Δελτίο Ελληνικής Γεωλογικής Εταιρίας τομ. XXX/1, 341-355, 1994 Bulletin of the Geological Society of Greece vol. XXX/1, 341-355, 1994
Πρακτικά 7ου Επιστημονικού Συνεδρίου, Θεσσαλονίκη, Μάιος 1994 Proceedings of the 7th Congress, Thessaloniki, May 1994

MICROSTONYX MAJOR (SUIDAE, ARTIODACTYLA) FROM THE LATE MIOCENE LOCALITY OF "NIKITI-1", MACEDONIA, GREECE; SOME REMARKS ABOUT THE SPECIES

D. Kostopoulos*

ABSTRACT

The suids from the late Miocene locality of "Nikiti-1", NKT (Macedonia, Greece) are described and compared with those of other Greek and Eurasian localities. The material is determined as *Microstonyx major*, while its importance to the definition of the species, as well as to the dating of the locality is also discussed.

ΣΥΝΟΨΗ

Στην παρούσα εργασία περιγράφονται τα δείγματα του είδους *Microstonyx major*, που προέρχονται από την απολιθωματοφόρο θέση του ανώτερου Μειοκαίνου "Νικήτη-1", ΝΚΤ (Μακεδονία, Ελλάδα). Το διαθέσιμο υλικό συγκρίνεται μ' εκείνο του γένους *Microstonyx* απο διάφορες απολιθωματοφόρες θέσεις της Ελλάδας και Ευρασίας. Εξετάζεται επίσης η συμβολή των ανευρεθέντων δειγμάτων στον καθορισμό του είδους *Microstonyx major* καθώς και στον προσδιορισμό της ηλικίας της θέσης ΝΚΤ.

INTRODUCTION

The mammalian fossiliferous site of "Nikiti-1" (NKT), discovered in the summer of 1990 , is located northwest of Nikiti village, in the central part of Chalkidiki peninsula (Macedonia, Greece) (Fig. 1). The locality of NKT is situated in Nikiti Fm, consisted of clastic sediments (KOUFOS et al., 1991). The fauna of NKT is not yet completely determined, because the research is still in progress. The faunal list of NKT includes the species: *Ouranopithecus macedoniensis, Hipparion macedonicum, Hipparion* cf. *primigenium, Bohlinia attica, Bohlinia* n. sp., *Palaeotragus* cf. *rouenii, Helladotherium duvernoyi, Microstonyx major, Tragoportax* cf. *rugosifrons, Prostrepsiceros* aff. *houtumschindleri, Mastodon* sp. and *Rhinicerotidae* ind. The fauna suggests a late Vallesian - early Turolian age for the locality (KOUFOS et al., 1991; KOUFOS, 1993; KOSTOPOULOS et al., in press).

In the late Miocene faunas the suids are less abundant than the other artiodactyls. However, it is doubless that interest of Eurasian Suidae is growing (MADE & MOYA-SOLA, 1989). *Microstonyx* is a common suid, referred from numerous late Miocene localities of Eurasia. A rich sample of *Microstonyx* is described from the Greek locality of Pikermi (ROTH & WAGNER, 1855; GAUDRY, 1862-1867). Nevertheless, the presence of the genus in the rest of the Greek area is still scarce (THENIUS, 1955; MADE & MOYA-SOLA, 1989;

* Aristotle University of Tessaloniki, School of Geology, Dep. of Geology & Physical Geography, 54006 Thessaloniki, Greece.

Fig. 1: Skech map, indicating the late Miocene localities of Nikiti, Macedonia, Greece. 1= "Nikiti 1", NKT; 2= "Nikiti 2", NIK.

Σχ. 1: Σκαρίφημα της περιοχής Χαλκιδικής με τις απολιθωματοφόρες θέσεις της Νικήτης, Μακεδονία, Ελλάδα. 1= "Νικήτη 1" NKT, 2="Νικήτη 2" NIK.

MELENTIS, 1968; SOLOUNIAS, 1981).

Few specimens of *Microstonyx* from Macedonia were also described by ARAMBOURG & PIVETEAU (1929), while BONIS et al. (1992) refer this genus from the late Miocene localities of Axios Valley. The material of *Microstonyx* from NKT is the first important occurence of this genus in Macedonia. This material is described and compared with that of other Greek and Eurasian localities. Its importance to the determination of the genus as well as to the dating of the locality will be also discussed.

PALAEONTOLOGY

Order: Artiodactyla OWEN, 1848
Family: Suidae GRAY, 1821
Genus: *Microstonyx* PILGRIM, 1926

Microstonyx major (GERVAIS, 1848-1852)

Locality: "Nikiti- 1", NKT, Macedonia, Greece.

Horizon: Late Vallesian - early Turolian (MN 10 -MN 11), late Miocene,

Material: Skull, NKT-68; part of the maxilla with dP^2-M^1, NKT-174; part of the mandible with dI_2-M_1 sin and M_2 dex, NKT-126.

DESCRIPTION

Skull: The skull NKT- 68 is well preserved and belongs to an adult individual. The upper canines, both I^2 and the right I^3 of the skull are missing, while the anterior part of the premaxillary bones is partially destroyed. The skull is large-sized, remarkably elongated and relatively shallow (Tab. 1). In lateral view (profile) its upper surface forms an inclined straight or slightly concave line (Pl. I, fig. a). The posterior part of the skull is strongly elevated, ending in a large occipital crest (Pl. I, fig.a, b). The frontoparietal surface of the skull is flat and wide, while the maxillary and nasal bones are extremely elongated. The nasal bones seem to be slightly convex. The zygomatic arches are strong, large and strongly projected laterally (Pl. I, fig. b); their anterior end is situated above the middle of M^1. The elongation of the skull and the inflated zygomatic arches are the predominant characters of NKT- 68. The orbit is oval-shaped and small; its anterior margin is situated well behind M^3. The infraorbital incisura is clear and wide. The presence of the alveolar crests, situated above the upper canines, is obscure. The left alveolar crest is present but not well developed. This is probably due to the absence of the canines and to the slightly deformation of the skull in its anterior part. The occiput is large, triangular shaped, very wide in its upper part and concave in the middle. The pear-shaped foramen magnum and the occipital condyles are small. The occipital condyles are touched eachother in the lower part of the foramen magnum and they are directed backwards. The mastoid processes are elongated, laterally depressed and

Table 1: Skull measurements of *Microstonyx major*. NKT= "Nikiti -1", Macedonia, Greece, PIK= Pikermi (skull measuremens from the figs of GAUDRY, 1862) the specimens MGRI-1781 and MOGU-2642 are from Grebeniki, while MOGU 2641 is from Taraklija, U.S.S.R. (measuremens from TROFIMOV, 1954).

Πιν. 1: Μετρήσεις του κρανίου του *M. major*. NKT="Νικήτη 1", Μακεδονία, Ελλάδα, PIK=-ικέρμι (μετρήσεις από τα σχ. του GAUDRY, 1862) τα δείγματα MGRI-1781 και MOGU-2642 προέρχονται από το Grebeniki, ενώ το δείγμα MOGU-2641 από την Taraklija, πρώην Σ. 'Ενωση (μετρήσεις από TROFIMOV, 1954).

Skull measurements	**NKT-68**	**MGRI-1781**	**MOGU-2642**	**MOGU-2641**	**PIK**
1. Length Prosthion -Basion	430	450	480	483	(470)
2. Length Prosthion - Opisthion	510	550	587	610	(600)
3. Length from the end of nasal bones to the middle of occipital crest.	>450	516	565	580	
4. Length from the middle of the line connecting the zygomatic protuberancies of the frontal to the middle of occipital crest.	132	125	144	166	-
5. Length of nasal bones.	260+	290	302	310	-
6. Length from the basion to the posterior end of sphenoid.	69	70	80	-	-
7. Length from basion to the anterior end of choane.	124.5	125	132	132	-
8. Greatest breadth of the skull (in the zygomatic arches).	220	255	295	257	(310)
9. Breadth of the front (in its zygomatic protuberancies).	137	146	-	136	
10. Minimal breadth of nasal bones.	68	65	79	56	-
11. Palatal breadth in the anterior end of M^3.	44	45	48	45	-
12. Palatal breadth in the anterior end of M^1.	48	48	53	50	-
13. Palatal breadth in the anterior end of P^2.	56.7	52	65	56	-
14. Palatal breadth in the posterior end of C.	66.6	67	81	75	-
15. Breadth of palat in the posterior end of I^2.	53	48	50	40	-
16. Height of the skull from basion to the middle of occipital crest.	150	197	215	233	-
17. Minimal distance between the orbits.	96	112	127	116	-
18. Maximal length of the orbit.	52	63	54	-	-

curved anteriorly. The anterior margin of the choanae is situated well behind M^3. The palate is elongated and narrow (Pl. I, fig. c).

Dentition: The main dental morphological character of the skull NKT-68 is the presence and the position of P^1. P^1 is present in both toothrows and it is situated in front of P^2, without intermediate diastema (Pl. II, fig. a). The diastema C-P^1 is 27 mm, while the diastema I^3-C is about 10 mm. The distance C-P^2 is 39.5 mm (measurements are taken according to the system proposed by MADE, 1991). The teeth are little worn; the talon of M^3 barely appears. The dental measurements are given in Tabs. 2 and 3. The total length of the upper toothrow (I^1-M^3) is 283 mm, while the length P^1-M^3 is

Table 2: Measurements of the upper permanent and milk cheek teeth of *Microstonyx major* from "Nikiti 1" (NKT), Macedonia, Greece.

Πιν. 2: Μετρήσεις των μόνιμων και γαλακτικών δοντιών της άνω γνάθου του *Microstonyx major* από τη "Νικήτη 1" (NKT), Μακεδονία, Ελλάδα.

	n	mean	min	max	s	v
L P^1	2	12.20	12.10	12.30	0.141	1.15
Ba P^1	2	5.12	5.00	5.25	0.176	3.44
Bp P^1	2	5.47	5.30	5.65	0.247	4.52
L P^2	2	17.35	17.20	17.50	0.212	1.22
Ba P^2	2	8.25	8.20	8.30	0.070	0.85
Bp P^2	2	11.45	11.40	11.50	0.070	0.61
L P^3	2	17.95	17.80	18.10	0.212	1.11
Ba P^3	2	11.40	11.30	11.50	1.141	1.24
Bp P^3	2	17.25	16.80	17.70	0.636	3.68
L P^4	2	17.10	16.70	17.50	0.565	3.30
B P^4	2	19.75	19.70	19.80	0.070	0.35
L M^1	4	25.30	24.10	25.90	0.909	3.59
Ba M^1	3	22.20	22.10	22.60	0.360	1.62
Bp M^1	3	20.40	19.70	20.80	0.608	2.98
L M^2	2	29.75	29.30	30.20	0.636	2.13
Ba M^2	2	25.30	25.25	25.30	0.035	0.10
Bp M^2	2	23.90	23.50	24.30	0.565	2.36
L M^3	2	43.45	43.40	43.50	0.070	0.16
Ba M^3	2	27.75	27.70	27.80	0.070	0.25
Bp M^3	2	24.70				
Bt M^3	2	14.45	14.30	14.46	0.212	1.46
L DP^2	2	14.65	14.30	15.00	0.494	3.37
B DP^2	2	7.70	7.60	7.80	0.141	1.80
L DP^3	2	17.40	17.10	17.70	0.424	2.43
B DP^3	1	14.30	-	-	-	-
L DP^4	2	19.70	-	-	-	-
B DP^4	2	16.45	16.1	16.8	0.495	3.00

Table 3: Measurements of the lower teeth of *Microstonyx major* from "Nikiti 1" (NKT), Macedonia, Greece.

Πιν. 3: Μετρήσεις των γαλακτικών δοντιών της κάτω γνάθου του *Microstonyx major* από τη "Νικήτη 1" (NKT) Μακεδονία, Ελλάδα.

L DP_4	B DP_4	L M_1	Ba M_1	Bp M_1	L M_2	Ba M_2	Bp M_2
26.8	13.0	24.0	15.1	16.2	30.5	19.4	20.5

162.4 mm. Unfortunately I^2 and the upper canines are missing and thus, no morphological remarks can be given for these teeth.

The alveolus of the left upper canine is well preserved and elliptical-shaped; its dimensions are 18 x 13 mm, indicating a small canine. I^1 is elongated and relatively narrow with a clear internal cingulum, forming two large cusps, situated posterolingually. This character is mentioned by MADE et al. (1992) as typical for Dicoryphochoerini. I^3 is elongated with a main central cusp, a smaller anterior and a lower posterior one. A posterolingual cusp is also developed on the cingulum.

The double rooted P^1 is small with a main central cusp, which is divided by a thin groove. An anterior and a posterior style (corresponding to the parastyle and metastyle) are clear in the labial wall of the tooth. P^2 is similar morphologically to P^1 but it is larger with a stronger anterior and internal cingulum, which is extended posterolingually and consisted of numerous small cusps. P^3 has triangular shape with an internal talon, formed on the cingulum. The main cusp is large and the anterior and internal cingulum strong. A large cusp is also developed on the internal talon; this cusp is connected to the internal face of the metacone. The parastyle and the metastyle are well developed in the labial wall; another style is also developed labially in the position of the metacone. P^4 is sub-squarish, more wide than long. The protocone is well developed, while the presence of the hypocone is obscure. The paracone and metacone are of equal size, distinguished by a clear groove between them. The paracone projects anteriorly with two parallel crests; the labial one is connected with the parastyle. The parastyle is strong, while the metastyle is very small or absent. The cingulum is strongly developed; the posterior cingulum forms an important style in the posterolingual angle of the tooth, corresponding to the hypocone.

The molars have the typical morphology of Suidae. The paracone and the metacone are situated more anteriorly than the protocone and the hypocone. The paracone and metacone of $M^{1,2}$ seem to be larger than the other two main cusps. In M^3 the protocone and the paracone are larger than the metacone and the hypocone. A small cusp is situated in the central valley of the molars, while all mentioned cusps are connected by strong crests, forming deep and narrow valleys. The anterior cingulum is well developed, increasing from M^1 to M^3. The posterior cingulum is also important, forming a rudimentary talon in $M^{1,2}$. A lingual and a labial tubercle are present between the two lobes of the molars. The talon of M^3 is large and almost squarish. MADE et al. (1992) note that "...In the M^3 the morphology of the talon varies from one extreme, a type with one dominant cusp lingually of the axis of the tooth, through intermediate types, to the other extreme, a type with a group of smaller cusps without clear structure...". The talon of the studied M^3, belongs to the first type with a distal large cusp, situated lingually, and associated by 6 or 7 secondary cusps.

The morphology of the upper milk teeth (Pl. II, fig. b) of the specimen NKT-174 is similar generally to Suidae: dP^2 possesses a simple premolar structure, dP^3 is triangular shaped with three main cusps and dP^4 is morphologically similar to the molars.

In the specimen NKT-126, the morphology of the lower canine and the molars is clear. The right lower permanent canine, which barely appears in NKT-126, is well pointed, with oval or atractoid (elliptical) cross section and seems to be small. The morphology of the available lower molars ($M_{1,2}$) is similar to that of the upper ones with four main cuspids,

another central one and a rudimentary talonid (Pl. II, fig. c).

DISCUSSION

PILGRIM (1926) proposes the generic name *Microstonyx* for the large suid with elongated snout, found in numerous late Miocene localities of Europe. Later the generic determination of *Microstonyx* was modified and completed by TROFIMOV (1954), HÜNNERMANN (1968), THENIUS (1972), MADE & MOYA-SOLA (1989). However, the specific distinction of the genus is still discussed. Recently, MADE & MOYA-SOLA (1989) have recognized three forms of *Microstonyx*:

-*Microstonyx antiquus*, a lower Vallesian form with very large dentition, which retains its Pl,

-*Microstonyx major major*, an upper Vallesian - middle Turolian form with smaller dentition, which also retains its Pl, and

-*Microstonyx major erymanthius*, an upper middle Turolian form with still smaller dentition, which has not P_1 and often lacks its P^1.

The general morphological features of the NKT skull, such as the large size, the elevated occiput, the elongated snout, the wide and flat frontoparietal region, the inflated zygomatic arches, the narrow and elongated palate, the presence of alveolar crests and the clear infraorbital incisura, are typical for *Microstonyx* (TROFIMOV, 1954; THENIUS, 1972; MADE & MOYA-SOLA, 1989). A comparison of the NKT suid with *Microstonyx* from the various Eurasian localities, is necessary in order to clarify its specific determination and to find its relationchips with them.

Microstonyx antiquus is known only by dental remains; the skulls from Stratzing (Germany) and Terrassa (Spain), referred to *Microstonyx antiquus* (THENIUS,1972; GOLPE-POSSE, 1980) belong to *M. major* (MADE & MOYA-SOLA, 1989; MADE et al., 1992; MADE, 1989-1990). *Microstonyx major major* and *M. major erymanthius* have similar morphology and dimensions. Their distinction is based to the frequency of Pl's presence and to small differences in the size of the dentition (MADE & MOYA-SOLA, 1989; MADE, 1989-1990). The subspecific distinction needs a good knowledge of the variation in dental dimensions, as well as in the presence of Pl.

Skull measurements of *Microstonyx* are only given by GAUDRY (1862-67) and TROFIMOV (1954); the skull comparison is mainly based on the morphological features. The skull NKT-68 is similar to that of *Microstonyx major* from Pikermi, Tito Veles, Grebeniki, Taraklija and Mont Luberon, described and figured by GAUDRY (1862, 1873), GAREVSKI (1956) and TROFIMOV (1954). The NKT skull is metrically similar to the skulls of *M. major* from Pikermi, Grebeniki and Taraklija (Tab. 1). The skull MGRI-1781 from Grebeniki is slightly smaller than MOGU-2642 from the same locality and closer to the studied specimen from NKT. The skulls from these localities preserve the characters given for *Microstonyx major* and they are attributed in two subspecies: *M. m. major* and *M. m. erymanthius*. A morphological character, usually referred as distinctive between *M. major major* and *M. major erymanthius*, is the development of the alveolar crests (TROFIMOV, 1954). In *M. major major* the alveolar crests are not well developed, while in *M. major erymanthius* they are strong. The left alveolar crest of *Microstonyx* from NKT seems to be small and more similar to *M. major major*. Nevertheless, the study of the recent wild suid, showed that the maxillary bones of the old idividuals have often a strong crest (GAUDRY, 1873). The small variation in the size of the skulls and the observed morphological differences, are probably related to the sex and / or to the age of the individuals and they cannot be considered as important.

The skulls from Stratzing and Terrassa were initially described as *M. antiquus* (THENIUS, 1972; GOLPE POSSE, 1978, 1979, 1980a) and later transferred to *M. major major* (MADE & MOYA-SOLA, 1989). Stratzing and Terrassa skulls differ from the other skulls of *Microstonyx major* from NKT, Pikermi, Tito Veles, Grebeniki, Taraklija and Mont Luberon in the shorter snout, the more elevated and narrow occiput, the position of the orbit, situated more anteriorly, the strongly concave skull profile and the larger upper canines. Some of these differences are also mentioned by THENIUS (1972) as distinctive characters between *Microstonyx* from Stratzing and Pikermi. MADE & MOYA-SOLA (1989) note that the elongation of the snout and the position of the orbit, are charecters related to the sex and/ or to the ontogenetic age. Nevertheless, these differences cannot be observed between the skulls from Pikermi, NKT, Tito Veles, Grebeniki, Taraklija and Mont Luberon, which probably belong to individuals of both sexes and / or of different ontogenetic ages. The same authors attribute the skull from Stratzing, and consequently that from Terrassa, to *M. major major*, because of their small dental dimensions. The dentition of *Microstonyx* from Terrassa is clearly larger than that from Stratzing (Tab. 5) but both are into the limits of variation for *M. major* (MADE et al, 1992). The inclusion of both skulls in *Microstonyx major,* proposed by MADE & MOYA-SOLA (1989) seems to be right. The observed differences are not sufficient for a specific distinction, while the size of the dentition is more similar to *M. major* than to *M. antiquus*. Nevertheless, their attribution to the subspecies *M. major major* seems to be more problematic; the cranial characters of Terrassa and Stratzing material permits their inclusion in a group different from *M. major major* and *M. major erymanthius*.. The age of Terrassa and Stratzing also supports this idea; both are dated to MN 10, while *M. antiquus* is dated to MN 9 and *M. major major-erymanthius* to MN 11- MN 12 (MADE & MOYA-SOLA, 1989). Thus, "Stratzing-Terrassa group" could be corresponded to a more primitive chronological subspecies of *M. major*. If this hypothesis is correct than the evolution of the skull of *M. major* through the time is characterized by an elongation of the snout and an inclination of the occiput backwards, associated by a reduction of the canines and a more posteriorly situated orbit. From this point of view, it is clear that the skull features of the NKT suid correspond to the more evolved forms of *M. major major-erymanthius*.

The morphological characters of the upper teeth present a great variation and no important differences between *M. major* from the various localities can be observed. Dental features which are referred as distinctive between *M. major* and *M. antiquus* (GINSBOURG, 1988) seem to be more related to local ecological factors. The great geographical expansion of the genus seems to support this idea. The most important dental character observed in NKT-68 is the presence and the position of P^1. GAUDRY (1862-67) notes that from 10 dentitions of *M. major* from Pikermi only two have a P^1 (20%). This tooth is also present in the skulls of *M.major* from Stratzing, and Terrassa, as well as in some maxillae from Russia and Tito Veles. Its presence is mentioned by many authors as a possible distinctive character between the forms of *M. major* (TROFIMOV, 1954; THENIUS, 1982). MADE & MOYA-SOLA (1989) note that the upper Vallesian - middle Turolian form of *M. major* (*M.major major*) retains its first premolar while the upper middle Turolian form (*M.major erymanthius*) lacks its P^1 probably during the life of the individual. In this character *Microstonyx major* from NKT seems to be close with the upper Vallessian-middle Turolian forms. In the russian

specimens of *Microstonyx major*, where P^1 is present, the tooth is single rooted (TROFIMOV, 1954). The skulls from Terrassa and Stratzing possess a double rooted P^1, similar to that of NKT. In the known skulls of *M. major*, where P^1 is present there is always a clear diastema between this tooth and P^2. The length of this diastema varies greatly (THENIUS, 1972; GOLPE POSSE, 1979, GAREVSKI, 1956). The diastema P^1 - P^2 is completely absent in NKT-68. P^1 is situated in front of P^2 like in the recent wild suid. The variation in the length of the diastema P^1-P^2 and the absence of P^1 in some specimens from the same locality cannot support then as clear distinctive characters. The distance between C-P^2 seems to be a more valid character for comparison (MADE, 1991). This distance is 39.5 mm in NKT , close to that of *M. major* from Tito Veles (40 mm), Grebeniki (> 40 mm) and Taraklija (> 35 mm) and clearly larger than that from Terrassa and Stratzing (< 25 mm) (GOLPE POSSE, 1980a; TROFIMOV, 1954; GAREVSKI, 1956; THENIUS, 1972).

The alveolar dimensions of the upper canine in NKT are small (18X13 mm) like in the late Vallesian - early Turolian forms of *Microstonyx*. Moreover, they are similar to those of *M. major* from Grebeniki, Taraklija and Tito Veles (Fig. 2). MADE et al. (1992) make an effort to use the decrease of I^2, I^3 length as an evolutionary character for the distinction of the different forms of *M. major*. However, the data used by the authors are remerkably few and cannot allow certain conclusions; a more detail study of these characters seems to be necessary.

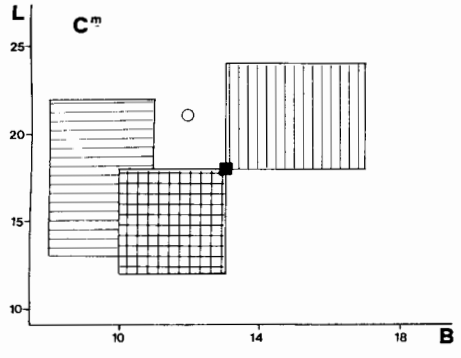

Fig. 2: Ratio diagram, comparing the upper canines of *Microstonyx major*. (measurements from GAREVSKI, 1956 and TROFIMOV, 1954).

Σχ. 2: Διάγραμμα διασποράς, στο οποίο συγκρίνονται οι διαστάσεις των άνω κυνοδόντων του *M. major* (μετρήσεις από GAREVSKI, 1956 και TROFIMOV, 1954).

■ "Nikiti 1", NKT, Macedonia, Greece (measurements in the alveol)

○ Tito Veles, former Jugoslavia

▥ Grebeniki, Russia

▦ Taraklija, Russia

▤ Todurovo, Russia.

The size of the upper dentition of *Microstonyx major* varies remarkably (Tab. 4). A clear size distinction within the species seems impossible; only *Microstonyx* from Terrassa is slightly larger (Tab. 4). The NKT suid fits better with that from Grebeniki, while *Microstonyx major* from Pikermi, Taraklija, Todurovo, Tito Veles, Mont Luberon and Stratzing possess a more reduced premolar row relatively to the molar's one (indices 4, 6 in Tab. 4). Considering the age of the localities and the above mentioned observations the upper dentition of *Microstonyx major* decreases from late Vallesian to middle Turolian. This decrease is due to the reduction of the premolar row. The ratio between the length of the skull and the length of the upper toothrow (indices 7-9 in Tab. 4) supports this idea.

The metrical comparison of the upper cheek teeth from NKT with those of *Microstonyx* from Spain (Fig. 3) shows that the NKT suid is closer to *Microstonyx major* from Crevillente-2 and Cero de la Carita, localities which

Table 4: Comparison of the upper dentition of *Microstonyx major* (Measurements taken from GAREVSKI, 1956; TROFIMOV, 1954 and MADE et al., 1992)

Πιν. 4: Σύγκριση της άνω οδοντοστοιχίας του *Microstonyx major* (Μετρήσεις από GAREVSKI, 1956; TROFIMOV, 1954 και MADE et al., 1992).

* Measurements from the Figs. of GAUDRY, 1862-67

** Measurements from the Figs. of GAUDRY, 1873 and

*** Measurements from the Figs. of THENIUS, 1972.

	M. major "Nikiti 1" NKT-68 dex	sin	*M. major* Grebeniki MGR1 1781	MOGU 2642	*M. major* Taraklija MOGU 2640	MOGU 2641	*M. major* Todurovo MOGU 2679	*M. major* Pikermi *	*M. major* Tito Veles	*M. major* Luberon **	*M. major* Spain Terrassa	Pierra	*M. major* Stratzing ***
1. P^2-M^3	152.6	148.3	144.0	151.0	146.0	140.0	139.0	146.0	136.0	153.0	162.5	157.8	149.5
2. M^1-M^3	97.5	96.0	92.0	97.0	98.0	92.0	90.0	94.5	90.0	99.0	102.9	102.5	97.0
3. P^2-P^4	55.7	52.2	52.0	55.0	51.0	49.0	48.0	51.5	46.0	51.0	59.6	55.3	52.5
4. P^2-P^4 x 100/ P^2-M^3	36.5	35.0	36.1	36.4	34.9	35.0	34.5	35.3	33.8	33.3	36.6	35.0	35.1
5. M^1-M^3 x 100/ P^2-M^3	63.9	64.7	63.8	64.2	67.1	65.7	64.7	64.7	66.2	64.7	63.1	64.9	64.8
6. P^2-P^4 x 100/ M^1-M^3	57.1	54.4	56.5	56.7	52.0	53.3	53.3	54.3	51.1	51.5	57.3	53.9	54.1
7. P^2-M^3 x 100/ [1]	34.9		32.0	31.4	30.2	-	-	(31)	-	-	-	-	-
8. M^1-M^3 x 100/ [1]	26.4		20.4	20.2	20.2	-	-	(20)	-	-	-	-	-
9. P^2-P^4 x 100/ [1]	12.5		11.5	11.4	10.4	-	-	(10.9)	-	-	-	-	-

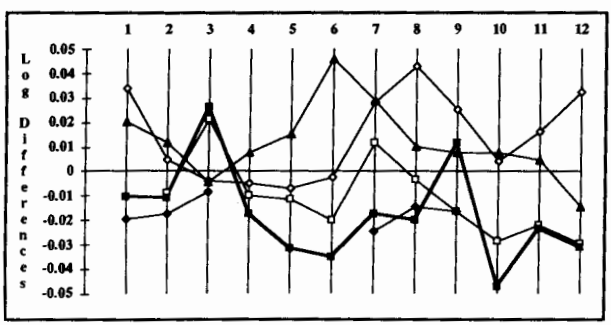

Fig. 3: Logarithmic ratio diagram, comparing the upper cheek teeth *Microstonyx major* from NKT and Spain (measuremants from MADE et al.,1992).

Σχ. 3: Διάγραμμα λογαριθμικών διαφορών στο οποίο συγκρίνονται οι διαστάσεις των δοντιών της άνω γνάθου του *M. major* από τη NKT και την Ισπανία (μετρήσεις από MADE et al. 1992)
1= Length M^3; 2= Length M^2; 3= Lenght M^1; 4= Length P^4; 5.= Length P^3; 6= Length P^2; 7= Breadth M^3; 8= Breadth M^2; 9= Breadth M^1; 10=Breadth P^4; 11= Breadth P^3; 12= Breadth P^2.

■ "Nikiti 1", NKT, Macedonia, Greece

□ Crevillente 2, Spain

◆ Cero de la Carita, Spain

◇ Pierra, Spain

▲ Terrassa, Spain.

have been dated to early and middle Turolian respectively (MADE et al., 1992). The upper teeth of *Microstonyx* from Pierra and Terrassa are clearly larger (Fig. 3). The comparison with the russian *Microstonyx major*, indicates great similarities between NKT and Grebeniki sample (Fig. 5). The difference in the length of M^1, is pobably due to the stage of wear. The cheek teeth from Taraklija and Todurovo (Fig. 4) as well as from Thessaloniki, Pikermi and Tito Veles (Fig. 4) are smaller than those from NKT . The locality of Grebeniki is dated to early Turolian, while those of Taraklija, Todurovo and Pikermi are considered as middle-late Turolian (MEIN, 1990). [In the figs. 3-5, as standar for comparisonare used the mean values of *Microstonyx major* from Spain (MADE et al, 1992)]

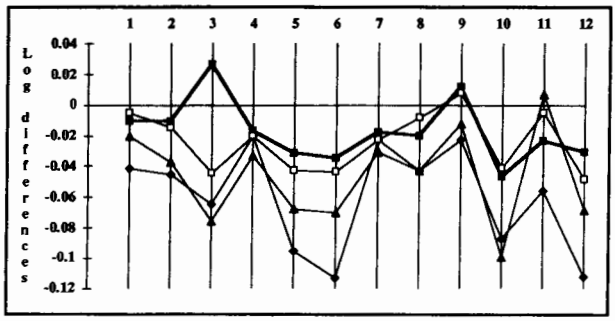

Fig. 4: Logarithmic ratio diagram, comparing the upper cheek teeth of *Microstonyx major* from NKT and Russia (measurements from TROFIMOV, 1954; for the numbers of the measurements see Fig. 3).

Σχ. 4: Διάγραμμα λογαριθμικών διαφορών στο οποίο συγκρίνονται οι διαστάσεις των δοντιών της άνω γνάθου του *M. major* από τη ΝΚΤ και τη (μετρήσεις από TROFIMOV, 1954; οι αριθμοί των μετρήσεων όμοια με το Σχ. 3).

■ "Nikiti 1", NKT, Macedonia, Greece

□ Grebeniki, Russia

▲ Taraklija, Russia

◆ Todurovo, Russia

The available lower molars (M_1, M_2) of the specimen NKT-126 are situated closer to the specimens of *M. major* from Spain and France (*M. major major*), while they are smaller than those of *M. antiquus* from Eppelsheim and slightly larger than those from Pikermi (*M. major erymanthius*) (Fig. 6). The dimensions of the lower M_1 and M_2 of *Microstonyx antiquus* from Montredon, given by GINSBURG (1988), are clearly smaller than those of *M. antiquus* from Eppelsheim and similar to those of *M. major*. One M_2 from four of Montredon is situated in the variation of *M. antiquus*.

CONCLUSIONS-BIOCHRONOLOGY

According to the above mentioned data the NKT suid is attributed to *Microstonyx major*. Additionally, the comparison of the NKT suid with that of *Microstonyx major* from various eurasian localities, allow some conclusions about the species.

- The upper cheek teeth of *Microstonyx major*, presents a great morphological variation, related probably to local ecological factors; the geographical expansion of the species consils the main part of the Europe, from Russia to Spain. Moreover, characteristics, referred as typical for *M. antiquus* are also present in *M. major* from NKT, Terrassa and Stratzing.

- The upper dentition of *Microstonyx major* decreases from late Vallesian to middle Turolian forms. This reduction is clear in the spanish and russian sample of *Microstonyx major*.

- The presence or absence of P^1, as well as its position between C and P^2 are variable and cannot be used for a subspecific distinction of *Microstonyx major*.

- The similar morphology of Stratzing and Terrassa skulls [stronghly elevated and narrow occiput, relatively short snout, orbit situated anteriorly, small diastema C-P^2 (<25 mm), stronghly concave skull profile, large upper canine] and their differences from the other skulls of *M. major* (Pikermi, Grebeniki, Taraklija, Tito Veles, M. Luberon, NKT) allow the inclusion of the material from both localities into a distinct group of *Microstonyx major*. Relations between *M. antiquus* and "Terrassa- Stratzing group" are evident. This group is present in late Vallesian (MN 10) of western Europe.

- The distinction between *M. major major* and *M. major erymanthius* is doubt. The morphology and the dimensions present a great variety and they

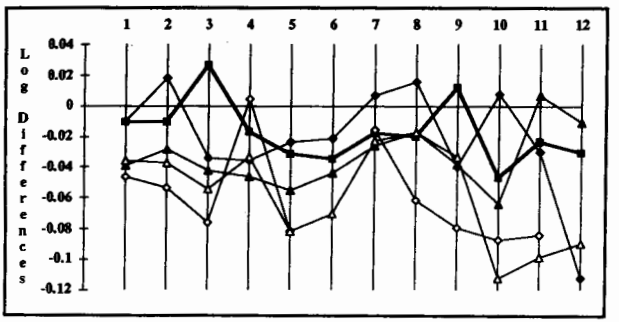

Fig. 5: Logarithmic ratio diagram, comparing the upper cheek teeth of *Microstonyx major* from NKT, Pikermi, Thessaloniki and Tito Veles (measurements from PEARSON, 1928; TROFIMOV, 1954 and GAREVSKI, 1956; for the numbers of the measurements see Fig. 3).

Σχ. 5: Διάγραμμα λογαριθμικών διαφορών στο οποίο συγκρίνονται οι διαστάσεις των δοντιών της άνω γνάθου του *M. major* από τη NKT , -ικέρμι, "εσσαλονίκη και Tito Veles (μετρήσεις από PEARSON, 1928; TROFIMOV, 1954 και GAREVSKI, 1956; οι αριθμοί των μετρήσεων όμοια με το Σχ. 3).

■ "Nikiti 1", NKT, Macedonia, Greece

▲ Pikermi, Greece

◇ Thessaloniki, Greece

△ Tito Veles, former Jugoslavia.

◆ Stratzing

cannot be used as certain criteria for a subspecific distinction. Size differences, observed between *M. major major* and *M. major erymanthius*, are not very far from those between males and females of recent Suinae (MADE, 1991; MADE et al., 1992). Morphological differences (like the development of the alveolar crests) could be also related to the sex of the individuals. The distinction of both forms as "geographical subspecies" (TROFIMOV, 1954; MADE, 1989-1990) seems to be also difficult. *Microstonyx major* from NKT and Grebeniki are closer to *M. major* from western Europe than to *M. major* from eastern Europe, while the material from Teral d' en Matias (Spain) is more similar to *M. major* from eastern Europe (MADE et al., 1992). A consideration of both forms as chronological subspecies seems to be more reliable. Thus *Microstonyx* from early Turolian localities is referred as *M. major major*, while *Microstonyx* from middle- late Turolian localities as *M. major erymanthius*. The transition from the first to the second form is characterized by a gradual reduction of the upper premolar row and by a decrease of the molars and the canines. The NKT suid seems to be closer to the early Turolian forms and could be referred as *Microstonyx major major*. *Microstonyx major* from Mont Luberon is morphologically and dimensionally similar to *M. major* from Pikermi (GAUDRY, 1873). The absence of alveolar crests in the skull specimen from Mont Luberon could be probably due to sexual dimorphism as it is already mentioned by GAUDRY (1873). Moreover, the locality of Mt. Luberon is dated to middle-late Turolian (MN 12 according MEIN, 1990). Thus, the inclusion of *M. major* from Mont Luberon to the chronological subspecies M. major erymanthius seems also to be possible.

The locality of NKT was initially dated between late Vallesian and early Turolian (KOUFOS et al., 1991); the presence of *Ouranopithecus macedoniensis* indicates a late Vallesian age, while the NKT *Tragoportax* is closer to that from the early Turolian localities of Axios Valley. The comparison of the NKT suid material with that from the various Eurasian localities shows that it is more similar to the early Turolian *Microstonyx major* (*Microstonyx major major*) from Crevillente-2 (Spain) and Grebeniki (Russia). Both localities have been dated to early Turolian (MN 11) (MEIN, 1990; MADE et

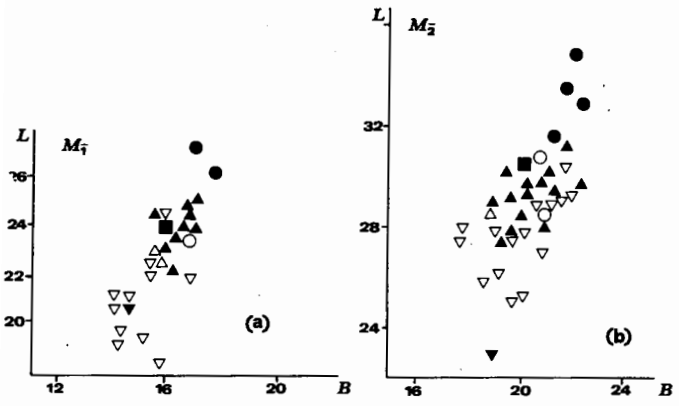

Fig. 6: Ratio diagram, comparing the lower molars of *Microstonyx*: a. M_1 and b. M_2 (according MADE et al., 1992; modified).

Σχ. 6: Διάγραμμα διασποράς στο οποίο συγκρίνονται οι διαστάσεις των γομφίων της κάτω γνάθου a. M1 και b. M2 (από MADE et al. 1992, τροποποιημένο)

● Microstonyx antiquus

Microstonyx major major

■ "Nikiti 1", NKT, Macedonia, Greece

○ Tito Veles, former Jugoslavia

▲ Spain

△ France

Microstonyx major erymanthius

▼ Spain

▽ Pikermi

al., 1992), indicating a similar age for the locality of NKT. This age also agrees with the presense of *Microstonyx* in the rest of the late Miocene localities of Macedonia. The genus is referred from the localities of Axios Valley (BONIS et al., 1992); it is present in the early Turolian (MN 11) localities of "Ravin de Zouaves-5", "Vathylakkos-2,3" and "Prochoma" as well as in the late Turolian (MN 12-MN 13) locality of "Dytiko-2", while it is absent in the late Vallesian localities of "Ravin de la Pluie" and "Ravin de Zouaves 1". Taking in account all these data, the age of *Microstonyx major* confirms the initialy proposed age of the locality. Since the rest of the material from NKT is on study, more data for the age will be provided in the near future.

Acknowledgements: Thanks are due to the community of Nikiti and to the Major of the village, Mr. M. Anagnostaras. I m also gratful to Prof. G. D. Koufos and Prof. S. Moya-Sola for reading the manuscripts and making usefull comments and ameliorations, as well as to Dr. G. Syrides for the illustrations.

REFERENCIES

ARAMBOURG, C. and PIVETEAU, J. (1926). Les vertébrés du Pontien de Salonique. *Ann. de Paléont.*, 18, 59-138.

BONIS, L., de-BOUVRAIN, G., GERAADS, D. and KOUFOS, G. (1992). Diversity and paleoecology of Greek Late Miocene mammalian faunas. Pal. Pal. Pal., 91, 99-121.

GAREVSKI, R. (1956). Neue Fundstellen der Pikermifauna in Mazedonien. *Acta Mus. Mac. Scient. Natur.*, 6, 4-35.

GAUDRY, A. (1862-67). Animaux fossiles et geologie de l' Attique, Savy, Paris, 1-472.

GAUDRY, A. (1873). Animaux fossiles du Mont Luberon. Paris.

GINSBURG, L. (1988). Contribution à l' étude du gisement Miocène supérieur de Montredon (Herault). Les grands mammifères. 4- Les artiodactyles

Suidae. *Palaeovertebrata, Montpellier, Mém extraordinaire 1988*, 57-64.
GOLPE POSSE, J., M. (1978). Presencia del género Microstonyx PILGRIM, 1926 en el Vallesiense superior de Terrassa. *Butll. Inf. Inst. Paleont. Sabadell*, 10, 28-33.
GOLPE POSSE, J., M. (1979). Contribution al estudio de la dentition maxillar de Microstonyx antiquus (KAUP, 1833). *Butll. Inf. Inst. Paleont. Sabadell*, 11, 20-24.
GOLPE POSSE, J., M. (1980 a). Notas sobre la dentition anterior de Microstonyx antiquus (KAUP, 1833). *Acta Geol. Hisp.*, 15, 109-111.
GOLPE POSSE, J., M. (1980 b). Le genre Microstonyx en Espagne et ses relations avec les autres espèce du même genre hors d' Espagne. *Palaeovertebrata Mém. Jubil R. Lavocat*, 213-231.
HÜNNERMANN, K. A. (1968). Die Suidae (Mammalia, Artiodactyla) aus den Dinotheriensanden (Unterpliozän=Pont) Rheinheissens (Südwestdeutschland). *Schweiz. Paläont. Abh. Mém. suisses Paléont.*, 86, 1-92.
KOUFOS, D. G. (1993). Mandible of Ouranopithecus macedoniensis (Hominidae, Primates) from a new late Miocene locality of Macedonia (Greece). *Amer. J. Phys. Anthr.*, 91, 225-234.
KOUFOS, D.G., SYRIDES, G., KOLIADIMOU, K. and KOSTOPOULOS, D. (1991). Un nouveau gisement de vertébrés avec hominoide dans le Miocene supérieur de Macèdoine (Grèce). *C. R. Acad. Sc. Paris*, 313, S. II, 691-696.
KOSTOPOULOS, D.S., KOLIADIMOU, K. K. and KOUFOS, D. G. (1994). The giraffids (Mammalia, Artiodactyla) from the late Miocene localities of Nikiti (Chalkidiki, Macedonia, Greece) in press.
MADE, J. van der (1989-1990). A range-chart for European Suidae and Tayassuidae. *Paleontologia i Evolucio*, 23, 99-104.
MADE, J. van der (1991). Sexual bimodality in some recent pig populations and application of the findings to the study of fossils. *Z. Säugertierkunde*, 56, 81-87.
MADE, J. van der and MOYA-SOLA, S. (1989). European Suinae (Artiodactyla) from the late Miocene onwards. *Bull. Soc. Pal. Ital.*, 28 (2-3), 329-339.
MADE, J., van der -MONTOYA, P. and ALCALA, L. (1992). Microstonyx (Suidae, Mammalia) from the upper Miocene of Spain. *Geobios*, 25 (3), 395-413.
MEIN, P. (1990). Updating of MN Zones. *In Europe Neogene Mammal Chronology, E.H. Lindsay et al. Ed.*, Plenum Press, N.Y. 1990.
MELENTIS, J. (1968). Die Pikermifauna von Halmyropotamos (Euboea-Griechenland). *Ann. g_ol. Pays Hell.*, 19, 283-411.
PEARSON, H.S. (1928). Chinese fossil Suidae. *Palaeont. Sin.*, C, 5, 1-75.
ROTH, J. and WAGNER, A. (1854). Die fossilen Knochen Überreste von Pikermi in Griechenland. *Abh. K. bayer. Akad. Wiss.*, 2 (7), 371-464.
SOLOUNIAS, N. (1981). The Turolian fauna from the island of Samos, Greece. *Contr. Vertebr. Evol.*, 6, 1-232.
THENIUS, E. (1955). Sus antiquus aus Ligniten von Shophades (Thessalien) und die Alterstellung der Fundsichten. *Ann Geol. Pays Hell.*, 6, 199-206.
THENIUS, E. (1972). Microstonyx antiquus aus dem alt Pliozän mittel Europas. Zur Taxonomie und Evolution der Suidae (Mammalia). *Ann. Naturhist. Mus. Wien*, 76, 539-586.
TROFIMOV, B. A. (1954). Les suidés fossiles du genre Microstonyx. *Trudy paleont. Ist. SSSR*, 47, 61-99.

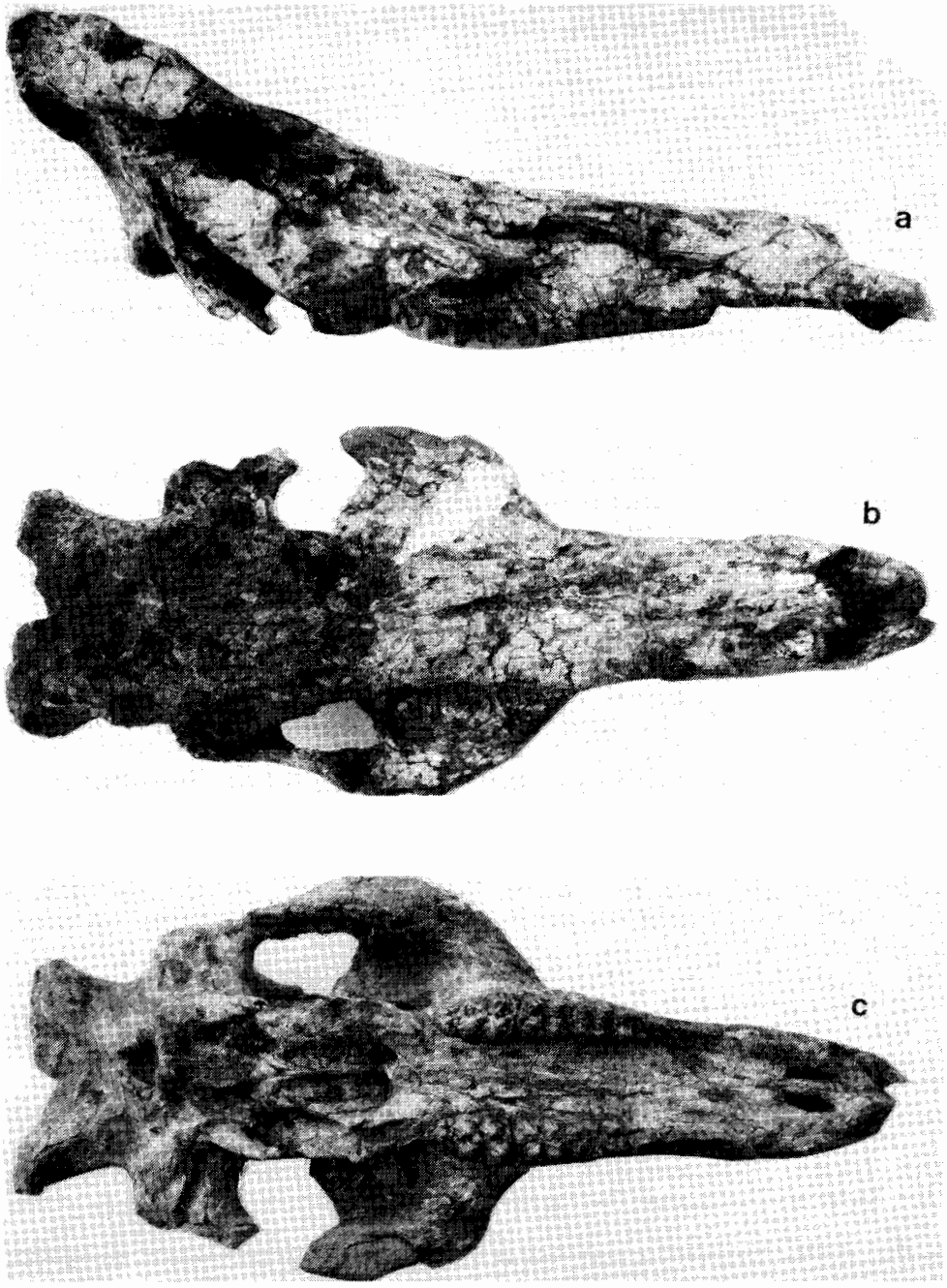

PLATE I
Microstonyx major, "Nikiti 1", Macedonia, Greece; NKT-68, skull;
Fig. a. lateral
Fig. b. dorsal
Fig. c. ventral view. 1/ 4 nat. size

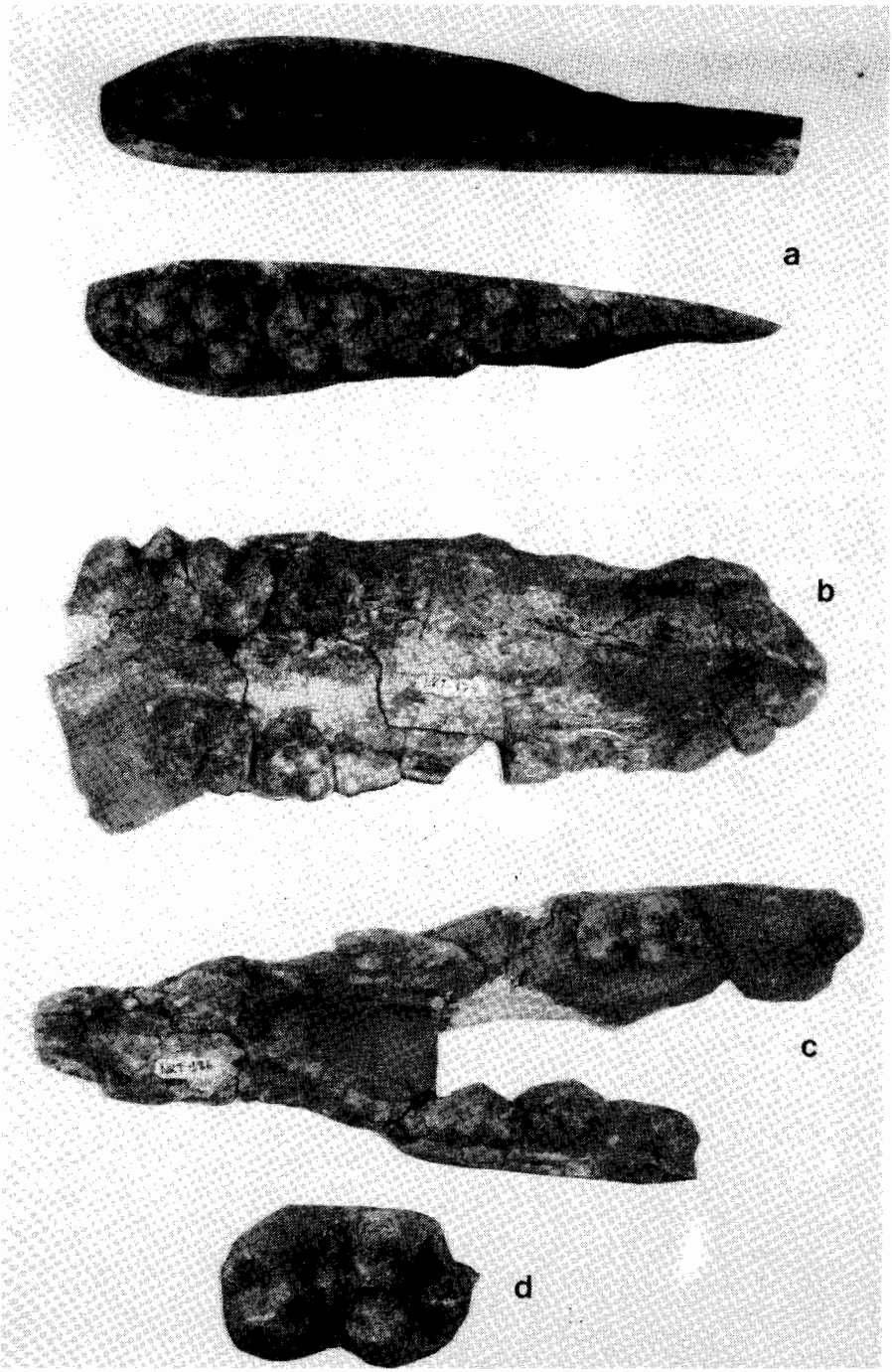

PLATE II

Fig. a. *Microstonyx major*, "Nikiti 1", Macedonia, Greece; NKT-68, right and left maxillar ramus with P^1- M^3; 1/ 2 nat. size.

Fig. b. *Microstonyx major*, "Nikiti 1", Macedonia, Greece; NKT-174, maxilla with D^2-M^1; 1/ 2 nat. size.

Fig. c. *Microstonyx major*, "Nikiti 1", Macedonia, Greece; NKT-126, part of mandible with dI_1-M_1 sin and M_2 dex; 1/ 2 nat. size.

Fig. d. *Microstonyx major*, "Nikiti 1", Macedonia, Greece; NKT-126, M_2 dex; nat. size.