GEOLOGY OF THE HASANOĞLAN-ANKARA REGION

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INTRODUCTION

The area under discussion lies around Hasanoğlan village, 35 km ENE of Ankara. Its approximate boundaries may be drawn as follows : It is contained in a rectangle the corners of which are formed by İdris Dağ and Yeşildere village on the northeast, Gölü village on the northwest, Elmadağ (Asiyozgat) district on the southeast, and Odabaşı village on the southwest. However, our studies were concentrated mainly on the northern part of the railway (Fig. 1).

The above-mentioned area, essentially consists of Paleozoic and Mesozoic sediments. Volcanic rocks and Tertiary formations are also represented. The region is generally made up of fairly low hills and shallow valleys. Dedekaya (1925 m), Gelin Tepe (1900 m), and Gözdere Tepe (1895 m) are the most important heights of the area, and they arc covered by Paleozoic limestones.

The principal running water in the region is Hasan Deresi, which is the only creek that does not dry up during the summer months. The second important running water is Çet Deresi, which, after joining Hasan Deresi on the south of Hasanoğlan village, pours into Lalahan Deresi toward the west. The area contains also numerous springs.

Among the previously written reports on the geology of the surroundings of Ankara, Chaput's report (1936) is the only one that contains any information concerning Hasanoğlan. Most recent and comprehensive information is given by O. Erol (1954).

The Paleozoic schists and graywackes, which were named as «The Dikmen Graywacke Series» by O. Erol (1956), are the oldest series in the region. A large part of the area is covered by this series and, in places, Paleozoic limestone blocks also are observed. Though most of these limestones are non-fossiliferous, because of their relation to the fossil - bearing Permo-Carboniferous limestones, there is no doubt of their being Paleozoic. Only in one place on the Paleozoic limestones, a Triassic series composed of Brachiopod- and Lamellibranch-bearing conglomerates, marls and sandstones was found. The Jurassic series, occupying nearly the middle part of the area and extending in an E-NE direction, starts with basal conglomerates followed by sandstones, then it is changed into abundantly fossiliferous limestones. The Jurassic series change upward into Ammonite-bearing marls and ends up in fine-grained flaggy limestones, which may be included in the Upper Jurassic. Cretaceous was not encountered in the area. Formations other than those so far mentioned in this region are considered to be Tertiary and Quaternary.

STRATIGRAPHY

Paleozoic

1. *Metamorphic schists.* — The highly metamorphic and the slightly metamorphic schists which are most extensive in the region will be discussed separately.

The highly metamorphic schists were included in the Lower Paleozoic, owing to the fact that they were observed under the series considered as Perrno-Carboniferous. According to Chaput's opinion (1936), this series which is found under the Ludumu Permo-Carboniferous limestones and sandstones, most likely belongs to an older age. Nowack (1928) considers the Elmadağ schists as Devonian, while Chaput (1931) points out their relation with the Devonian graywackes of the Bosphorus. The principal varieties of rocks encountered in this series are mica-schists, phyllites, graphite schists, chlorite schists, and graywackes with various-sized elements. The colour of the series is generally light beige, and it covers the area on the N-NW section of Hasan Deresi. Most extensive are the mica-schists which especially predominate in the clay pits and vineyards of Hasanoğlan, on the western part of Hasan Deresi, along Mezmir Dere and around Lalahan, while the green-colored chlorite schists completely cover Kozludere, İslamoğlu Arkacı and Kargasekmez regions, thus forming a very monotonous landscape. Phyllites are most common around Kozludere, and the purple colour of the slopes of Yeşildere village is due to the abundant graphite schists and phyllites. Graphite schists appearing on the slope, opposite Hasanoğlan flour mill also cast a distinctly dark color over the place. There is a similar outcrop also at the cut near by Lalabel station. Though the graywackes, occupying the southern section of the region, appear as the upper levels of the series, they are much closely related to various schists. However, it is evident that they form especially the base of the boulder series on the southern part of Hasan Deresi. Different types of these crystalline schists lie side by side almost all over the region and though their boundaries and relations cannot be definitely established because of their tectonic and stratigraphic conditions, the existence of an arrangement from top downward as indicated below may be conceivable :

a — Graywackes
b — Mica-schists and argillaceous schists
c — Phyllites and chlorite schists.

The schists contain also quartz veins and calc-schists in the form of lenses. From a tectonic view, they present very closely-packed folds with frequently and irregularly changing directions Although there is no regular order in their dips and strikes, they generally trend in a NE-SW direction.

2. *Sediments older than Permian.*— There is one formation that seems to be older than Permian. It is easily identified from the highly metamorphic schists and it may be included in the Upper Paleozoic. The following observations however support the inclusion of this formation in the Carboniferous :

a) Although the dark-colored sandstones and schistose clays are intermingled, they differ from the lower highly metamorphic schists in that they may be said to have a general trend.

b) They are less metamorphic and they contain mica flakes.

c) They are found under the Fusulina - bearing limestones of Karaca Dere.

S. Erk encountered this type of formations between the metamorphic Paleozoic and the Permian limestones of Ankara region, and he compared them to the culm facies (from his private notes). On the other hand, O. Erol includes in the same culm facies the Çet Deresi, Eski Yayla, Hasan Deresi, Çifte Kesen formations that surround especially the east flank along the deformed Jurassic syncline in the region.

d) Being under the Jurassic limestones, makes it older than the Jurassic, but being over the old Paleozoic, makes it younger than the Paleozoic. Chaput (1936) compares the argillaceous schists with plant remains, and the sandstones he observed around Ankara, to the schists and sandstones with culm flora of Zonguldak region.

3. *Permo - Carboniferous Limestones.*— Fossiliferous limestones within the area under study are found at Karaca Dere. Micropaleontological determinations of these quartz-bearing limestones were made by S. Erk, and as it is obvious from the fossils listed below, they contain the series continuing from the Upper Carboniferous to the Middle Permian.

Fusulinidae :

Millerella
Nummulostegina
Ozawainella
Staffella
Triticites
Pseudoschwagerina
Schwagerina
Paleofusulina

Other small Foraminifera :

Lunucammina
Endothyra
Plectogyra
Bigenerina
Monogenerina
Textularia
Glomospira
Climacammina
Cribrogenerina
Tetrataxis
Pachyphloia
Ammodiscus
Hemidiscus

As a result of further examination of the same samples the following species of limestone algae were determined:

Antracoporella
Epimastopora
Anchicodium
Girvanella

Aside from these, Bryozoa, Ostracoda and Corals were also encountered.

Continuation of these limestones appears along the foothills of Kırkkız Dağı on the NE boundary, and at Beypman locality of Odabaşı village on the SW boundary of the region.

The limestones east of Çet Deresi, which are associated with *Spirifer, Productus* and *Fenestella,* also may be included in the Permo - Carboniferous. Chaput (1936, pp. 28 and 239) has found a similar association in the Carboniferous of Ludumu and indicated it as Visean. The presence of Fusulina-bearing limestone gravels intermixed with red and green volcanics, particularly at Bektaş Kaya in Hasan Deresi, indicates that this tectonic breccia was formed as a result of tectonic movements which had taken place during the development of the deformed Jurassic syncline.

4. *Non-fossiliferous limestones.*— Two types of non-fossiliferous limestones were observed in the field. One is dark-coloured, contains indeterminable foraminifera, and forms scattered bands of blocks. The other contains rather crystalline marble veins, and

consists of light-coloured masses which cover rather large areas.

The dark limestones are found interstratified with volcanic rocks or in the form of lenses, and they appear sometimes under and sometimes over the massive crystalline limestones. As far as age is concerned, these two types cannot be separated from one another. The chief characteristics of the dark-coloured limestones are that they are found together with old eruptives and pillow lavas and they sometimes appear in bedded form, though mostly they occur in the form of blocks. Due to the fact that these non-fossiliferous limestones come under the Jurassic, the author is inclined to include them in the Permo- Triassic. Chaput (1936, p. 22) has included the crystalline limestones in the Triassic for the reason that they are found discordantly lying over the sandstones at Hasanoğlan, which contain *Fusulina elongata* Shumard.[1] O. Erol claims that the Triassic contains a complex series, and the formation which he calls «The Block Series» may correspond to this series. The dark-coloured limestones belong to the eastern flank of İdris Dağ, while the blocks seem likely to extend from Kırkkız Dağı and along Küçük Yozgat to Elmadağ. On the west of Kurbağalı village, these limestones go distinctly under the serpentine - radiolarite series.

The limestone blocks appear at the following places:

a) Oyuklu, Kasımoğlu, Dedekaya.

b) Hasandere, Arabelen, Bektaşkaya, Gelinkaya.

c) Dağarsacık, Karacadere, Lalabel, Elmadağ.

The massive limestones predominate at Çaltepe, Asartepe, Döşeme ridges, Göktepe and Dedeardıcı. Limestones at Çaltepe and Çettepe are intersected by faults.

Mesozoic

1. *Triassic.*— Some formations that can be definitely considered as Triassic appear between the Jurassic basal conglomerates and the Permian crystalline limestones at Bayramdere. The Triassic here is represented by Brachiopod-bearing conglomerates and marls containing Lamellibranchiata, Crinoidea and Brachiopods. Determinations of Brachiopods found in the conglomerates were made by E.F. Owen from the British Museum, and *Spirigera* cf. *oxycolpos* Emmrich, characterising the Triassic was discovered. The Lamellibranchiata contained in the marls were accepted as Permo-Carboniferous-Triassic by N. Karacabey. Under the circumstances, these look like Triassic formations which had been left in the Jurassic syncline. Resemblance in the characteristics of the Triassic and the Jurassic formations supports this assumption.

2. *Jurassic.*— The Jurassic is widely spread in this area, and it forms a complete series which is readily recognized by its fossils. Like in many other regions of Ankara, this limestone starts here with basal conglomerates and continues with lenticular marls and sandstones. According to certain authors and especially Chaput (1936), the Jurassic formations at Yakacık, and north of Köserelik and Etimesgut, are partly of a flysch facies. M. Türkünal, who examined the Ammonites collected from the marls and limestone lenses, and J. Roman, who studied the Crinoidea, have defined the following genus and species :

Macrofauna :

Lytoceras racile Vacek of group *L. cornucopiae* Vacek
Aractites cf. *orthoceropsis* Meneghini
Arietites. sp.
Phylloceras nilssoni Hebert
Pentacrinus laevisutus Pompecky
Pentacrinus goniogenos Pompecky
Ausseites sp. *(Atractites aucterum)*
Arnicoceras
Waldheimia anatolica Vasasz
Waldheimia (Zeilleria) aff. *sarthacensis* D'Orb.
Rynchonella

By these fossils the age of the formations was set as Liassic.

The following microfauna were identified from the limestone thin sections of the same formations :

Involutina
Nodosaria
Miliolidae (?)

In addition to these, Grinoid stems, Echinoid spines and sponge spicules were observed.

The second series consists of nodular brecciated limestones, and it contains the same fossils mentioned above. But the red marls and limestone lenses following the limestones contain the fossils listed below.

Macrofauna :

Phylloceras hatzegi Loczy
Phylloceras zignodianum d'Orb.
Lytoceras cornucopiae Vacek
Perisfenetes sp.
Millericrinus cf. *heridus* d'Orb.
Apiocrinites cf. *rosaceus* Schlotheim
Millericrinus cf. *echinatus* Schlotheim

Microfauna :

Vaginulina
Lenticulina
Globigerina
Nodosaria
Frondicularia
Fissurina
Robuius
Cornuspira
Miliolidae (?)

Aside from these, small Ammonites and fragments of Echinoid and Brachiopods were seen.

On the basis of these fossils, the series under discussion contains all of the formations ranging from Dogger to Malm.

Toward Akbayır, the red marls and limestone lenses change into fine-grained flaggy limestones which cover the whole Jurassic series. They present color variations ranging from green to beige and in some places they contain radiolarite beds. The following fossils were identified in these limestones:

Macrofauna :

Aptychus
Belemnites
Lamellaptychus sp. (Upper Jurassic-Neocomian)
Lamellibranchiata

Microfauna:

Radiolaria

The author considers these limestones as Upper Jurassic. Chaput (1936) claims that the Upper Jurassic of Yakacık region has the same facies. These limestones are fine-grained, compact, somewhat argillaceous, partly siliceous, and have conchoidal fracture. The best outcrops are found at Akbayır and Lalahan.

The entire Jurassic formation seems to have been preserved in a syncline surrounded by Azattepe, Akbayır, Kısık Dere and Hasan Dere. The sequence of conglomerates and marls is very clear at Kısık Dere, and both these and the Jurassic limestones always

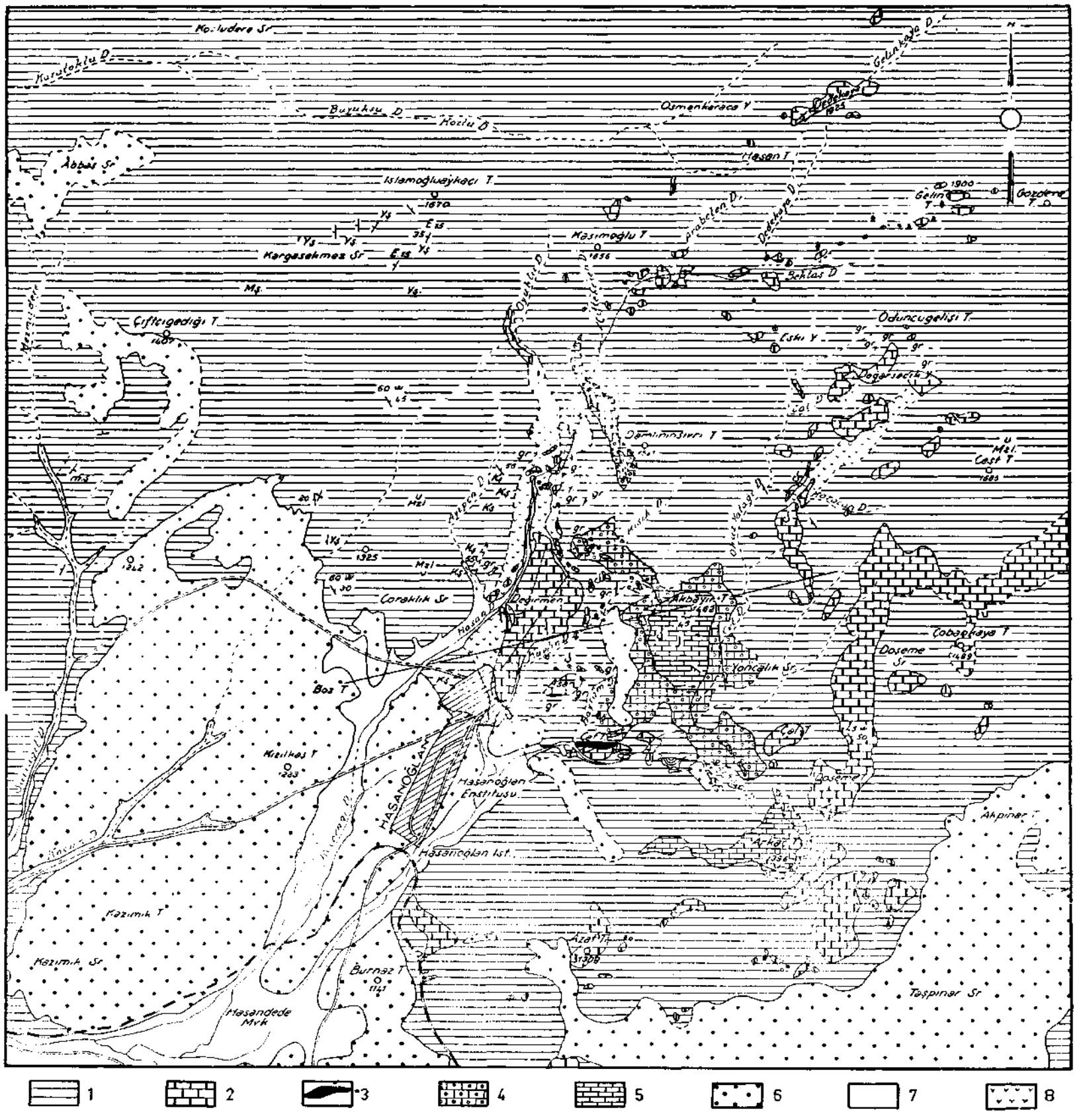

Fig. 1 - Geologic map of Hasanoğlan region

1 - Paleozoic schists; 2 - Paleozoic limestones; 3 - Triassic; 4 - Jurassic conglomerates; 5 - Jurassic limestones; 6 - Continental Neogene; 7 - Alluviums; 8 - Volcanic series

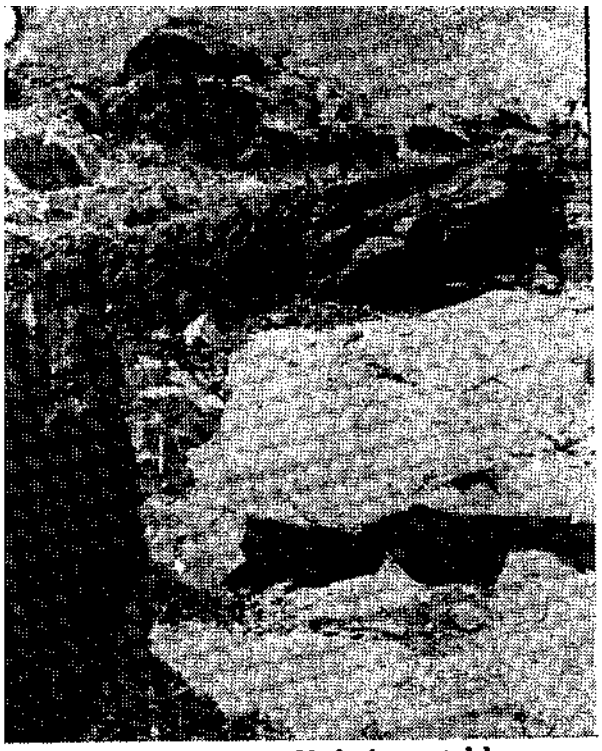

Photo 1 - Limestone blocks intersected by eruptives, Hasan Deresi

Photo 2 - A small fold in the schists encountered going up to Eski Yayla

Photo 3 - Limestone blocks along Hasan Deresi, near Gelinkaya

Photo 4 - Yamlıkaya at Hasan Deresi (around the flour mill)

Photo 5 - Flaggy limestones at Akbayır, seen from a distance

show SW dips. Therefore it is expected that a syncline would exist along the NE direction. Obviously the Jurassic formation was deposited on top of a Paleozoic anticline extending along the NW-SE direction. It is interesting to note that the Jurassic basal conglomerates lack in limestone fragments, but they contain granite gravels with silex and large orthosc crystals. S. Erk observed the same situation at Yakacık,

Tertiary and Quaternary

Hasanoğlan region and Asiyozgat Yazısı are predominantly covered by Pliocene gravels and red soil. The gravels attain a great thickness near Hasanoğlan village and they expand toward the neighbouring hills. The concretionary limestones found at the Lalabel cut also belong to the same period. O. Erol reported a lacustrine limestone outcrop, which he thinks is Miocene, beneath the gravels between Aksu Tepe and Böhrüş Tepe, NW of Elmadağ. No Tertiary formations other than those mentioned here were encountered in the region.

The Quaternary found in the valley floors and along the streams consists partly of gravel and partly of alluvium. The alluviums occupy especially the place where the vineyards are located, and the area between the vegetable gardens of. Hasanoğlan and the Lalahan village south of the railway.

VOLCANIC ROCKS

Volcanic rocks, though small in quantity are scattered almost all over the region. The Paleozoic limestones and schists in Hasan Dere are intersected by a rather wide spilite vein. A green-coloured eruptive dike appears around Lalahan. White volcanic tuffs of andesitic character appear between the Pliocene gravels and the Paleozoic-schists NW of Yenişeyh village and they cover the floors and banks of Kaşkesik and Keklik Dere. These tuffs contain abundant amphibole crystals. It is highly probable that these volcanic rocks are the result of volcanic activities which took place after Paleozoic, because they contain gravels of Fusulina-bearing limestones. Or, they may have resulted during the development of the Jurassic syncline, whereas the white tuffs are probably of Tertiary age.

TECTONIC

The region has undergone two types of foldings : The Hercynian uplifting movements affecting the Paleozoic formations, and the Alpine movements affecting the Jurassic system. These movements, in general, have formed the geologic structure under discussion. The Jurassic layers were laid upon the Paleozoic anticline, which was formed as a result of Hercynian movements, and they received their last shapes during the Alpine movements. The Paleozoic, already subjected to uplifting, went through further changes under the influence of the pressures and movements which brought about the deformed Jurassic syncline. The more or less soft schists became severely folded, while the hard limestones in many places were broken by large and small faults which caused them to slide. In some places (Bektaş Kaya) fragments of these limestones intermixed with volcanic materials, appear in the form of a tectonic breccia. Due to the complexities resulting from these influences, no further information other than just mentioning the possible existence of a rather large anticline which extended between İdris Dağ and Elmadağ during the Paleozoic, can be given. The Jurassic syncline with general dips along E-W and SE-NW, is located on the side of the anticline NE of Hasanoğlan vil-

lage. Paleozoic beds are found dipping SE-NW on the east and SW-NE on the west.

PALEOGEOGRAPHY

It should be pointed out that it is rather difficult to talk about Paleogeography in this region where the field work covered only about 1/8 th of the whole area represented by a 1: 100,000-scale map. Nevertheless, certain paleogeographic aspects which may be of interest are presented.

During the Paleozoic time the area remained under an epicontinental sea. The formations that were then deposited were changed later into schists through some dynamometamorphic influences. As far as fossils are concerned, these formations are sterile. In time, as the sea became shallow, deposition continued with limestones. On the other hand, the depth during the Carboniferous and the Permian was around 150-200 m, and the sea had already become more or less warm which is inferable from the presence of Fusulina- and algal limestones. It is probable that the sea remained further for some time before it completely receded during the beginning of the Triassic, and it is again likely that it became a stage for strong erosions during the remaining part of the Triassic.

The Jurassic starts with a basal conglomerate consisting mostly of volcanic materials which are evidences of eruptions older than the Jurassic. After the deposition of the basal conglomerates, the transgressive Jurassic sea becomes deeper and deeper, assuming a neritic character and creating a suitable environment for the formation of Ammonite-bearing limestones and later it finally changes into an abyssal sea where Radiolaria- and Aptychus-bearing limestones are formed. The Cretaceous was not observed, and the only known fact concerning the region is that the Tertiary marine sediments are missing. The Mesozoic Irmak series is found over the Hasanoğlan area underlying the Eocene. Thus, it may seem likely that the Hasanoğlan region remained under the sea till the end of the Eocene, and probably it was emerged after the Lutetian. The Lower Pliocene age vertebrates which were found by M. Şenyürek around Elmadağ support this theory.

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