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THE MOLAR OF AN ARCHIDISKODON FROM AKDOĞAN

MUZAFFER ŞENYÜREK, Ph. D.

Professor Ordinarius and Chairman of the Division of Palaeoanthropology
University of Ankara

In a preliminary report on the remains of fossil elephants, belonging to both *Archidiskodon* and *Elephas*, found in Anatolia, I had briefly referred to a broken molar from the neighborhood of the village of Akdoğan.[1] The results of my study on this molar tooth are reported in the present study. The other remains mentioned in my preliminary report[2] will be taken up at a later date.

Archidiskodon from Akdoğan, represented by a broken upper left third molar, was found in the lower part of the cutting beside the Ankara-Kızılcahamam highway about 150 meters to the north of the Primary School of the village of Akdoğan, which is situated about nine kilometers to the south-east of the district center of Kızılcahamam in the Province of Ankara. In the lower section of this cutting, on the western side of the highway, a stratum of clay with sand and tuff is exposed, which is covered on top by a layer of consolidated conglomerate (see fig. 1).[3] The fragments of this tooth were first collected by Dr. Oğuz Erol and then by me, in 1957, when I con-

[1] Şenyürek, 1960. In this connection see also Erol, 1961, p. 81.
[2] Şenyürek, 1960, pp. 697-698.
[3] *Ibid.*, 1960, p. 696.

ducted excavations in the neighborhood of Akdoğan.[4] I have been able to restore the largest part of this fossil tooth (see figs. 3-4).

In this molar from Akdoğan the worn masticatory surface is slightly convex in the antero-posterior direction (fig. 3) and the anterior surfaces of the enamel figures are usually convex toward the front (fig. 4), indicating that the specimen is a maxillary tooth. The worn chewing surface of the crown slopes toward the lingual side in the region of the moderately worn middle plates and toward the buccal side in the region of the more heavily worn anterior plates. The buccal side of the crown, in occlusal view, is noticeably convex (fig. 4), the part of this side behind the seventh plate from the front retreating more rapidly. The lingual side is partly damaged, but from the preserved lingual extremities of some of the plates it would appear that this side, in occlusal view, was roughly straight. The intact anterior buccal root is only slightly curved backward, in lateral view (fig. 3), and supports the first and the second enamel plates. Then, after an interval, come two more slenderer roots, which are unfused. It is apparent that these two roots, the tip portions of

[4] As I mentioned before (Şenyürek, 1960, p. 696) the fossiliferous beds in the neighborhood of the villages of Akdoğan and Üçbaş were discovered by Dr. Oğuz Erol, Docent of Physical Geography and Geology in the University of Ankara, in 1957. Upon being notified by Dr. Erol of this discovery, I conducted excavations at a place, called Kaypak by the villagers, about 200 meters to the East of the village school of Akdoğan in the summer of 1957. During this sojourn at Akdoğan I picked up more fragments of the *Archidiskodon* tooth in the cutting beside the highway, some being at the time still in the matrix of clay with sand and tuff.

In the excavation at Kaypak (see fig. 2), consisting of several layers of yellowish clay, containing some tuff, and interbedded with bands of gravel, I found some teeth of a form approaching *Nyctereutes megamastoides* (Pomel), somewhat larger than those of the known specimens of this species, remains of some antelopes, turtles, and in the uppermost part of the series of layers of clay a lower P_2 of a *Hipparion sp.* I am still studying the fauna of these beds at Kaypak which are somewhat earlier in date than those of the cutting beside the highway where the molar of *Archidiskodon* was found. These beds of Kaypak, including *Hipparion sp.*, appear to date from either the beginning of the Pleistocene (the Lower Villafranchian) or the end of Pliocene. As my study on the fossil remains from this locus is still in progress, it is not possible for me at the time of this writing to give a more exact date. In this connection I wish to extend my thanks to Dr. Oğuz Erol for notifying me of this fossiliferous region and also to the Faculty of Languages, History and Geography of the University of Ankara, for grants that have enabled me to conduct excavations in this region in 1957, 1958 and 1959.

which are broken, exceeded the anterior one in height. The roots behind these are broken. In this last upper molar from Akdoğan the transverse valleys between the plates as well as the intact buccal surface are well covered with cement. In the lateral view (fig. 3), the worn enamel plates still stand distinctly beyond the cement filling the valleys, in which this specimen approaches the molars of *Archidiskodon planifrons* (Falconer and Cautley).[5] The buccal and lingual sides of the enamel plates, in anterior or posterior view, are seen to be convex, the basal parts of these being slightly wider than the apical parts. The valleys between the enamel plates, in lateral view, are observed to be V-shaped, with the apex pointing in the direction of the roots, but are considerably narrower than those of the upper molars of *Archidiskodon planifrons* from the Siwalik Hills depicted by Falconer and Cautley,[6] Osborn[7] and Hooijer.[8]

Ten enamel plates are preserved in the restored fragment, together with the anterior wall of the bed of the ll th plate. It appears probable that there were at least twelve plates in this tooth, which, if this is the number of plates, would place it at the upper limit of the maxillary last molars of *Archidiskodon planifrons* (Falconer and Cautley) and in the range of variation of those of *Archidiskodon meridionalis* (Nesti), the ranges of which given by Vaufrey are respectively 8-12 and 11-15 plates.[9]

[5] See Hooijer, 1953 [b], p. 196; Falconer and Cautley, 1846, pls. 11-12; Osborn, 1942, figs. 831-845; Hooijer, 1958, pl. 32, fig. 1, pl. 34, figs. 3-4 and pl. 35, figs. 1-2.

[6] See Falconer and Cautley, 1846, pl. 2, fig. 5 a.

[7] See Osborn, 1942, figs. 827, 828, and 855, C and D.

[8] See Hooijer, 1956, pl. I, fig. 4.

[9] Vaufrey, 1958, pp. 262 and 265. The characteristic number of plates in the upper last molars of *Archidiskodon planifrons* are given as 8—10 by Depéret and Mayet (1923, p. 100), 9—10 by Hopwood (1935, p. 88) and as 10 by Osborn (1942, p. 950). However, the list of Osborn, based upon Falconer and Cautley's material, which he gives under the heading of "Typical Archidiskodon planifrons: M3 $\frac{10+}{11+}$, Ascending to Typical A. meridionalis: M3 $\frac{13—14"}{11—14}$, as well as his lists based on the specimens collected by Barnum Brown, clearly show that in the Siwalik series the number of plates in this species may run up to 12, plus the talons, thus overlapping the range of *Archidiskodon meridionalis* (see Osborn, 1942, pp. 949, 954 and 955).

The enamel of the plates is crimped, that is folded, but there are no jagged and irregular enamel projections toward the transverse valleys between the plates, as occurs in the lower last molar of *Archidiskodon meridionalis* from Sivrihisar, shown in fig. 5. The enamel is thick (3.8-6.0 mm.), with, taking all preserved plates into account, an average thickness of about 5.0 mm. In the upper last molar of *Archidiskodon planifrons* (Falconer and Cautley) from the Tatrot zone of the Siwalik Hills the thickness of enamel is given by Hooijer as 5—7 mm.,[10] while that of the upper second and third molars of *Archidiskodon cf. planifrons* from Bethlehem is 5-6 mm.[11] The thickness of enamel in M^3 of *Archidiskodon cf. planifrons* from Shansi, in China, is given by Hopwood as 3.5—4.0 mm.,[12] which, as already noted by this author, is thinner than that of the specimens of this species from the Siwalik Hills,[13] as well as being thinner than that of the Bethlehem form. As for *Archidiskodon meridionalis* (Nesti) Soergel gives the thickness of enamel in two upper third molars from Val d'Arno in Italy as 3.0 mm.[14] The thickness of enamel in a fragment of M^3 from the Schelde Estuary in Holland, described as *A. meridionalis* (Nesti) or *A. planifrons* (Falconer and Cautley) by Hooijer, is also 3 mm.,[15] which aligns this specimen with *Archidiskodon meridionalis* (Nesti). The specimen from Akdoğan, in the thickness of enamel, thus comes nearer to *Archidiskodon planifrons* (Falconer and Cautley), which possesses thick enamel,[16] than to *Archidiskodon meridionalis* (Nesti) in which the enamel appears to be thinner.

In the anterior part of the masticatory surface the strongly worn plates are wider, in antero-posterior direction, than the valleys between them, but toward the posterior end, where the plates are less worn, this difference diminishes. In the anterior half of the preserved

[10] See Hooijer, 1956, pp. 115-116.

[11] See Hooijer, 1958, pp. 273-274.

[12] See Hopwood, 1935, p. 89.

[13] See *ibid.*, p. 90.

[14] See Soergel, 1913, Table VIII.

[15] See Hooijer, 1953 [b], p. 193. In this connection it may also be recorded that the average thickness of enamel in a last lower molar of *Archidiskodon meridionalis* (Nesti) from Sivrihisar is 3.0 mm., while in a lower second molar of this species from Sarayköy it is 3.7 mm.

[16] See Hooijer, 1956, p. 116.

tooth, the plates extend in a transversal direction, while plates 6-7 are, in occlusal view, seen to incline in mesio-lingual direction, the lingual extremity being in advance of the buccal end. The same also appears, from its general direction, to be true for plate 8.

The first plate, from the front, is heavily worn, only the buccal and lingual parts of its posterior wall remaining, which is open in the middle. These remaining ridges of enamel continue into the corresponding parts of the anterior wall of the second plate, which is confluent with the first one in the middle. An intermediate pillar of enamel blocks the external extremity of the buccal remnant of the transverse valley between the first and second plates (fig. 4). There are no other intermediate pillars in the preserved parts of the other transverse valleys. Plates 3 to 7 form single, continuous enamel figures from side to side, which also appears to be the case in the 8 th plate, the lingual extremity of which is broken. The preserved parts of the 9 th and 10 th plates consist of two independent, that is yet unfused, enamel figures, an elliptical buccal one and part of a more central one which is, in both cases, wider antero-posteriorly than the external figure. The transverse diameter of the external figure, in both cases, is longer than its antero-posterior diameter.

A distinct projection in the form of a loop is observed at the distal surfaces of plates 6 and 8. A smaller loop also occurs at the distal part of the more central figure of plate 9 and at the posterior wall of plate 5. Faint traces of a posterior loop are also discerned in the more strongly worn 4 th and 3 rd plates. An anterior projection of the 4 th plate comes quite close to the remnant of the posterior loop of the third plate, but still does not touch it. On the other hand, the anterior wall of the third plate and the posterior wall of the second plate, with the more advanced wear, have already come into contact at a corresponding place.

A posterior loop to the enamel figures is a characteristic of the molars of *Archidiskodon planifrons* (Falconer and Cautley), in some of which it is conspicuously developed,[17] and those of *Archidiskodon celebensis* Hooijer[18] and of the form named *Elephas africanavus* Aram-

[17] See Hooijer, 1953 [b], p. 196; Hooijer, 1956, p. 116; Hooijer, 1958, p. 272 and Pl. 32, fig. 2; Falconer and Cautley, 1846, Pl. 11, figs. 1 and 5 and Pl. 12, figs. 5 a and 8 a; Hopwood, 1935, Pl. VIII, fig. 1.

[18] See Hooijer, 1953 [a], p. 312 and Pl. 31.

bourg.[19] Regarding this feature Hooijer states. "*As Schlesinger (1912, pp. 101, 106) writes, these median posterior expansions do not appear in typical* A. meridionalis."[20] However, in a lower molar of *Archidiskodon meridionalis* of archaic type from Italy, depicted by Depéret and Mayet, small posterior projections are still present.[21] Thus while the Anatolian specimen agrees, in the presence of posterior loops, in general with *Archidiskodon planifrons*, it also may not differ from some primitive examples of *Archidiskodon meridionalis* (Nesti) in this feature.

In this last upper molar from Akdoğan the laminar frequency, that is the number of plates occurring in 10 centimeters, which was first used by Pavlow,[22] is $4\frac{1}{2}$ on the average. The ranges of the laminar frequencies of the upper last molars of *Archidiskodon planifrons* (Falconer and Cautley) and *Archidiskodon meridionalis* (Nesti) are given respectively as 3.5—5 and 4.5—6 by Vaufrey.[23] Thus this figure of $4\frac{1}{2}$, which corresponds to Depéret and Mayet's archaic mutation,[24] would place the specimen from Akdoğan in the range of variation of *Archidiskodon planifrons* (Falconer and Cautley) and at the lower limit of *Archidiskodon meridionalis* (Nesti).

In *Archidiskodon cf. planifrons* from Bethlehem, in Israel, the laminar frequency is $3—3\frac{1}{2}$ in the upper second molar and 4 in the upper third molar,[25] while in the last molar of *Archidiskodon planifrons* from the Tatrot zone of the Siwalik Hills it is just short of four plates in 10 centimeters.[26] The figure for the upper last molar of *Archidiskodon cf. planifrons* from Shansi in China is given as 3.25—3.4 by Hopwood.[27] These forms are thus more primitive in this respect than the

[19] See Arambourg, 1952, fig. 2. It must however be stated here that this North African form, as has been pointed out by Hooijer, belongs to an *Archidiskodon* (see Hooijer 1956, pp. 112 and 117 and 1958, p. 278).

[20] Hooijer, 1953 [a], p. 313.

[21] See Depéret and Mayet, 1923, fig. 25.

[22] See Pavlow, 1910, p. 54. In this connection see also Vaufrey, 1929, p. 56.

[23] See Vaufrey, 1958, pp. 262 and 265.

[24] See Depéret and Mayet, 1923, p. 157.

[25] See Hooijer, 1958, pp. 273-274. In an upper third molar of a form from Omo in East Africa, labelled as *Elephas (Archidiskodon)* cf. *planifrons* Falc. by Arambourg, the laminar frequency is also given as four (see Arambourg, 1947, pp. 270-271).

[26] See Hooijer, 1956, pp. 116.

[27] See Hopwood, 1935, p. 89.

specimen from Akdoğan. In their now classical study, Depéret and Mayet have taken a laminar frequency of $3\frac{1}{2}-4$ as characteristic of *Archidiskodon planifrons*, referring those with higher figures to *Archidiskodon meridionalis*.[28] According to Hopwood,[29] Teilhard de Chardin and Trassaert[30] and Hooijer[31] the norm for *Archidiskodon planifrons* is a laminar frequency of 3—4, but still, Hooijer, citing the figures of Osborn,[32] points out that the figure may run up to $5\frac{1}{2}$ or 6 plates.[33] It is evident that the laminar frequency of the last upper molars of *Archidiskodon planifrons* from the Siwalik Hills is remarkably variable and that a figure of $4\frac{1}{2}$ does not distinguish the specimen from Akdoğan from this species as well as the primitive stage of *Archidiskodon meridionalis*, unless the arbitrary limit of a laminar frequency of 4 is taken as the dividing line as is done by some writers.

The measurements of the specimen from Akdoğan are as follows:

Length (along the middle)	224 + mm.
Maximum width (plates 4 and 6)	83.5 mm.
Height of the crown (Plate VIII)	71 + mm.
Height of the anterior root (buccal side)	72 mm.

The actual length of the specimen is 224 + mm., but allowing at least two more plates at the back the length would be, judging by the dimensions of posterior plates, about 256 mm., which would place it in the range of variation of both *Archidiskodon planifrons*[34] and *Archidiskodon meridionalis*.[35] In the specimen from Akdoğan the cement on the lingual side has peeled off, but calculating from the average

[28] See Depéret and Mayet, 1923, pp. 123, 135 and 157.

[29] See Hopwood, 1935, p. 88.

[30] Teilhard de Chardin and Trassaert, 1937, p. 43.

[31] Hooijer, 1954, p. 105; Hooijer, 1955, p. 102.

[32] See Osborn, 1942, p. 954.

[33] See Hooijer, 1955, p. 102.

[34] According to the figures given by Schlesinger the range for the length of upper last molars of *Archdiskodon planifrons* from the Siwaliks is 247-280 mm. (see Schlesinger, 1913, table 1). The range given by Hooijer is 201-279 (see Hooijer, 1956, table 2), which is given as (201) 225-279 by Vaufrey (1958, p. 262).

[35] According to the figures given by Schlesinger, after Weithofer, the range for the length of upper last molars of *Archidiskodon meridionalis* is 245-310 mm. (see Schlesinger, 1913, table 2), while Vaufrey gives the range as 230-310 mm. (see Vaufrey, 1958, p. 265).

thickness of cement on the intact buccal side the maximum width of the crown is 83.5 mm., which probably is slightly inferior to the minimum of *Archidiskodon planifrons* from the Siwalik Hills[36] and in the range of *Archidiskodon meridionalis* (Nesti).[37] The length/width ratio of the specimen from Akdoğan is 3.06. The ranges for the length/width ratios of the upper last molars of *Archidiskodon planifrons* and *Archidiskodon meridionalis* are given as respectively (219) 2.30-2.93 and 2.40-2.74 by Vaufrey.[38] However, the range for the upper last molars of *Archidiskodon meridionalis* calculated from the figures given by Schlesinger, after Weithofer, is 2.26-3.10, a range that includes that of the specimen from Akdoğan.[39] The crown index (width × 100/length) of the specimen from Akdoğan is 32.61. The range for the crown indices of the upper last molars of *Archidiskodon planifrons* from the Siwaliks is given as 34—47 by Hooijer,[40] while the range for the upper third molars of *Archidiskodon meridionalis* (Nesti) calculated from the figures given by Schlesinger, after Weithofer,[41] is 32.25-44.23. The crown index of the upper last molar of *Archidiskodon meridionalis* from Bargone, calculated from the figures given by Depéret and Mayet (252 × 75 mm.)[42] is 29.76, that is even lower.

It is thus apparent that in its relatively narrow width the specimen from Akdoğan agrees with some specimens of *Archidiskodon meridionalis* (Nesti) and is relatively narrower than those of *Archidiskodon planifrons* (Falconer and Cautley).

[36] The range for the widths of the upper last molars of *Archidiskodon planifrons* (Falconer and Cautley) are given as 88 (89) - 114 by Vaufrey (1958, p. 262) and 63-123 by Hooijer (1956, table 2). However, the minimum figure (63) given by Hooijer is after Osborn which is based on the posterior part of a damaged molar with a length of only 135 mm. (see Osborn, 1942, p. 949), figured by Falconer and Cautley (see Falconer and Cautley, 1846, Pl. XI, fig. 4). In view of this, the width given may be narrower than the actual one (see the other figures given by Osborn, 1942, pp. 949, 954 and 955).

[37] According to the figures given by Schlesinger, after Weithofer, the range for the widths of the upper last molars of *Archidiskodon meridionalis* is 100-122 (see Schlesinger, 1913, table 2), while according to Vaufrey (1958, p. 265) it is 75-122.

[38] Vaufrey, 1958, pp. 262 and 265.

[39] See Schlesinger, 1913, table 2.

[40] See Hooijer, 1956, table 2.

[41] Schlesinger, 1913, table 2.

[42] Depéret and Mayet, 1923, p. 141.

The maximum measured height of the crown (71 + mm.) is lower than the maximum width (83.5 mm.) yielding a height-width index (height × 100/width) of 85.02. However, as the eighth plate is already worn, it is evident that originally the absolute as well as the relative height of this tooth was somewhat higher than this figure. As the tooth is worn this height-width index is not of much comparative value, as in order to be comparable the teeth must be fresh or in the same stage of wear, but still it is evident that this upper last molar from Akdoğan was relatively low-crowned, that is rather primitive.

The available maximum height of the crown (71 + mm.) is near the height of the anterior root (72 mm.). From this it is evident that in this specimen from Akdoğan the height of the crown was, in the fresh state, greater than that of the anterior root. Regarding this relation in the molars of archidiskodonts Hooijer states: "*Schlesinger (1912, p. 103) has pointed out that in* A. meridionalis *the crown of the molars not only is higher than that in* A. planifrons, *but that it is also higher relative to the height of the root. While in* A. planifrons *the molar crown is about as high as the root, in* A. meridionalis *the root occupies less than one-third of the total height of the tooth.*" [43] It would appear that in this feature, that is in having a crown that is somewhat higher than the root, the upper last molar from Akdoğan comes nearer to *Archidiskodon meridionalis* (Nesti) than to *Archidiskodon planifrons* (Falconer and Cautley).

The account given above shows that the upper last molar of *Archidiskodon* from Akdoğan agrees with that of *Archidiskodon planifrons* (Falconer and Cautley) in some of its characters, with *Archidiskodon meridionalis* (Nesti) in some and falls in the ranges of variation of both species in others. It thus appears that this specimen from Akdoğan is, on the whole, intermediate between those of *Archidiskodon planifrons* and *Archidiskodon meridionalis*. However, while it is in general on the borderline between the two species still its relatively narrow width and the crown that was, in fresh state, higher than the anterior root appear to point more toward *Archidiskodon meridionalis* (Nesti) and to a primitive stage of this species. A laminar frequency of $4\ \frac{1}{2}$, which is just above the arbitrary limit accepted as the dividing line between

[43] Hooijer, 1953 [a], p. 313.

the two species by some writers, suggests that this specimen from Akdoğan may represent a form of the archaic type of *Archidiskodon meridionalis* (Nesti),[44] which would explain the retention of the primitive features, which are characteristic of *Archidiskodon planifrons*.

The late Schreuder attributed *Archidiskodon planifrons* (Falconer and Cautley), from Asia and Europe,[45] to the Lower Villafranchian stage and the more advanced species *Archidiskodon meridionalis* (Nesti) to the Tegelian or the Upper Villafranchian stage.[46] In a more recent paper Kretzoi also equates *Archidiskodon planifrons* with an earlier horizon in the Calabrian stage than *Archidiskodon meridionalis*.[47] In North Africa also the form designated as *Elephas africanavus*, which according to Hooijer is affiliated with *Archidiskodon planifrons*,[48] antedates a form labelled as *Elephas aff. meridionalis* Nesti, which is equated by Arambourg with the Upper Villafranchian.[49] In view of the above, although a single specimen is not enough for a certain dating, still the primitive morphology of the specimen from Akdoğan suggests that it may belong to the very beginning of the Upper Villafranchian stage.

[44] Regarding the archaic form, or archaic mutation of *Archidiskodon meridionalis*, Depéret and Mayet (1923, p. 135) state "Forme archaïque *avec couronne basse (hauteur moyenne d'une lame médiane moyennement usée: 60 à 75 millimètres) et* fréquence laminaire *d'environ 4,5 pour 10 centimètres de couronne. Cette forme est une mutation de passage à l'E.* planifrons." See also Depéret and Mayet, 1923, p. 157.

[45] As is known primitive archidiskodont remains from a number of European localities have been referred to *Archidiskodon planifrons* by various writers (see Pavlow, 1910, Schlesinger, 1913, Mayet and Roman, 1923, Depéret and Mayet, 1923, Pontier, 1925, Osborn, 1942, Schreuder, 1944 and Vaufrey, 1958), but while at least some of these determinations appear to be justified there still exists some divergencies of opinion (see Stehlin, 1923, and Schaub, 1948). For this see also Hooijer, 1953 [b], p. 197; Hooijer, 1958, p. 279.

[46] See Schreuder, 1944, p. 54 and the table; Schreuder, 1945, p. 197.

In this connection I wish to express my thanks to Dr. D. A. Hooijer of Leiden for kindly supplying me with these papers of the late Miss Schreuder.

[47] Kretzoi, 1954, pp. 262-263.

[48] See Hooijer, 1956, pp. 112 and 117; Hooijer, 1958, p. 278.

[49] Arambourg, 1952, p. 417. See also Hooijer, 1953 [b], p. 197.

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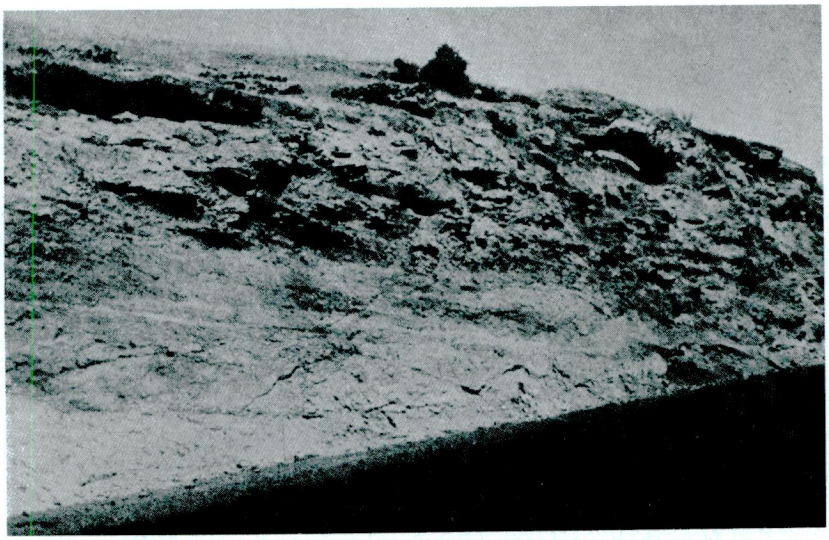

Fig. 1. The cutting beside the Ankara - Kızılcahamam highway, where the tooth of *Archidiskodon* was found.

Fig. 2. A view of Kaypak. On top an ancient filled - in valley is seen.

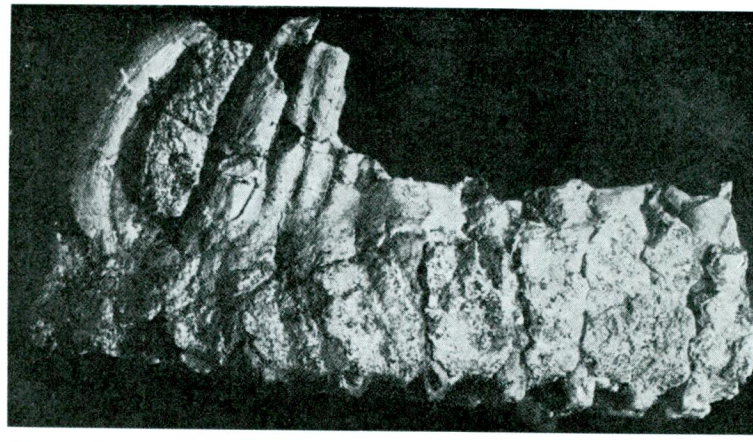

Fig. 3. The upper left last molar of *Archidiskodon* from Akdoğan, seen from the buccal side. Slightly more than $\frac{2}{5}$ natural size.

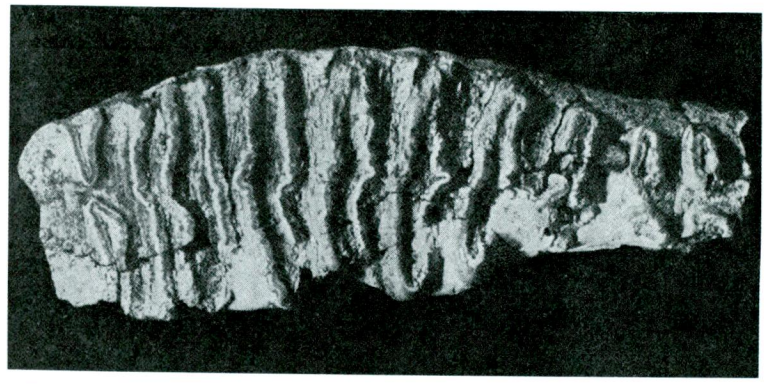

Fig. 4. The upper left last molar of *Archidiskodon* from Akdoğan, in occlusal view. Slightly more than $\frac{2}{5}$ natural size.

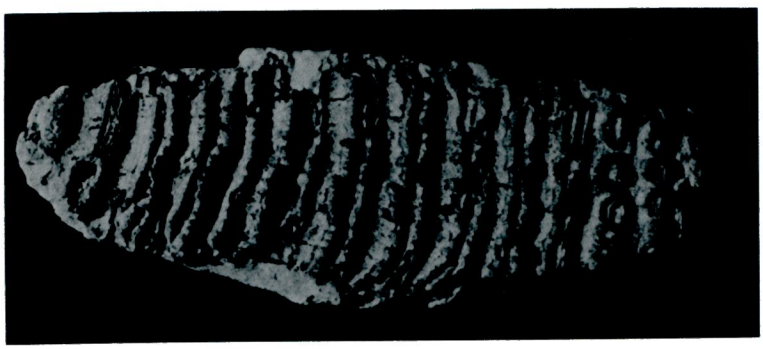

Fig. 5. The lower right last molar of *Archidiskodon meridionalis* (Nesti) from Sivrihisar, in occlusal view. Slightly more than $\frac{1}{3}$ natural size.