FOSSIL FEATHERS FROM THE MIOCENE ROCKS OF PASİNLER BASIN (EASTERN ANATOLIA)

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ABSTRACT. — Fossil impressions of 3 contour feathers and a down feather from thin-bedded greenish marly beds of Yastıktepe Formation of Pasinler basin, Eastern Anatolia, are described. Implication of this discovery on the geological history of the region is also discussed.

INTRODUCTION

During 1965 summer, when the author was engaged in the detailed mapping (on 1:25,000 scale) of Pasinler basin for Petrol Servisi, M.T.A. Enstitüsü, Ankara, the author encountered nicely preserved fossils of plants, feathers, fish, mollusca, insects and other arthropods from Miocene rocks in the southern parts of the Pasinler basin. With the kind permission of Dr. S. Alpan, General Director, and Dr. C. Erentöz and Dr. Z. Ternek of Jeoloji Şubesi, the author was able to take part of the samples of this fauna to Panjab University, Lahore, for personal studies. Part of the material was sent to Paleontology section of M.T.A. Enstitüsü as sample no. 127 (Rathur, 1965—Erzurum-Pasinler area). This present paper is one of a series describing the excellent fauna of this area. The material of the present study is deposited in the collection of the Geology Department, Panjab University, Lahore, Pakistan (Dep. R 52-R 55).

GEOLOGY

Pasinler basin is situated east and southeast of Erzurum in Eastern Anatolia and consists of Tertiary sediments (see Fig. 1—Location map and Fig. 2—Geological map of Pasinler basin). It is separated from Erzurum basin; in the west by the Palandoken Dağı, Yıldırım Dağı, and Kargapazarı Dağı and from Tekman basin in the south by Topcu Dağı, Nalbant Dağı and Saktutan Dağı.

These mountain rises consist of Mesozoic-Paleogene ophiolitic series. Sedimentation in Lower Tertiary is mainly marine, whereas Upper Tertiary sediments are continental in nature. During Mio-Pliocene period and intermittent with sedimentation, there occurred extensive volcanic activity in the basin resulting in the widespread deposits of basalts, andesites, tuffs, agglomerates, etc. Earlier eruptions (? Miocene) are mostly andesitic in nature and more extensive than the upper volcanic (? Pliocene), which are mostly basaltic. These basaltic rocks occasionally show flow structures. In the west, the Pasinler basin is a flat plane and consists of Quaternary sediments - alluvium and terrace deposits.

Information regarding geology of Pasinler basin appears in many publications (Rathur, 1966; Altınlı, 1966, pt. I, pt. II; Kurtman &-Akkuş, 1971; Irrlitz, 1972), but is of a very broad and generalized nature, except Rathur (1966) and more recently Irrlitz (1972). Kurtman and Akkuş consider Pasinler basin as part of their Erzurum basin, whereas Irrlitz (1972) regards Pasinler basin as a separate

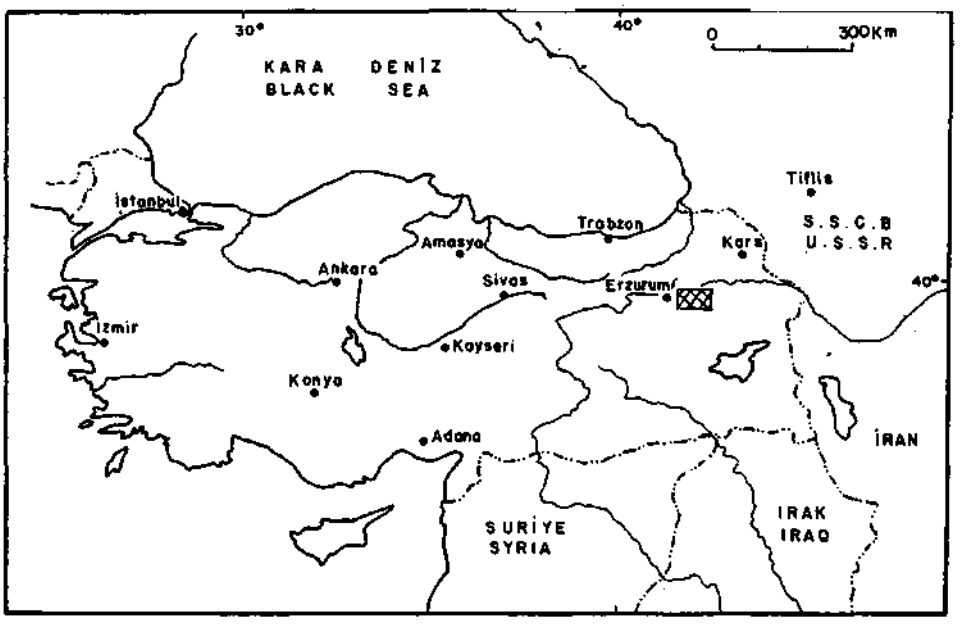

Fig. 1 - Location map.

geological entity. Author fully agrees with Irrlitz, who has described detailed lithostratigraphy and tectonics of Pasinler basin. For the purpose of this publication, the author has used the stratigraphical names of different formations as in his report (1966). Figure 3 shows the co-relation of Rathur (1966), Kurtman and Akkuş (1971) and Irrlitz (1972).

Most of the fauna was obtained from Yastıktepe Formation of Miocene age, and was confined to southern margin of the Pasinler basin. Similar fossils of plants, fish, insects, feathers, arthropods, etc. were found by Sıtkı İlker (1966) and T. Erdoğan (1966) from Tekman basin. Yastıktepe Formation extends in an east-west direction forming foothills of Pasinler basin. Yastıktepe Formation mostly consists of red, pink, and dark brown sandstones and conglomerates with some light green and olive-green sandy marls. Near the base, some thin, yellow-cream-colored, compact limestones also occur. The formation is unfossiliferous except for some basal limestones and finely banded greenish marls (locally referred to as «Paper Shales»). Most of the material presented here was obtained from these greenish marls as exposed near Avnik village (1:25,000 scale topographic sheet Erzurum i-47-b_3) on the southern margin of Pasinler basin. Figure 4 shows a sketch of the geology of this area. Fossils are rarely exposed on the surface because of the fragile nature of thin-bedded marls resulting in the disintegration of these rocks on exposure. These marls can be easily split by pocket knife, thus exposing the fauna on these thin bands.

DESCRIPTIONS

Plate I shows the fossil feathers preserved in Yastıktepe formation of Miocene age. Fig. 1 to 4 of Plate I represent contour feathers whereas fig. 5 and 6 represent two magnifications of a single down feather.

Fig. 1 and 4 show two different magnifications of a contour feather. Fig. 1, which is two-thirds actual size, shows the contour feather with other arthropod fauna, whereas fig. 4 shows the same feather enlarged to X 4. Preservation is incomplete and calamus appears to have been replaced by clay particles. Portion of rhachis which is fossilized appears to be thin and slightly curved. Barbs lie close to

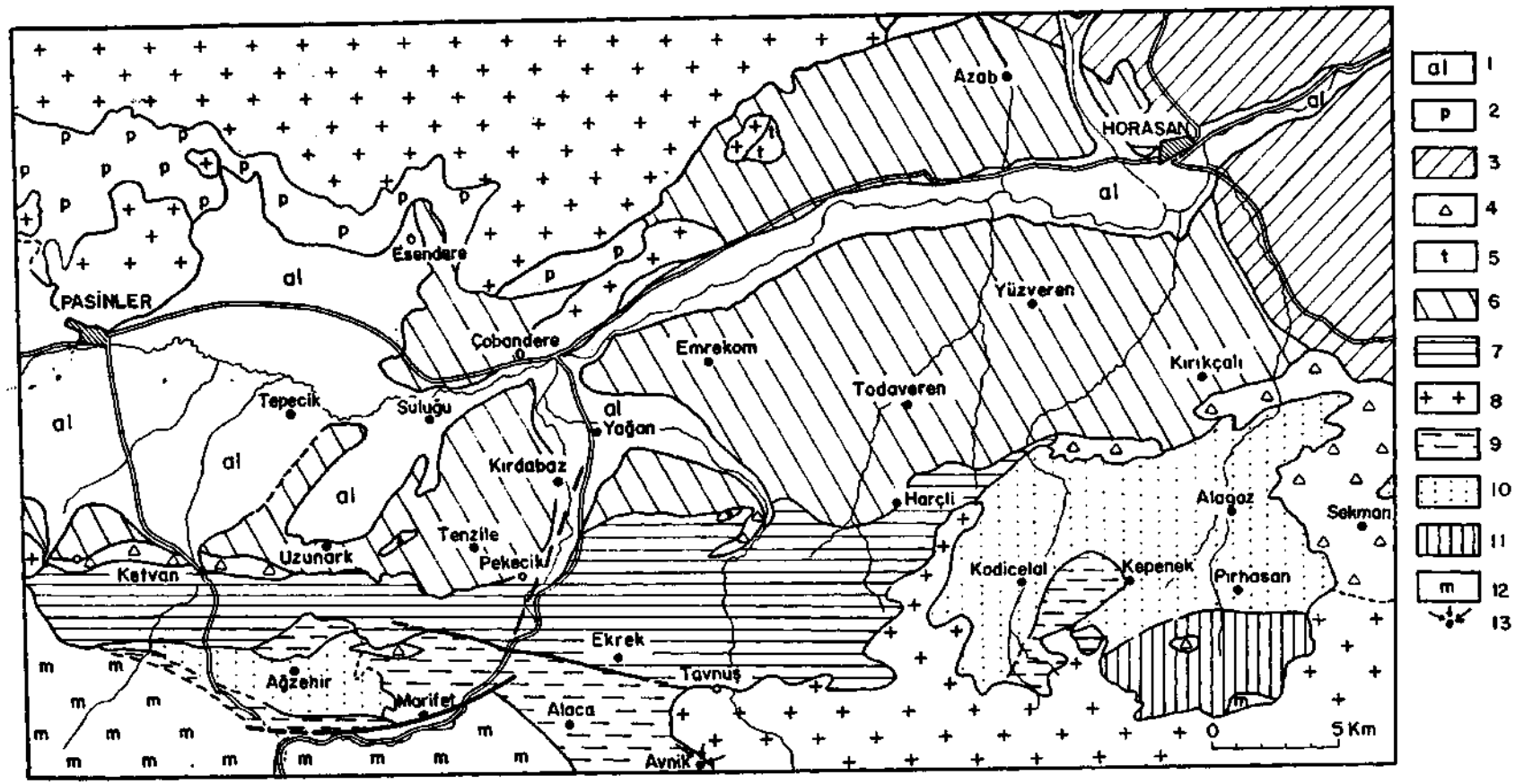

Fig. 2 - Geological map of Pasinler basin.

1 - Alluvium *(Re.)*; 2 - Pasinler Sr. *(Mio-Pliocene)*; 3 - Up. Horasan Fm. *(Mio-Pliocene)*; 4 - Up. Volcanic Sr. *(Mio-Pliocene)*; 5 - Tuffs & calc. tuff. *(Mio-Pliocene)*; 6 - Lr. Horasan Fm. *(Mio-Pliocene)*; 7 - Up. Yastıktepe Fm. *(Mio-Pliocene)*; 8 - Lr. Volcanic Sr. *(Mio-Pliocene)*; 9 - Lr. Yastıktepe Fm. *(Mio-Pliocene)*; 10 - Molasses *(Ol.)*; 11 - Gökçeharman Fm. (Flysch) *(Eo.)*; 12 - Ophiolitic Sr. *(M.)* 13 - Fossil locality.

(Modified from Rathur, 1966, and Irrlitz, 1972.)

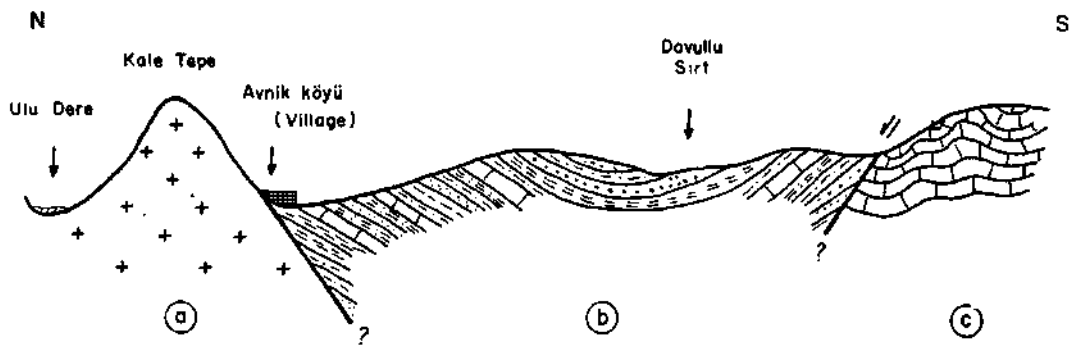

Fig. 4 - Sketch showing geology near Avnik village (1:25,000 sheet Erzurum i-47-b_3).
a - Mostly dark-colored volcanic rocks; b - Greenish, grayish fossiliferous marls with some thin limestone bands, reddish sandstones and conglomerate beds; c - white, cream-colored, crystalline, fossiliferous limestone.

each other, forming both inner and outer vanes, and are elongate, filamentous, symmetrical structures on each side of rhachis. On the outer vane, these barbs or rarni appear to cross one another, as if their cohesion has been destroyed by damage to their microscopic elements (such as barbules, booklets, flanges, etc.). These barbs become progressively short towards the apex. The barbs are slightly curved upwards and outwards from the rhachis and the angle of divergence from the rhachis is approximately 25°-30°. Details of microscopic structures such as barbules, hooklets, nodes, etc. are not discernible because of the nature of fossilization. Length of rhachis of this feather is approximately 10 mm and greatest width is 3 mm; maximum length of barbs is approximately 6 mm, and average width of barb about 0.05 to 0.10 mm.

Plate I, fig. 2, represents a more complete fossil of contour feather than in fig. 1 and 4. In this specimen calamus is not preserved but rhachis is well-developed, strongly curved and moderately long (32 mm) and shows more or less constant width (0.15 mm). Barbs consist of a network of elongate, filamentous, cohesive structures, showing symmetry of inner and outer vanes except on the inner vane where distal margins of these barbs have been destroyed due to rock particles erosion. These barbs show shortening in length near apex. Barbs are slightly curved upwards and outwards and diverge from the rhachis at angle of 25°. Occassionally barbs show loss of cohesion due to damage to their microscopic elements. Maximum length of these barbs is 10 mm and width varies from 0.05 mm to 0.10 mm. Microscopic structures could not be observed in this specimen because of the preservation.

Plate I, fig. 3 shows an incomplete feather but better preservation than other specimens. Structure of calamus end is lost, probably due to erosion of rock particles from this area. Rhachis is well developed, slightly curved, and tapering . The incomplete rhachis has a length of 13 mm with a width near calamus of 0.25 mm and 0.15mm towards apical side. Maximum width of the feather is about 8.0 mm. Barbs are elongate, filamentous, cohesive and symmetrical in nature but their cohesion is broken both in outer and inner vanes, probably due to the destruction of their microstructures. Barbs are slightly curved upwards and outwards and diverge from the rhachis at an angle of approximately 30°. Length of barbs is up to 10 mm and width varies from 0.05 mm to 0.12 mm. Except for occassional barbules, no other microstructures are visible in this specimen.

Plate I, fig. 5 and 6 represent two different magnifications of a single specimen of down feather with moderately developed calamus and fluffy barbs. These barbs appear to radiate upwards and outwards from the calamus and do not show any cohesion as seen in contour feathers. Width of the calamus is 0.25 mm and maximum length of barbs is 7.0 mm.

RATHUR (1966)

Age	Formation	Thickness (m)	Lithology
QTY	Alluvium		Gravel, silt, clays.
PLIOCENE	Horasan fm.	+ 850	Alternating brown, yellow, green sst., congl., marls, clays. Also shelly bands.
MIO-PLIOCENE	Up. volcanic	+ 250	Black, medium-fine basalt, also flow-struct.
	? Lr. Horasan	+ 500	Light gray, green tuffs; sst.; congl.; marls with occas. plant fossils.
	Lr. volcanic	+ 500	Light, med.-fine andesites.
MIOCENE	Yastıktepe fm.	+ 800	Red, pink, dk. brown sst., congl.; with green and olive sandy marls; rarely fossilif.
OLIGO-CENE	Çığılgan fm.	+ 500	Gypsiferous marls; ssts.; congl.; cream-yellow lsts.
EOCENE	Gökçeharman fm.	+ 750	Mostly dk.-light green ssts.; marls; congl. (flysch-type sediments).
MESO-ZOIC	Ophiolitic sr.	?	Green rocks; - cherts, serpentines; basic, ultrabasic rocks.

KURTMAN & AKKUŞ (1971)

Age	Formation	Thickness (m)	Lithology
QTY	Alluvium		
PLIOCENE		400	Basalt.
		1500	Alternation of congl.; sst.; shales; volcanics.
		100	Basalt.
MIOCENE		+ 1500	Alternation of shale; gypsum; congl.; lmst.
			Basal part salt.
		500	Shale Gypsum Lmst.
OLIGO-CENE		1000	Ssts. and shales (? molasse).
EOCENE		1200	Cong.; sst.; shales; laterally passing into dol. lmst. (? flysch).
MESO-ZOIC		?	Green rocks; basic; ultrabasic; cherts.

IRRLITZ (1972)

Age	Formation	Thickness (m)	Lithology
QTY	Alluvium		Terraces; silt, clay.
PLIOCENE	Pasinler fm.	> 300	Gray, loose, poorly-sorted congl. with tuffites.
	Horasan fm.	?	Dk. brown, orange, red, loosely consolidated fine sst.; marls, congl. with some mollusk beds.
	Up. volcanic	?	Tuffs; ? basalt.
	Emrekom/ Pekecik fm.	?	Congl.; green-grayish, brown-red marls, sst. with some fine sst. Also calc. marl with coal.
MIOCENE	Lr. volcanic		? Andesites.
	Marine Miocene	?	Neritic lst.; coarse clastics, intertonguing with reddish congl. and abundant marine fauna at places.
OLIGO-CENE	Molasse	? 800	Gray, green, reddish marls; sst. and coarse clastics with some calc. sst.
EOCENE	Flysch	> 500	Thin marls with thick-bedded sst. unfossiliferous. Basal part with Mesozoic ultrabasic rocks.
MESO-ZOIC		?	Basic, ultrabasic rocks, cherts.

Fig. 3 - Stratigraphical columns of Pasinler Basin.

(Not to scale.)

DISCUSSION

The presence of rhachis and strongly cohesive barbs in Plate I, fig. 1-4 show these specimens to be contour feathers. Slight curvature of the rhachis suggests an original pliability. Chandler (1916) has shown the significance of the microstructures of feathers in their taxonomy. In spite of the excellent preservation of present specimens, these cannot be placed in any taxonomic group because of the lack of microscopic structures of barbs or barbules. Comparison with modern fauna was also prohibitive on these grounds. Brodkorb (1963, 1964, 1967, 1971) considers the feather impressions as unsatisfactory evidence and relegates these features to the category of *Incertae Sedis* in his catalogue of fossil birds. Lambrecht (1933) has also pointed out the importance of fossil feathers in stratigraphical studies.

Vertebrate remains have been described from Turkey by Yalçınlar (1952, 1954) and F. Ozansoy (1961, 1969, and others) but their investigation is restricted to the region west of Erzurum. In their description, they do not describe any fossil birds. The occurrence of fossil feathers in Miocene rocks of Pasinler basin could have strong implications on the geological history of this region.

Close association of fossil feathers with plants, insecta, fish, molluscs etc. suggest that this fossilization took place in a lacustrine, estuarine or shallow marine environment. The rocks containing fossil feathers are mostly fine-grained in texture and point to lacustrine to shallow marine conditions of deposition. Irrlitz (1972) points out that these deposits of Yastıktepe Formation intertongued by neritic Miocene limestones in the vicinity of the location where these fossils have been found.

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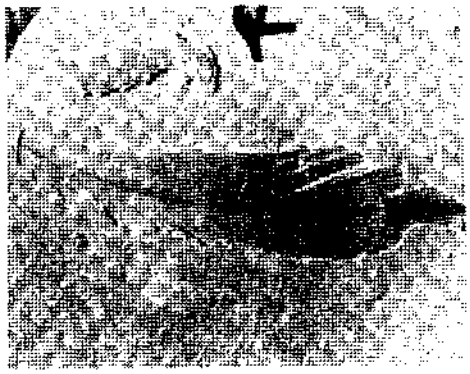

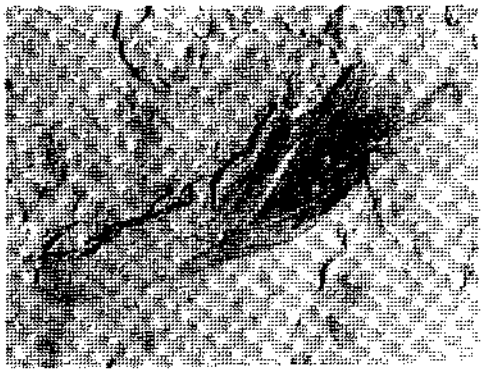

Fig. 1 - 4 — Contour feathers.

1 — Feather with other arthropod fauna (× 2/3) (Pan. Uni. R-52.).

4 — Enlargement of 1 (× 4).

2 — Almost complete contour feather (× 2) (Pan. Uni. R-53).

3 — Nicely preserved incomplete contour feather (× 4) (Pan. Univ. R-54).

Fig. 5 - 6 — Down feather (Pan. Univ. R-55).

5 — (× 6.5).

6 — (× 4).