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The presence of *Sus strozzii* in the Villafranchian (Villanyian) of Macedonia (Greece)

GEORGE D. KOUFOS, Thessaloniki*

With 5 figures and 3 tables

Kurzfassung: Die Fundstätte Gerakarou wurde 1978 in Mazedonien entdeckt. Das dort gesammelte Material enthielt den dieser Abhandlung zugrunde liegenden Suiden-Schädel, der sich nach seiner Form und seinen Dimensionen als *Sus strozzii* FORSYTH MAJOR bestimmen läßt. Er scheint mit den Suiden der Fundorte Olivola und oberes Valdarno übereinzustimmen, sich dagegen von *Sus minor*, dem anderen Suiden des Villafranchium, zu unterscheiden. Die Fundschicht unseres Schädels gehört dem oberen Villafranchium an. Da aus Griechenland bisher nur isolierte Einzelfunde von *Sus* cf. *strozzii* bekannt waren, erweitert der nun gesicherte Nachweis der Art die Kenntnis ihrer geographischen Verbreitung in Südeuropa.

Abstract: The locality of Gerakarou is a new Pleistocene one in Macedonia (Greece) found in 1978. Between the material recovered there is a suid skull, which is studied in this article. Its morphological characters and dimensions allow us to determine this as *Sus strozzii* FORSYTH MAJOR. It seems to be similar to the Upper Valdarno and Olivola suids and different from the other Villafranchian suid, *Sus minor*. Thus it is dated to Late Villafranchian (Villanyian). The certain presence of the species in Greece, where it was known only from some isolated specimens referred as *Sus* cf. *strozzii*, completes the knowledge of the geographic distribution of the species in Southern Europe.

Introduction

The well known Pleistocene mammal localities of Macedonia are few. However, a lot of isolated specimens, found by chance, are known from the Pleistocene deposits of the area. Some Villafranchian mammal localities are known from the Grevena area in western Macedonia (BRUNN 1956). In the Ptolemais-Florina basin some Pleistocene mammals are also found. The collection from both areas is not systematic and complete, but a lot of isolated specimens were found and described by various scientists. In eastern Macedonia the Villafranchian locality of Volax (SICKENBERG 1968) and the Late Pleistocene one of Aggitis (KOUFOS 1981) are referred. Both of them are situated in the northern part of the Drama basin. However, some isolated specimens were found in the southern part of the Drama basin (MARINOS 1965).

The best known Pleistocene mammal localities are situated in central Macedonia and more precisely in the Mygdonia basin. These are the Villafranchian locality of Krimni (SAKELLARIOU et al. 1979) and the Gerakarou one (ZAMANIS et al. 1980, KOUFOS-MELENTIS 1983). The skull of suid, which is studied in this article, comes from the Gerakarou locality. It is determined as *Sus strozzii* and its presence is interesting for Greece. In the Villafranchian (Villanyian) of Greece the species is doubtfully referred from some Aegean islands. In 1928 AIR-

*Address of the author: GEORGE D. KOUFOS, Aristotelian University of Thessaloniki, Department of Geology and Physical Geography, Thessaloniki 54006, Greece.

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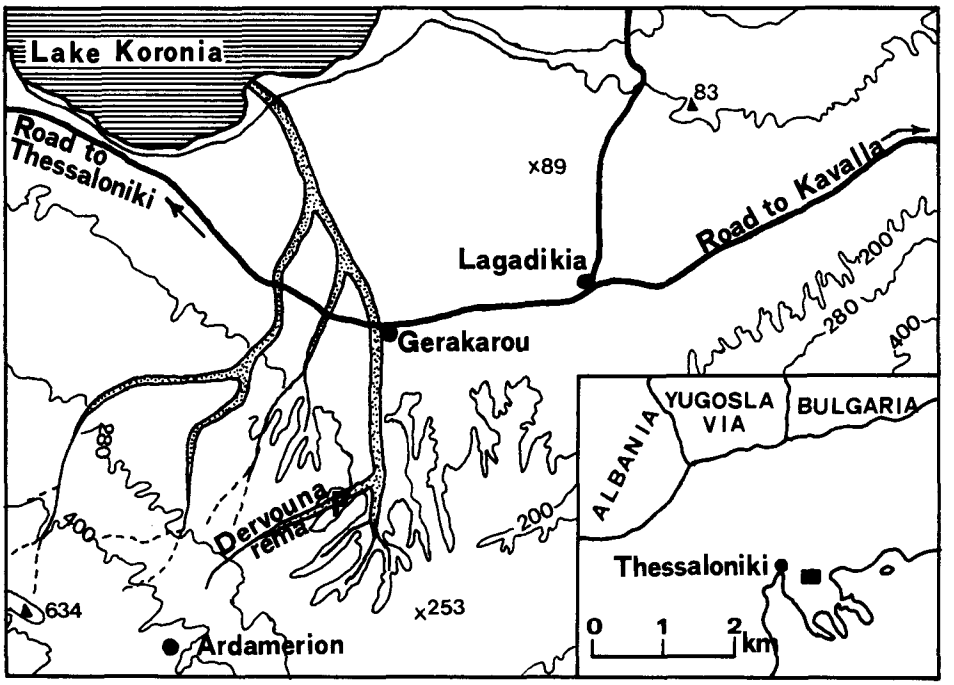

Fig. 1. Map indicating the position of the locality.

AGHI (in KOTSAKIS et al. 1980) describes from the island of Kos (Almiri, Antimachia, Cardamena) some suid remains as *Sus* cf. *strozzii*. In the island of Rhodes two different suid species are also found in the Damatria Formation and referred as *Sus* sp. Considering that Damatria is of Ruscinian age (DERMITZAKIS-SONDAAR 1979) these suids are older, may be belong to *Sus minor*. The presence of *Sus strozzii* in the Villafranchian locality of Gerakarou is the first certain appearence of the species in Greece and completes its geographic distribution in Europe. The species is well known in western Europe (France, Italy), and now its presence in Greece shows that it was homogeneous and well distributed in all southwestern Europe.

Locality

The Gerakarou locality was found in 1978 by some geologists, who worked in the area mapping the faults after the large earthquake of Thessaloniki. The locality is situated in the Mygdonia basin about 35 km east of Thessaloniki near the village of Gerakarou. More exactly it is situated 2 km southwest to the village in the Dervouna ravin (Fig. 1).

The Neogene/Quaternary deposits of the Mygdonia basin are divided into two groups, the Premygdonian and the Mygdonian one (PSILOVIKOS 1977). The first group is of fluvio-terrestrial origin and consists of conglomerates, sandstones, sand-silts and red-beds, dated to Late Miocene – Early Pleistocene. The other group is of fluvio-lacustrine origin and consists of gravels, sands, sand-silts, sands and alluvial deposits, dated to Pleistocene – Holocene.

The fossils are into the upper part of the red-beds of the Premygdonian group and were uncovered by the erosion, found now in the banks of the river. The material collected first gave the following fauna (ZAMANIS et al. 1980):

Cervidé de la taille de *Cervus philisi*
Bovidé de la taille de *Procamptoceras brivatense*
Gazella sp.
Gazellospira sp.
Equus cf. *stenonis*
Mimomys sp.
Hyaenidé ind.

Later a better collection gave the following fauna with certain species (KOUFOS-MELENTIS 1983):

Canis etruscus s. l.
Equus stenonis senezensis
Sus sp.
Croizetoceros ramosus cf. *minor*
Eucladoceros senezensis senezensis
Cervus cf. *philisi*
Gazella sp.
Gazellospira sp.

The collection of new material from the Gerakarou locality allow us to determine the Gerakarou canid as *Canis arnensis* and the Gerakarou gazella as *Gazella borbonica* (KOUFOS in prep., KOUFOS 1986).

The above mentioned fauna allow us to date the locality. The presence of *Equus stenonis*, which is similar to the Sénèze one indicates a Late Villafranchian age. The species *Eucladoceros* and *Croizetoceros* are similar to those of Sénèze confirming the above age. The age of the Gerakarou locality is also confirmed by the Krimni locality, situated in the upper part of the redbeds of the Premygdonian group too. The species *Equus stenonis* and *Dicerorhinus etruscus* found in the locality of Krimni dated it to Late Villafranchian (SAKELLARIOU et al. 1979).

Systematics

Order: Artiodactyla OWEN 1848
Suborder: Suiformes JAECKEL 1911
Family: Suidae GRAY 1821
Genus: *Sus* LINNAEUS 1758

Sus strozzii FORSYTH MAJOR (ex MENEGHINI), 1881

Material: Skull, GER-51.
Locality: Gerakarou, Macedonia, Greece.
Horizon: Late Villafranchian or Late Villanyian (Early Pleistocene).
Diagnosis: Large size, narrow and elongated palate; nasals separated by a prominence of the bones across them; elongated and parallel toothseries; last two molars with well developed and high talon; all the molars with two lobes.

Description

1. Skull

The studied skull is not well preserved and a great part of it is broken. It is laterally compressed and the nasals, as well as, all the posterior part of the skull are broken. The maxilla with both toothseries is well preserved.

The palate is narrow and along its midline there is a crest. The toothseries are more or less parallel and only the third molars show a slight curving lingually. The width of the palate between the middle of the teeth is:

P^2	P^3	P^4	M^1	M^2	M^3
33.4	34.0	31.7	35.0	35.0	30.0

The anterior border of the choane is situated far behind the posterior border of M^3 and the distance P^1 – anterior border of the choane, measured across midline, is 145 mm. The orbits are broken but the right one is preserved better. They are rounded and their borders are not projected. The anterior border of the orbits is enough behind the posterior end of M^3. The anteroposterior diameter of the orbit is about 46 mm. The nasals are broken but there are some remains of the posterior part. They are separated by a prominence of the bone along them. The supraorbital groove is well developed, narrow and forms an angle with the toothseries axis. Its hinder margin is situated above the posterior border of M^3. The parietal region is flat and slightly inclined anteriorly. The skull dimensions are given in the Table 1.

Tab. 1. *Sus strozzii.* Skull dimensions; estimated values into brackets.

	GER-51
1. Distance anterior border of the orbit-anterior border of P^1	177
2. Distance anterior border of choane-anterior border of P^1	145
3. Width of palate in the middle of M^3	30
4. Interorbital width	(90)
5. Width at posterior ends of the orbits	(115)
6. Anteroposterior diameter of the orbit	46
7. Premolar length	50.1
8. Molar length	79.5
9. Toothseries length	130

2. Upper cheek teeth

The upper cheek teeth are well preserved, worn and the right P^1, P^2 and P^3 are absent. The enamel of the teeth is thick (1–2 mm).

P^1 is double rooted, elongated and narrow. There is a central cusp and two smaller cusps, which are situated anteriorly and posteriorly of the main. P^2 and P^3 are similar to P^1 but larger. A protocone and a hypocone begin to develope in both of them. P^4 is larger and especially wider than the other premolars. The occlusal surface of P^4 is more or less rounded. The external surface of the premolars is more or less flat without any remarkable projection.

The molars consist of two lobes which are separated labially and lingually by a clear and deep groove. Each lobe consists of two main cusps a labial and a lingual one. The main cusps are situated side by side and along the axis of the tooth. Between the main cusps there are other accessory ones of various size.

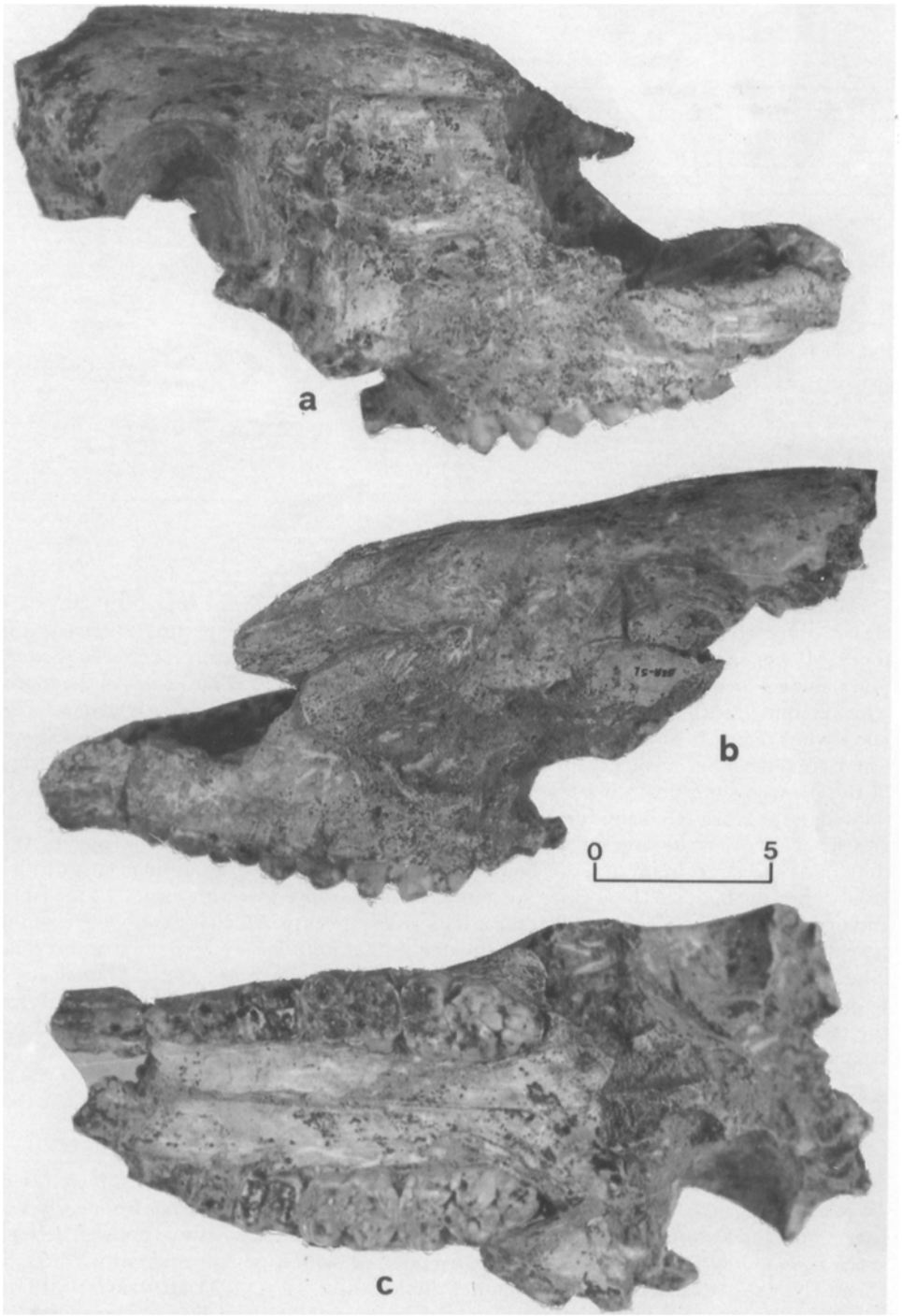

Fig. 2. *Sus strozzii*, Gerakarou, Macedonia, Greece, GER-51; a: right lateral view, b: left lateral view, c: ventral view; 1/2 nat. size.

Tab. 2. *Sus strozzii.* Upper cheek teeth dimensions; measurements after HÜNERMANN (1968).

Upper cheek teeth		GER-51			
		Length	Width anterior	Width posterior	Width talon
P^1	dex	–	–	–	–
	sin	11.3	–	5.7	–
P^2	dex	–	–	–	–
	sin	13.5	–	9.7	–
P^3	dex	–	–	–	–
	sin	12.7	–	11.5	–
P^4	dex	12.8	–	15.7	–
	sin	13.2	–	15.2	–
M^1	dex	17.8	17.5	17.2	–
	sin	18.2	17.3	17.1	–
M^2	dex	26.0	21.1	22.6	–
	sin	26.5	21.5	22.3	–
M^3	dex	37.4	24.8	21.8	15.0
	sin	37.1	24.4	22.6	15.3

M^1 is very worn and its morphology is disappeared, although the four main cusps are clearly observed and there are enamel remains as small islets on the occlusal surface of the tooth. M^2 is enough larger than M^1. In the labial and lingual groove formed between the two lobes, there is an accessory cusp. A large accessory cusp is situated in the center of the tooth, which is jointed with the hypocone in the advanced wearing stages. There is a well developed talon which consists of a large central cusp, situated between the paracone and metacone. There are some other smaller cusps in the talon situated in both sides of the main one. In front of the paracone and protocone there is a series of small accessory cusps. These cusps are jointed in the worn teeth and formed a transverse crest which is connected to the paracone and metacone. M^3 is the largest tooth and consists of three lobes. The four main cusps are well developed and large. In the anterior border of the tooth there is a series of small cusps with a large one in the middle. These cusps are jointed in the advanced wearing stages. In the labial and lingual groove between the lobes there is an accessory cusp, which is developed from the base of the tooth. Another large cusp is situated in the center between the first and second lobe. The talon is well developed and forms the third lobe. It consists of a series of small cusps with a large one in the middle. The last cusp is situated behind the large cusp which is between the second and third lobe. Five small cusps can be distinguished in the talon which are arranged in a curved line.

Discussion

The Villafranchian known suids of Europe are few and their taxonomy is still confused. Two certain species are referred from the Villafranchian of Europe, *Sus minor* from Early Villafranchian and *Sus strozzii* from Late Villafranchian. Nevertheless other two not well defined species, *Sus provincialis* and *Sus arvernensis,* are referred from Ruscinian and Early Villafranchian. These species are considered as »nomen dubium« (AZZAROLI 1975, HÜNERMANN 1971). *Sus minor* is considered as the direct ancestor of *Sus strozzii* (SCHAUB 1943, AZZAROLI 1975).

Sus strozzii is well known from Upper Valdarno and Olivola (Italy) and from Sénèze (France). The material from Italy is rich, well preserved and described by AZZAROLI (1954).

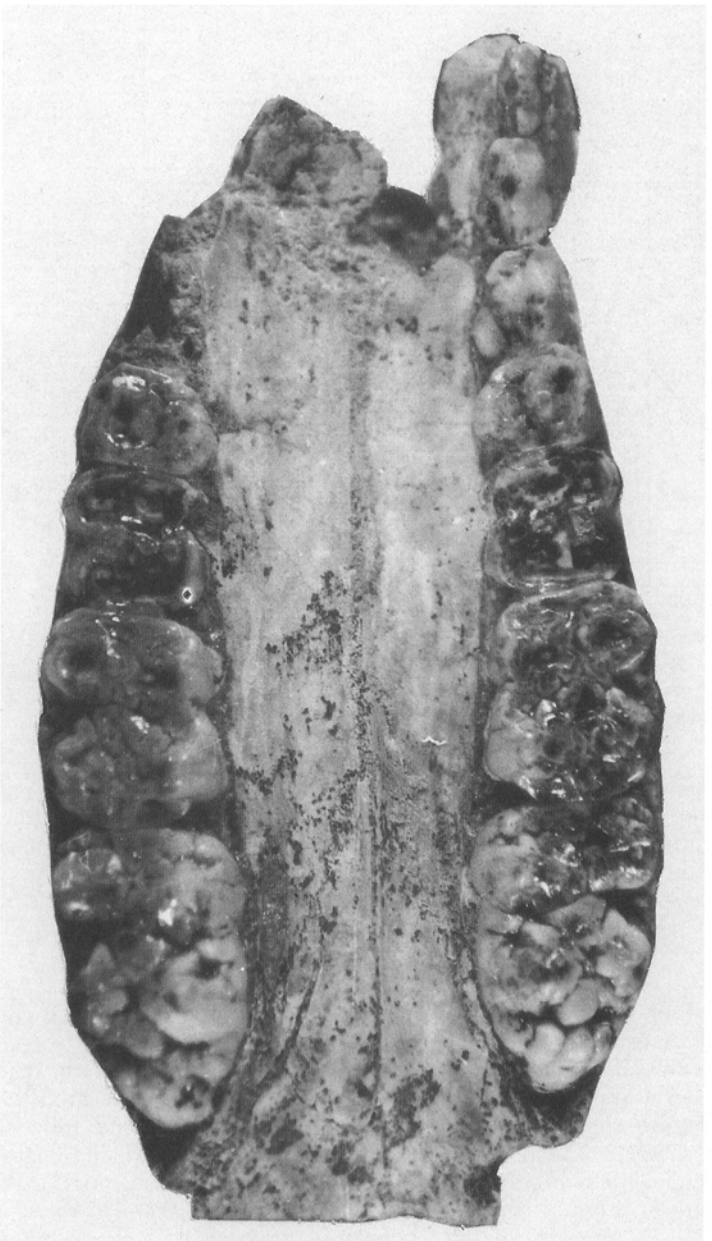

Fig. 3. *Sus strozzii,* Gerakarou, Macedonia, Greece, GER-51. Occlusal view of the toothseries; nat. size.

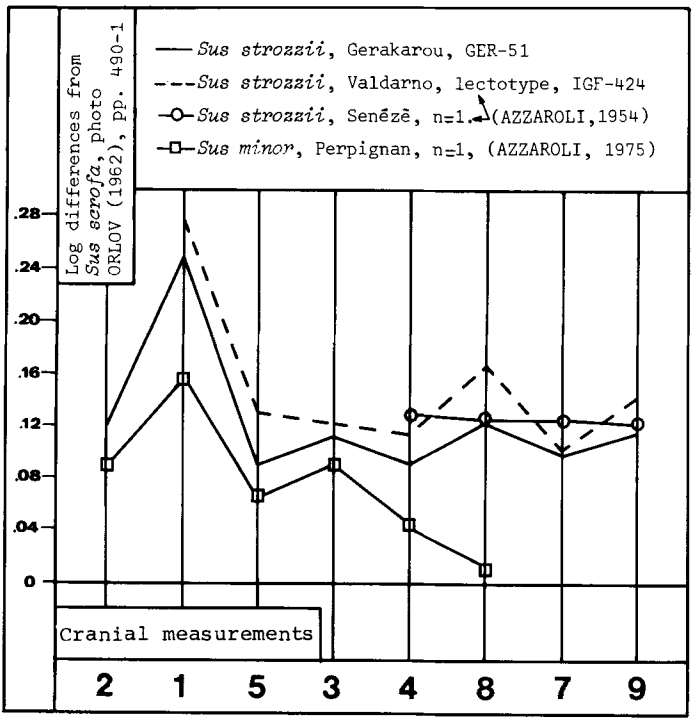

Fig. 4. Ratio diagram comparing the skulls of *Sus strozzii* and *Sus minor.*

The last author gives the following main characteristics of the skull and teeth. The parietal region is slightly inclined to the skull axis. The nasals are distinguished by a prominence of the bones along them. The orbits are flat and the muzzle is longer than that of *Sus minor.* The cheek teeth are characterized by thick and low plicated enamel. The molars are more evolved than those of *Sus minor.* They have well developed and high talon especially the last two. This morphology of the skull and teeth fits with that of the Gerakarou suid.

A metrical comparison of the Gerakarou skull with the lectotype of *Sus strozzii,* as well as, with *Sus strozzii* from Sénèze is given in Fig. 4.

There are no significant differences from the material of Sénèze and the opinion that the Gerakarou fauna is similar to that of Sénèze is confirmed (KOUFOS-MELENTIS 1983). The Gerakarou suid is also similar to the lectotype of *Sus strozzii* which comes from Valdarno. The lines for the two specimens are parallel. There is only one difference in the length of the molar series (measurement 8 in Fig. 4), which is longer in the Valdarno material. This difference is clear in the indices of Tab. 3. The indices A and B are more or less similar especially for the Gerakarou and Sénèze form. The index C is similar for Sénèze and Gerakarou but it is smaller in the Valdarno material and this is due to the elongated molar series.

The other Villafranchian suid is *Sus minor,* which is smaller and more primitive than *Sus strozzii.* The muzzle is shorter and the orbits are more flat than those of *Sus strozzii.*

The skull of *Sus minor* is more or less similar to that of *Sus strozzii* but it is enough smaller (Fig. 4) and it seems as a reduced copy of *Sus strozzii.* Nevertheless there are two significant differences. The first one is that the skull of *Sus minor* is narrower at the orbits (measurement 4 in

Tab. 3. *Sus strozzii.* Indices of the upper cheek teeth.

	A	B	C
Gerakarou	38.5	61	63
Sénèze	40	60	67
Valdarno IGF-424 (lectotype)	(37)	(64)	57
IGF-421	(36)	64	55

$$\text{Index A} = \frac{\text{Length } P^1 - P^4}{\text{Length } P^1 - M^3} \times 100 \quad \text{Index B} = \frac{\text{Length } M^1 - M^3}{\text{Length } P^1 - M^3} \times 100 \quad \text{Index C} = \frac{\text{Length } P^1 - P^4}{\text{Length } M^1 - M^3} \times 100$$

Fig. 4) and the second is that the molar series (measurement 8 in Fig. 4) of *Sus minor* is remarkably smaller than that of *Sus strozzii.* These two differences as well as the small size of *Sus minor* distinguish it well from *Sus strozzii.* The skull of the Gerakarou suid is close to the suids of Valdarno and Sénèze and must be considered as *Sus strozzii.*

The teeth of the Gerakarou suid have some more evolved characteristics than *Sus minor.* The last molars of *Sus strozzii* have a high talon which is an evolved character. The comparison

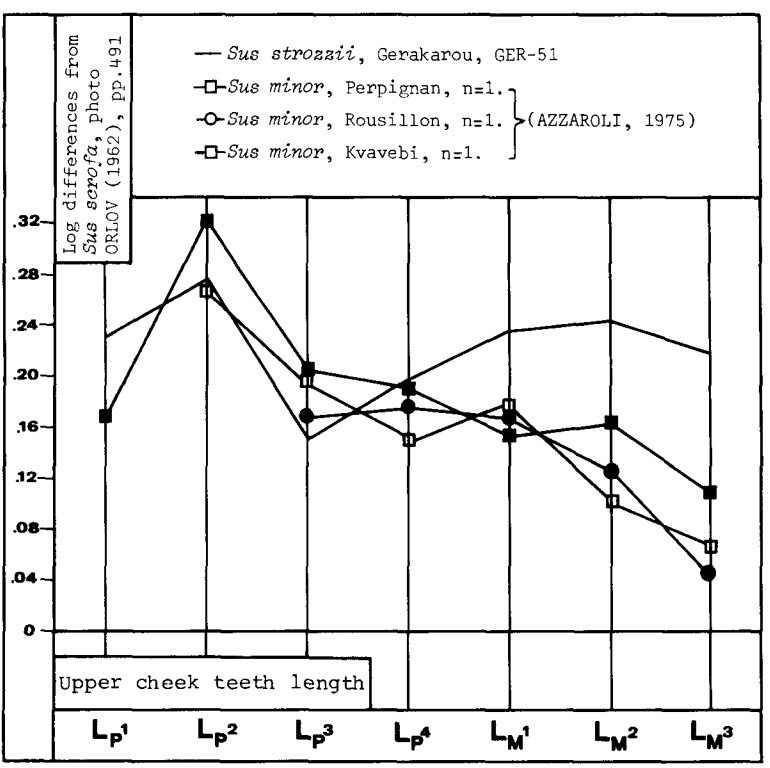

Fig. 5. Ratio diagram comparing the upper cheek teeth of *Sus strozzii* and *Sus minor.*

of the teeth of *Sus strozzii* from Gerakarou with *Sus minor* is given in the logarithmic ratio diagram of Fig. 5. The premolars of two species have more or less similar dimensions and they cannot be used for distinction. Nevertheless the molars of *Sus minor* are remarkably smaller than those of *Sus strozzii.* Especially the third molar of *Sus minor* is very small, compared to that of *Sus strozzii.* The small length of the molars of *Sus minor* can easily distinguish it from *Sus strozzii.*

The Gerakarou skull is also compared with the skull of *Sus scrofa,* which is used as standard (Fig. 4, 5). The comparison is based in the study of the skulls of recent pigs (*Sus scrofa domestica*) as well as in the skull of *Sus scrofa* given by ORLOV (1962, Fig. 460, 461, pp. 490, 491). The skull studied is generally larger and higher than that of *Sus scrofa* with wider frontal region. The angle formed between the muzzle and the posterior part of the skull is smaller in *Sus strozzii.* The prominence across the nasals, which separates them, is not observed clearly in *Sus scrofa,* although there is a shallow canal in both sides of the nasals. These canals begin from about the anterior border of the orbits and they are disappeared at about the middle of the nasals. The palate of *Sus strozzii* is longer and wider than that of *Sus scrofa,* although the width of the palate is not so long as the length. The crest across the palate of *Sus scrofa* is slightly developed, while it is well developed and prominent in *Sus strozzii.* The length of the teeth of *Sus scrofa* is smaller than both Villafranchian suids, although the length of M^3 of *Sus minor* and *Sus scrofa* are more or less similar (Fig. 5).

The morphological characters and the dimensions of the skull studied as well as its comparison with other similar species show that it belongs to *Sus strozzii.*

Age

As it is mentioned above two certain suid species are referred from the Villafranchian of Europe, the Early Villafranchian *Sus minor* and the Late Villafranchian *Sus strozzii.* The last species was found in Upper Valdarno and Olivola and both localities have been dated to Late Villafranchian (AZZAROLI 1967). It is also referred from Sénèze, another typical Late Villafranchian locality. The similarities of Gerakarou skull to those of Upper Valdarno, Olivola and Sénèze allow us to suppose a similar age for this skull.

Nevertheless the other faunal data gives a similar age for the locality. The equid *Equus stenonis* and the cervids *Eucladoceros* and *Croizetoceros* are similar to those of Sénèze, while the wolf *Canis arnensis* is similar to that of Upper Valdarno and Olivola (KOUFOS-MELENTIS 1983). All these data indicate a Late Villafranchian age. After this interpretation the Gerakarou *Sus strozzii* must be considered as Late Villafranchian. The species was well distributed in all southwestern Europe at that period and its certain appearence in Greece completes the geographic distribution of the species.

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