian *H. moldavicum* and from the Pontian *H. stavropolensis.* I. Nikolov (1971) mentions from Bulgaria three new species. So from the Sarmatian *H. praesulcatum,* from the „Pontian" *H. strymoniensis* and *H. microtaton.*

In western Europe M. Freudental and P. X. Sondaar (1964) mention as the lower boundary for the occurrence of hipparions the Vallesien. The most characteristic feature of the Vallesien according to them is the mixture of progressive „Pliocene" and archaic — „Miocene" elements in the fauna. The authors suppose that similarly as from the occurrences in Spain, also in all western and central Europe the Hipparion fauna can be divided into deeper zone with elements of archaic fauna and a higher zone with „modern" Pliocene fauna. In the lower zone Hipparion is found together with Anchitherium and the genus Cricetodon. In the more upper zone Anchitherium is missing and Cricetodontinae are replaced by the subfamilies Cricetinae and Murinae. These authors range the beds containing an archaic fauna into the Vallesien, the Hipparion fauna without archaic elements into the „Pikkermien". According to them the find of Hipparion with Cricetodontinae could be synchronized in wide areas. H. Tobien (1967) points out cor-

rectly that clearing up of this phenomenon could be also ecological. Whereas in central Europe in the Pontian stage the forest assemblage was developed, in the Mediterranean region the steppe assemblage and therefore the boundary between the Vallesien and Pikkermien would be a facies and not a time boundary. Probably also the small number of Hipparion species in central Europe has two causes. One of them is in relatively small number of finds, the second is ecological. The ecologic conditions in central Europe were more monotonous forest asemblage than in eastern and western Europe (transitions to steppes and proximity to the sea).

At present more than 40 species of hipparions are described from eastern but also from western Europe. I tend to the opinion of A. Forstén (1968, 1973, 1978), which on the basis of his extensive investigations holds the view that many of the newly described species are only synonyms to *Hipparion primigenium* (H. v. Meyer, 1829) and he opposes on principle the practice to give every local find a specific denomination.

Conclusion

All the described remnants of hipparions from Slovakia belong to one species, *Hipparion primigenium* (H. v. Meyer, 1829) and are from Upper Miocene — Pontian sediments. An exception is perhaps the locality Pezinok, where a rich fauna of molluscs and ostracodes was found, which makes us possible to range these sediments into the Pannonian Zone „E" according to A. Papp, 1951, to its uppermost part, which forms the transition to the Pontian in the sense of latest knowledge and conventions. Thus we may range in age the locality Pezinok to the base of 11 th Biozone according to Mein (1975), the other localities to Biozone 12 or 13 of the same author.

Translated by J. Pevný

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Review by Z. SCHMIDT Manuscript received April 14, 1981