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CONTENTS

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UNIVERSITY OF BAGHDAD
IRAQ NATURAL HISTORY MUSEUM
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(June 1970)

CONTENTS

GEOLOGY OF DARBANDIKHAN AREA IN SULAIMANIYA LIWA, IRAQ

BY

ADNAN B. NAQASH* and SHAIBAN K. AL-SHAIBANI**

ABSTRACT

As a result of a field work done during the summer of 1967, a detailed geological study was made on the rocks cropping out at Darbandikhan area and near the Dam site. Other exposures were examined about 15 kilometers away from the area towards Sulaimaniya. The geological map presented with this paper is drawn by the writers with scale 1/2800.

The main formations cropping out in the area are: Gercus Formation, Avanah Formation, Pila Spi Limestone Formation and Lower Fars Formation. An unconformity with an existence of thin bed of conglomerate is overlain by Middle Miocene and the Darbandikhan Village lies upon this Lower Fars Formation.

The main structure of the area is a wide and asymmetrical anticline transverse to the direction of Sirwan River. The northwest limb of this anticline is steeper than the southeast limb. The area of investigation covers the southeast limb of the anticline.

INTRODUCTION

Purpose and Scope

A geological field trip was arranged by the Department of Geology, College of Science, Baghdad, to Darbandikhan area, with an aim to study and map the area. This area might be an ideal geological field station for research and training purposes for geology students, which was proposed by the authors to the Department of Geology, College of Science, Baghdad.

Previous Works

Nothing has been published on this area except for a preliminary study of the Darbandikhan gorge by Hitchen during the latter part of October 1946 in connection with the Dam construction. Neither maps nor aearial photographs are available except for a

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very rough geological map of Iraq with a scale of 1/1,000,000, which has been used.

Geographical Setting

The area under investigation is located in the northern part of Iraq. It is about 25 sq. km., and limited by the road from the Darbandikhan Village leads to the Darbandikhan Dam and also by the secondary road to the University Camp. The other road from Darbandikhan Village to Sulaimaniya, a stretch of 5 km. Geographically it is located on a longitude of 45° 36 30 and a latitude of 35° 08 00 (Plate 1).

Field Procedure

The geologic and topographic mapping was done by the transit and stadia method. The control for mapping was layed by triangulation. The contacts of the formations were carefully mapped and the attitudes and the lithology of the beds were determined and recorded on the geologic map. (Plate 2).

The major portion of our effort was made in studing of the outcrops and drawing a geological map. Samples were collected at every major lithic variation. If no variation was noted, random samples were collected at intervals not exceeding five feet.

PHYSIOGRAPHY

The climate of the northeastern part of Iraq is characterized by moderate temperature in summer and mild in winter. More impressive still are diurnal variation in temperature during the summer time, especially near the waterfall of the spillway of the Dam and the Village of Darbandikhan.

The forest cover extends from the river valley up to an altitude of about 800 meters; most of the commercial timber is whithin the width of 5 kms. Except for those of the landslides that occur on the northwest limb of the structure, the area is covered with oak forests of low stocking density and some fig trees too. A dense undergrowth of shrubs, bushes (apple and grape trees) and shade-resistant small bushy trees occur in the forests.

The Darbandikhan area is characterized by rugged mountains and considerable relief which ranges in elevation from 375 meters at the Sirwan River near the Dam to over 800 meters on the sharp ridges of the northwest flank. The Darbandikhan gorge near the northwest flank cuts across the Baranand Dagh mountain range

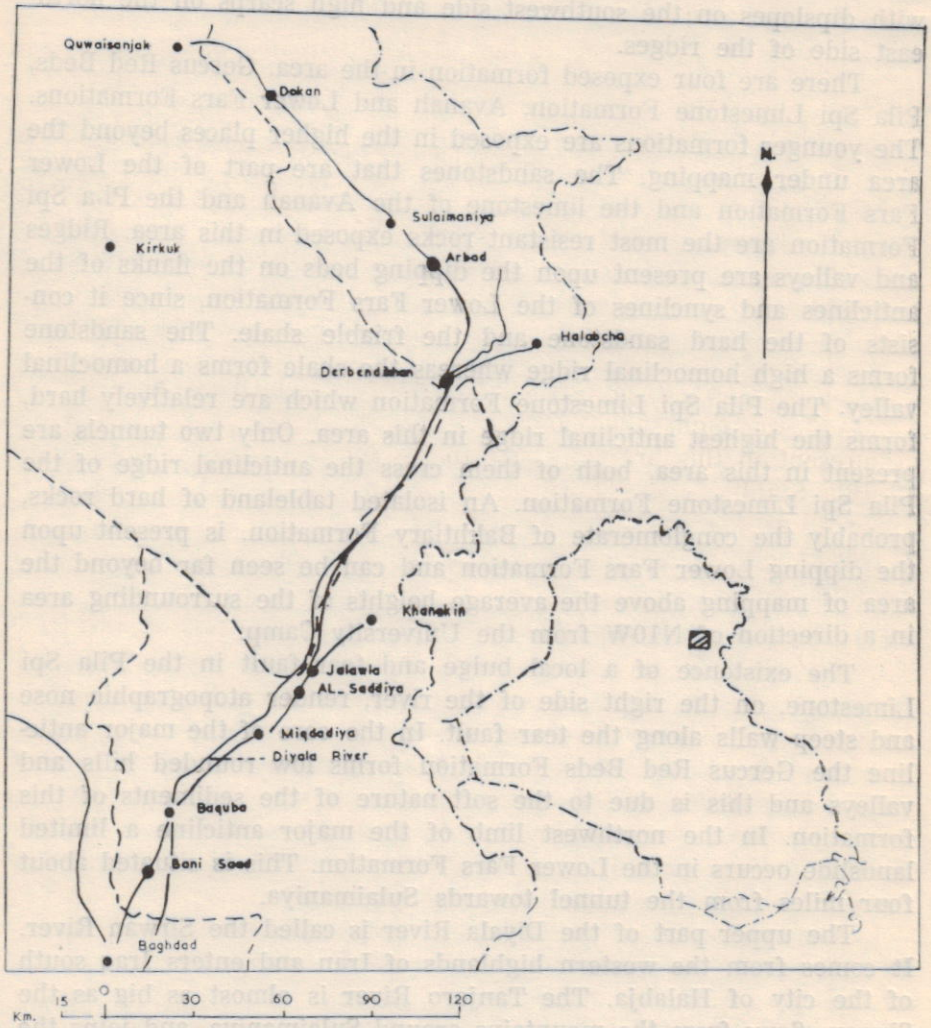

PLATE 1_ INDEX MAP SHOWING GEOGRAPHICAL LOCATION OF THE AREA

formed by northwest-southeast trend anticlinal structure. The ridges are formed by the limestones of the Pila Spi Limestone Formation with dipslopes on the southwest side and high scarps on the northeast side of the ridges.

There are four exposed formation in the area, Gercus Red Beds, Pila Spi Limestone Formation, Avanah and Lower Fars Formations. The younger formations are exposed in the higher places beyond the area under mapping. The sandstones that are part of the Lower Fars Formation and the limestone of the Avanah and the Pila Spi Formation are the most resistant rocks exposed in this area. Ridges and valleys are present upon the dipping beds on the flanks of the anticlines and synclines of the Lower Fars Formation, since it consists of the hard sandstone and the friable shale. The sandstone forms a high homoclinal ridge whereas the shale forms a homoclinal valley. The Pila Spi Limestone Formation which are relatively hard, forms the highest anticlinal ridge in this area. Only two tunnels are present in this area, both of them cross the anticlinal ridge of the Pila Spi Limestone Formation. An isolated tableland of hard rocks, probably the conglomerate of Bakhtiary Formation, is present upon the dipping Lower Fars Formation and can be seen far beyond the area of mapping above the average heights of the surrounding area in a direction of N10W from the University Camp.

The existence of a local bulge and tear fault in the Pila Spi Limestone, on the right side of the river, render atopographic nose and steep walls along the tear fault. In the core of the major anticline the Gercus Red Beds Formation forms low rounded hills and valleys and this is due to the soft nature of the sediments of this formation. In the northwest limb of the major anticline a limited landslide occurs in the Lower Fars Formation. This is situated about four miles from the tunnel towards Sulaimaniya.

The upper part of the Diyala River is called the Sirwan River. It comes from the western highlands of Iran and enters Iraq south of the city of Halabja. The Tanjero River is almost as big as the Sirwan, flows from the mountains around Sulaimaniya, and joins the Sirwan 18km west of Halabja, i.e. at the Village of Sheikh Maidan. The Sirwan River, which is a perennial consequent stream, cuts through the anticlinal northwest-southeast trending mountain range of the Baranand Dagh, and flows from the magnetic north to the south, but it changes its flow to the east as we go beyond the Dam. This river is one of the important tributaries of the River Tigris. The headwaters of the Sirwan River, draining from south to west into

the River Tigris, occur in the high mountains of this area. The source of the water supply of this river is mainly from Iraq and partially from Iran. The Sirwan River does not carry any amount of sediment in the Darbandikhan area and especially near the Dam, because of the big lake that deposits all the sediments upstream and that is before passing into the spillway. In other words, this lake acts as a filter and the river water is clear in the first couple 100 metres downstream.

GENERAL GEOLOGY

Regional Geology

Iraq is geologically comprised of a major geosynclinal basin bounded by the older mountain masses of Iran to the northeast. On the north is the Taurus mountains of Turkey and the basement complex of the Arabian Shield on the west and southwest. The sedimentary basin has a northwest-southeast trend throughout Iraq, center of this depression occuring along the northwest trend of the Arab Galf (Persian Gulf). The tectonic forces exerted from northeast towards the southwest have produced a series of folds parallel to the Iranian range ,and our area of study is located within them. These folds range from normal high type anticlines to folds showing great overthrusts. Therefore, the zones of folding on the northeast side of the geosynclinal trough are continuous into Iran (Plate 3).

STRATIGRAPHY AND HISTORICAL GEOLOGY

In the area covered by geologic survey, the beds were found to consist of a thick succession of limestones, sandstones, shales, marls, and few thin beds of conglomerates. These beds were divided into four formations exposed in the area: Gercus Formation, Avanah Formation, Pila Spi Limestone Formation and the Lower Fars Formation. The youngest formation attracks the attention of any geologist visiting this area with its thick, extensive, red and gray siltstones, and limestones with gypsum and anhydrite (lagoonal) that of the Lower Fars Formation (evaporitic). The Pila Spi Limestone Formation forms a very prominent high cliff of the southwest limb of the main anticline in this region. Avanah Formation is exposed in small patches near the outlet in the eastern bank of the Sirwan River as a highly fossiliferous limestone. Gercus Formation forms the core of the main anticline in the area. A small outcrop appears near the outlet of Darbandikhan Dam in the western bank of the Sirwan

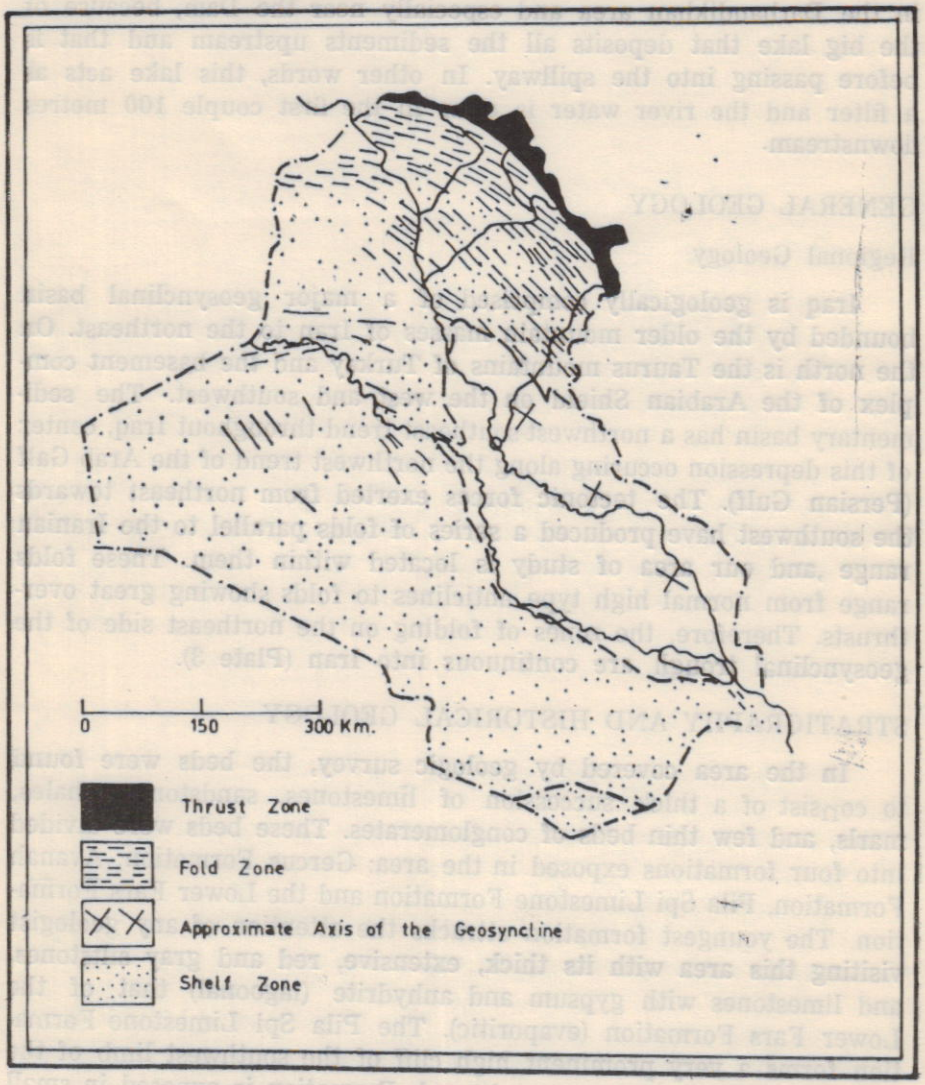

PLATE 3_ GENERAL FOLDED ZONES IN IRAQ
(After Al-Nagib)

River. An attempt was made to find Avanah Formation in the repeated formations of the northeast sequence, but no result has been obtained and, therefore, its age is still controversial. We believe that either the Avanah Formation is missing—and if this is the case then Avanah Formation represents a tongue dying out in this place—or it may be burried beneath the debris. This may be clarified by (Plate 4).

The stratigraphic column of the Darbandikhan area is briefly summarised as follows (Plate 5):

From the above table, the strata which crops out in the area ranges in age from Lower Eocene to Middle Miocene. The oldest rocks cropping out is the Gercus Formation, having somewhat recognised numerous fauna of Radiolaria, some of which are red in colour. This may come from haematitic red radiolarian chert which probably have been derived. Since the Gercus Formation is pre-Pila Spi Limestone Formation as seen in the Darbandikhan area and since the radiolarian fauna is considered to be Lower Eocene, then the probable age of this formation is the Lower Eocene.

The Avanah Formation generally is dolomitized and recrystallized of shoal facies that passed laterally into Pila Spi Limestone Formation with interfingering in the transitional zone. This formation is highly fossiliferous. It contains some *Alveolina elliptica*, *Asterigerina rotula*, *Nummulites discorbinus*. This formation is shorewards and interdigitate with the Pila Spi Limestone Formation, which represents a still more coastward formation.

The higher part of the area shows well bedded bituminus limestone, weathering white, chalky and sometimes crystalline bands of green marl (Pila Spi Limestone Formation); this limestone is poorly fossiliferous except for some Miliolids and some Quinqueloqulina. According to us this is due to recrystallization and dolomitization of the limestone. This formation rests on the Gercus Formation, with gradational contact. Gercus Formation mostly consists of sediments of lagoonal origin and overlain by the Lower Fars Formation that rest unconformably. This cover formation has been subdivided lithologically into two parts: the upper part consists mostly of coarse-to medium-grained sandstones with gray to brown colour. The lithologic units of this part from bottom to top is:

a. Gypsum layer: This is a good marker horizon for both surface and subsurface mapping of the Lower Fars Formation. It is eight meters thick.

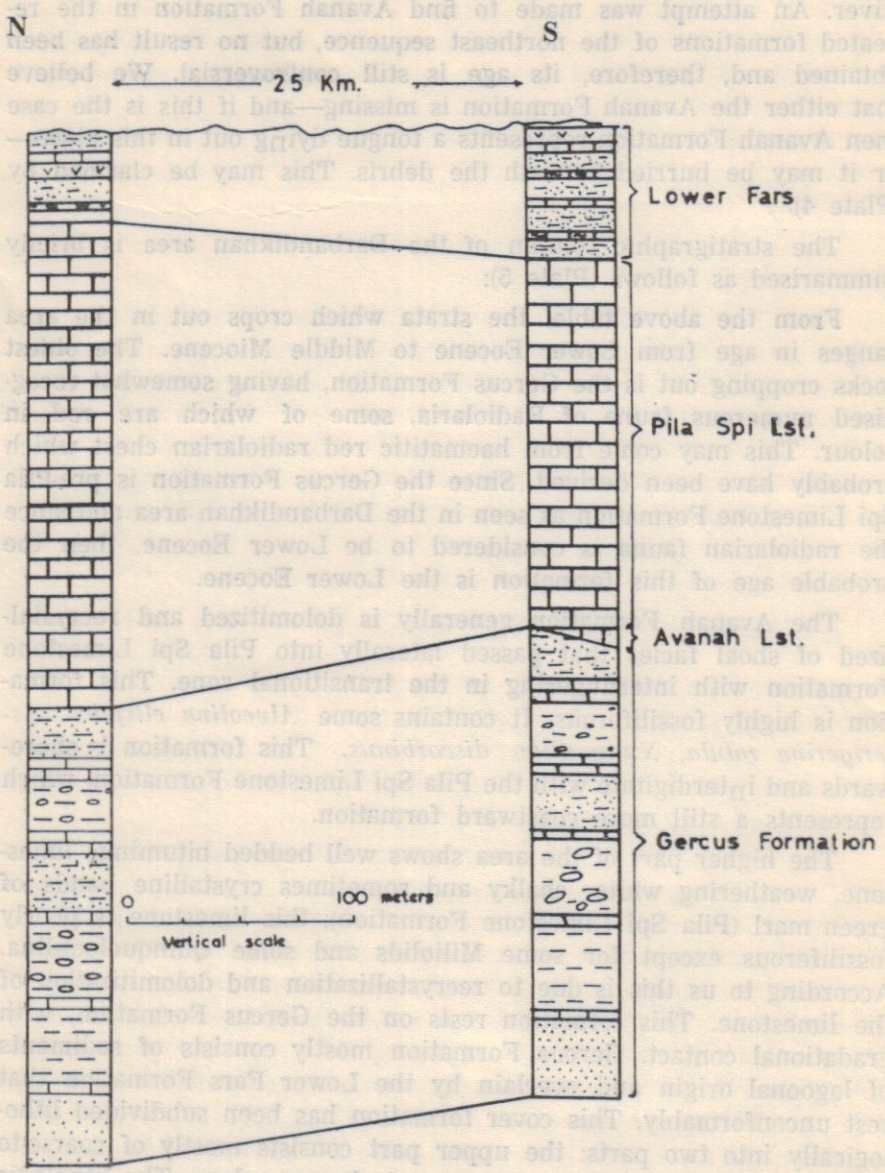

PLATE 4- STRATIGRAPHIC CORRELATION BETWEEN SOME OF THE SOUTHEREN LIMB AND NORTHERN LIMB OF THE STRUCTURE

b. Silty mudstone covering the gypsum layer.
c. Friable mud pebbles covering the gypsum horizon.
d. Hard limestone with flute casts on the lower surface.
e. Redish siltstone with twenty metres thickness.
f. Grey shale siltstone, highly fossiliferous.
g. Fossiliferous detrital limestone: Oscilation ripple mark is present in this bed. The colour is brownish in the weathered surgace and greyish in the fresh surface. It is highly jointed.
h. Limestone bed: Buff to redish in colour. Fresh surface is greyish, interbedded with silty shale.

AGE	FORMATION	LITH-OLOGY	DESCRIPTION
M MIOCENE	Lower Fars		Mudstone, red and grey, some red blue marl
U M	Pila Spi Limestone		Limestone, white, chalky and crystalline, some pale green marl and white chalky marl
EOCENE	Avanah Limestone		Dolomitized recrystallized limestone
L EOCENE	Gercus Beds		Red and purple shale, mudstones, sandy marls.

PLATE 5_ GENERALIZED STRATIGRAPHIC SECTION

SURFACE STRUCTURE AND TECTONICS

1. Surface Structure

There is a major elongated anticline present in this area with a curved axis toward the northeast, commencing 190 miles due northeast of Baghdad. The limb, which is situated about 5 miles from the tunnel towards Sulaimaniya, is that of the northwest and the other

over which Darbandikhan Village is situated is the southeast limb. In order to compare between these two limbs we have to compare between the strikes and dips. The following readings are taken from both sides of this anticline:

	Strike	Dip
Northwest limb	N40°W	88°NE
Southeast limb	N11°W	30°SW
	N12°W	38°SW
	N5° W	30°SW

From these readings it is obvious that it is an asymmetrical anticline with the northwest limb nearly vertical, and an average dip of 32° in the southeast limb (Plate 6). The Darbandikhan Village is situated in the southeast limb of this anticline. As we go to the southeast, we find a series of anticlines and synclines. The first syncline to the southeast of Darbandikhan area can be seen about 2 km. to the south of the village.

A probable fault along Sirwan Valley traverses to the southeast limb of the major fold; this fault has been observed in an old map in the survey office of Darbandikhan Village. An effort has been made to find such indication, but there is none, only the dragging of a thick bed of sandstone layer of the Lower Fars Formation in the west bank of Sirwan River. This river cut the southeast limb of the major anticline perpendicularly and flows from the magnetic north to the south, but it changes its flow to the east and west as we go beyond the Dam. This could be recorded as another indication of the fault, where the river generally flows in a weak fractured area until it makes a wide gap in the traverse anticline limb, and, therefore, we believe that the fault is existing. But if this is not the case, we may call Sirwan Valley as an antecedant valley, where the drainage established antecedant to the displacement of the beds by faulting and folding. From the Dam site one can clearly see the combination of scarp and dip slope on both flanks of the structure, separated by the Dam.

2. Tectonics

Darbandikhan area lies in the southeast part of the folded zone. The principal period of folding begins in Upper Cretaceous and continues to Miocene and probably post Middle Pliocene. The compressional force has a general direction from the northeast towards the

southwest. This indicated from the general trends of the mountains in the north part of Iraq. They have northwest-southeast orientation. This compressional force is a part of a large system of compressional and tearing force dominating the whole part of Arabia, Turkey and Iran. Ivanhoe (L.F. 1967, Geotimes P. 13) wrote about this system as follows: "The Arabia block is believed to have rotated since Late Cretaceous (Senonian) in a 6 arc counterclockwise around a point in a northeast of Libya. As a result of rotation, different types of structure were produced around the Arabian Rim. The rotation of the block produced strong compressive forces where it was under-thrust beneath Iran and Turkey, producing the crumpled Zagros mountains and associated ranges (Plate 7). The corresponding tension features in the opposite side of the Arabian block produced the Red Sea and the Gulf of Aden". Plate 7 shows the compressional and tensional forces. Since our area of study is part of the Zagros area, then it is effected by the crustal movement which is shown in the said section and the structure is a result of this compressional force.

ECONOMIC GEOLOGY

In the area under consideration, the water is of great importance as oil. The Darbandikhan Dam was built in 1957 to control the water of the Sirwan River.

The sedimentary rocks, such as hard sandstones are locally used as building stones. Quarries of gypsum and anhyrites are scattered here and there. These gypsum and anhyrite rocks are crushed, burned and used as mortar in buildings. The Pila Spi limestone in the area have been extensively quarried for manufacture of cement and mosaic.

PROSPECTS

On the basis of the preliminary examination, the area investigated seems to be geologically feasible for the proposed field station.

Looking over the structure, the anticlinal valley with its rim of sandstones and limestones is seen to even better advantages of an unforgettable sight which provides only one of the many reasons why we recommend this area as a University Geological Station.

More information on the environment of deposition may be gained by more detailed lithologic study in the northwestern limb. In addition, other outcrops, beyond the artificial lake should be studied to determine the lateral variation of the Pila Spi and Avanah Formations.

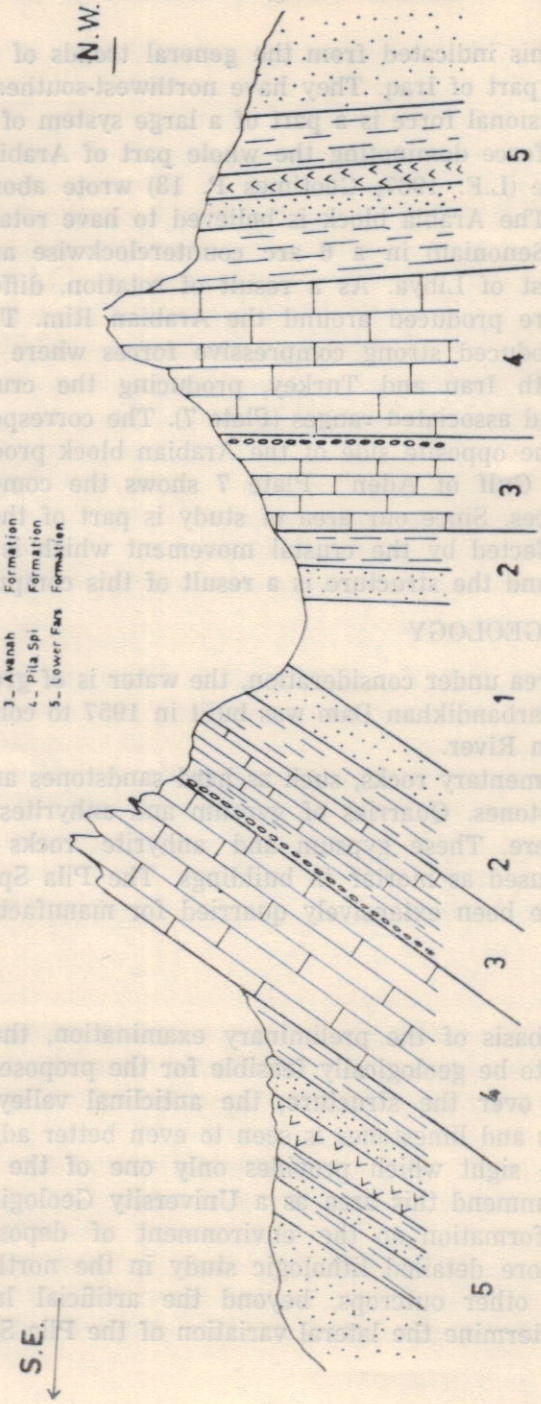

PLATE 6

DIAGRAMATIC CROSS-SECTION IN DARBANDIKHAN SHOWING THE STRUCTURE

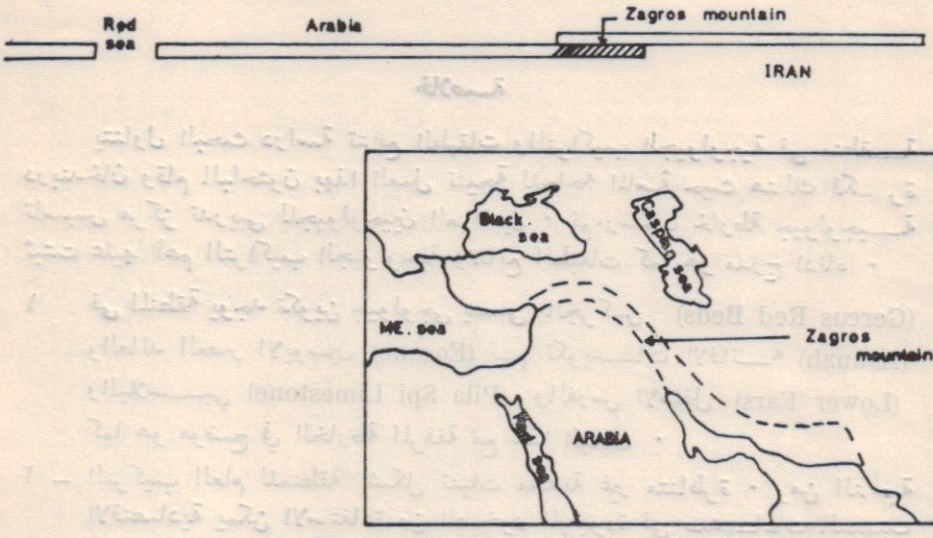

PLATE 7- SHOWS THE CRUSTAL BLOCK MOVEMENT

ACKNOWLEDGEMENTS

The authors wish to express their thanks to the College of Science, University of Baghdad, for lending the field vehicle for the above investigation, and also to Dr. Z. Kukal for reading and criticising this manuscript.

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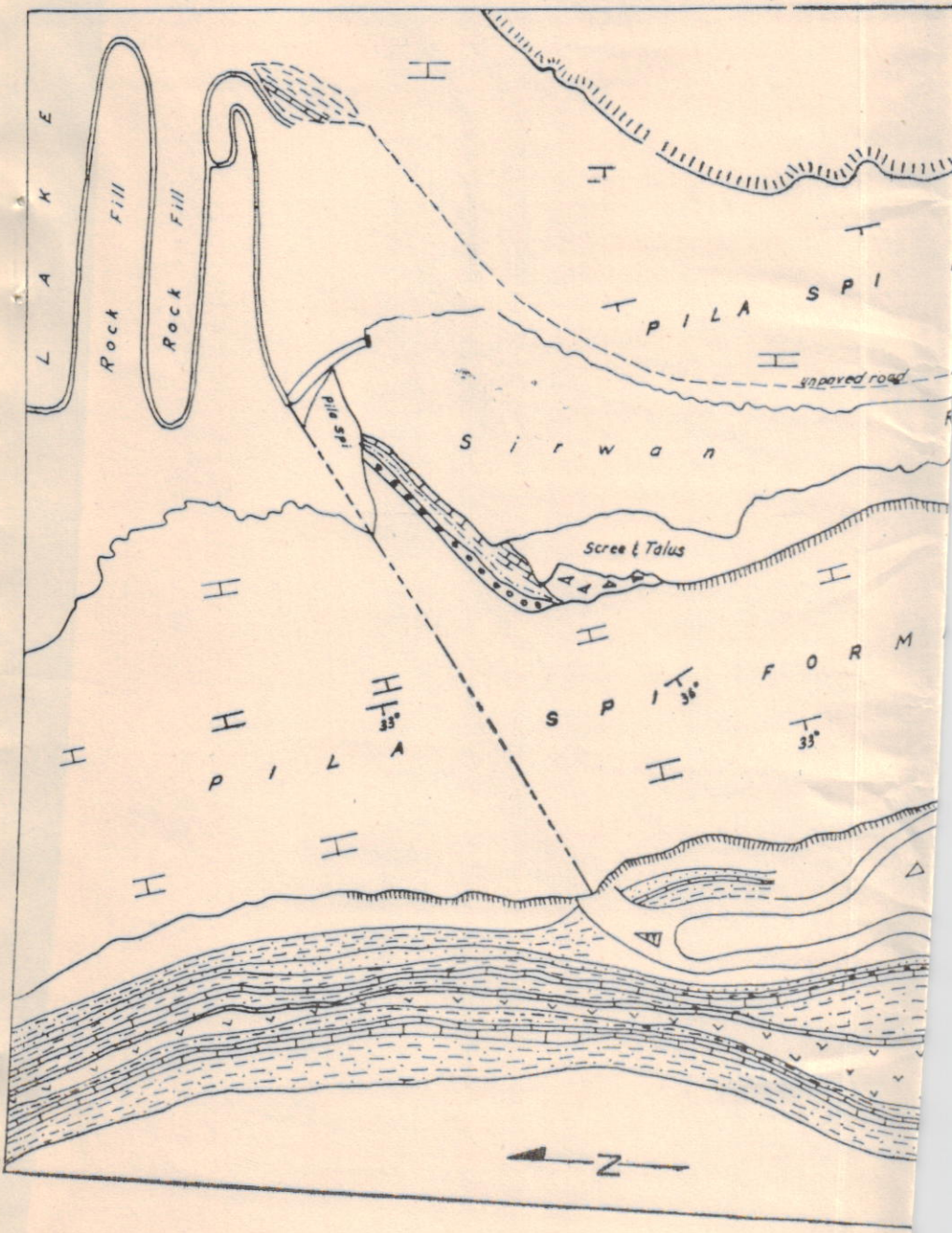
خلاصة

يتناول البحث دراسة تتابع الطبقات والتراكيب الجيولوجية فى منطقة دربندخان وقام الباحثون بهذا العمل نتيجة للحاجة الماسة حيث هنالك فكرة تأسيس مركز تدريبى للجيولوجيين العراقيين . ثم رسمت خارطة جيولوجية ثبتت عليها أهم التراكيب الجيولوجية وتتابع الطبقات كما هو مدرج ادناه .

١ فى المنطقة يوجد تكوين جيولوجى يسمى بالجركس (Gercus Red Beds) والعائد العصر الايوسين (Eocene) ثم تكوينات الافانة (Avanah) والبلاسبي (Pila Spi Limestone) والفرس الاسفل (Lower Fars) كما هو موضح في الخارطة المرفقة مع هذا البحث .

٢ ـ التركيب العام للمنطقة بشكل ثنيات محدبة غير متناظرة . ومن الناحية الاقتصادية يمكن الاستفادة من الصخور الموجودة فى صناعات السمنت والجص واحجار البناء .

PLATE 2 GEOLOGICAL MAP OF DARBANDIKH



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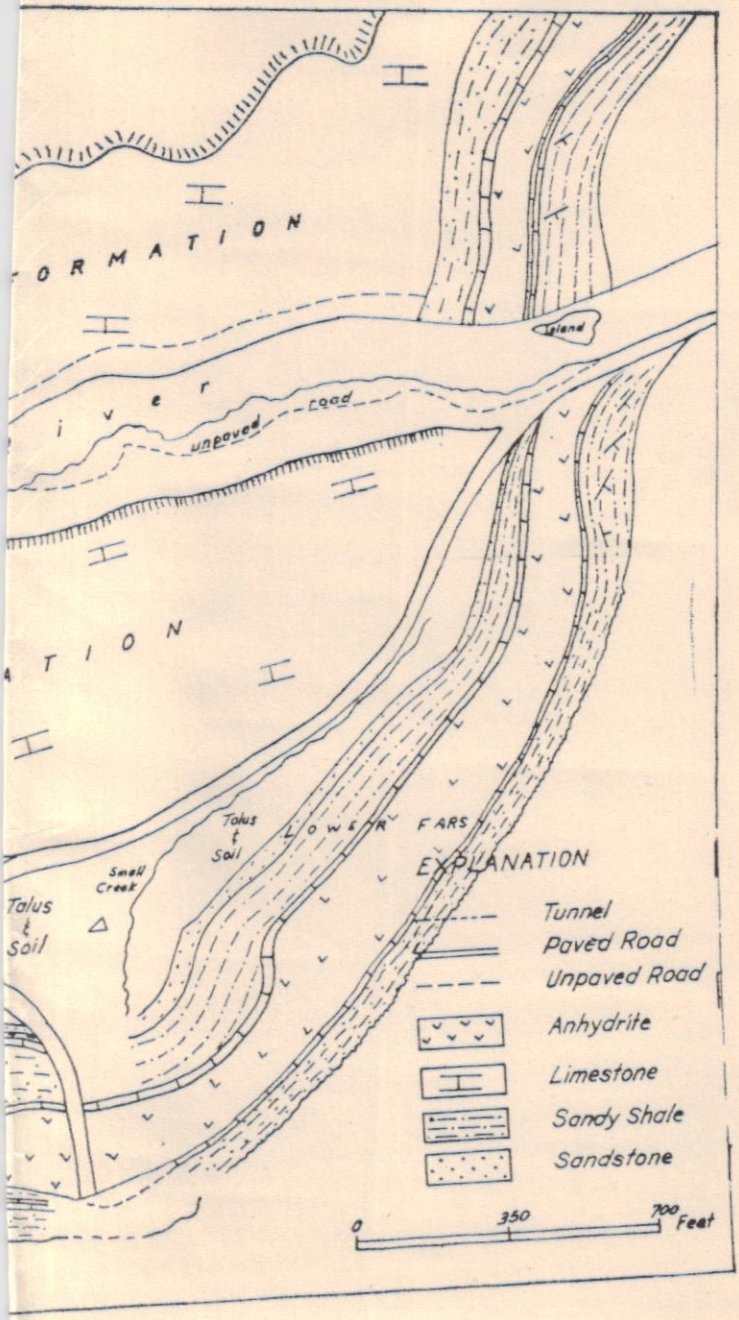
AN AREA sulaimaniya liwa



VEGETATION IN RELATION TO SOME EDAPHIC FACTORS IN OLIVER'S WILD-LIFE PRESERVE FLOODPLAIN FOREST, OKLAHOMA, U.S.A.

BY

AHMED S. ABDUL-WAHAB*

ABSTRACT

The vegetation in relation to some edaphic factors in Oliver's wild-life preserve flood-plain forest community was studied in two plots of one acre each. Edaphic factors studied and analyzed were pH, organic carbon, total nitrogen, total phosphorus, base exchange capacity, exchangeable potassium, soil compaction, and soil texture at the 0 to 6 and 18 to 24 inch levels. On the basis of frequency, density, basal area, and importance percentage, the type community in the south plot was *Quercus macrocarpa* Michx. and the dominant tree is the north plot was *Fraxinus pennsylvanica*, Marsh. The pH was generally above 8.0 at 0 to 6 and 18 to 24 inch levels in both plots. There was no correlation between the type of vegetation and the soil analyzed. The best correlation was between water-logging and vegetation type.

INTRODUCTION

Very few studies have been done on the flood-plain forest of Oklahoma, U.S.A. "The bottomland (flood-plain) forests of Oklahoma have been virtually neglected." Rice (1965), Duck and Fletcher (1945) reported about 3,400 square miles of bottomland type in Oklahoma. Varying from flat bottomland to steep canyon-like valleys, they described the tree species in bottomlands in a general way. Penfound (1948) reported that the elm-ash flood plain community occurs in nearly all the larger stream valleys of Oklahoma and is widely distributed throughout the deciduous forest formation. Rice (1965) reported that pecan, green ash, sugarberry, hackberry, and black walnut occurred as dominants only in the central counties in Oklahoma. American elm is well distributed throughout the area of study. Green ash is very important along the South Canadian River in Cleveland County. Rice and Penfound (1956) made a complete census of Oliver's wild-life preserve bottomland forest near Norman. They found that green ash was the only dominant, and the secondary important species were American elm, cottonwood, and persimmon. Penfound (1952)

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reported that hackberry-elm-ash associes occurs on low flats and sloughs in the Mississippi alluvial plain. Putnam (1951) reported that occassional small stands of pure ash may occur almost anywhere within the hackberry-elm-ash associes but most notably on moist flats or in shallow sloughs.

The paucity of information on edaphic factors and soil moisture in relation to vegetation composition in flood-plains forests in Oklahoma caused the initiation of the present investigation in Oliver's wild-life preserve flood-plain forest.

METHODS OF SAMPLING AND TESTING

The two stands to be investigated in Oliver's wild-life preserve were marked out previously in one acre plot by Dr. E.L. Rice (Fig. I). In the analysis the trees were sampled by a complete census and the seedlings by means of the arms-length rectangle method (Penfound and Rice, 1957). The DBH of all species over 4 inches diameter and the seedlings were recorded, care being taken to blaze each tree when sampled. From these data the frequency, density, and basal area and importance percentage of all species were calculated.

For soil analysis eight samples were collected from each plot at both the 0-6″ level and the 18-24″ level. Care was taken to insure that the samples were evenly placed over the entire area of each of the two plots. Soil from each of the eight locations and from each level, respectively, were composited so that one sample was secured to represent the 0-6″ level and one to represent the 18-24″ level for each plot. In the laboratory the samples were air-dried and the lumps were reduced by rubbing the soil in a porcelain mortar. The samples were thoroughly mixed and roots or other extraneous matter were removed. Samples were sifted through a 2 mm seive and stored in stoppered containers. Air-dry samples of known weight for each level and each plot were then oven-dried for 24 hours in a convection oven at 105°C. Oven dry weight of each soil was determined in this manner and per cent of moisture in air-dry soil was established . All subsequent calculations of chemical composition were based on oven dry weight of soil. Following the pH tests and mechanical analysis, the remaining composite soil samples were ground in a soil mill and thoroughly mixed to achieve homogeneity for the remaining analysis.

The Beckman pH meter was used for determining soil pH on all samples. Texture analysis of soil followed the method outlined by

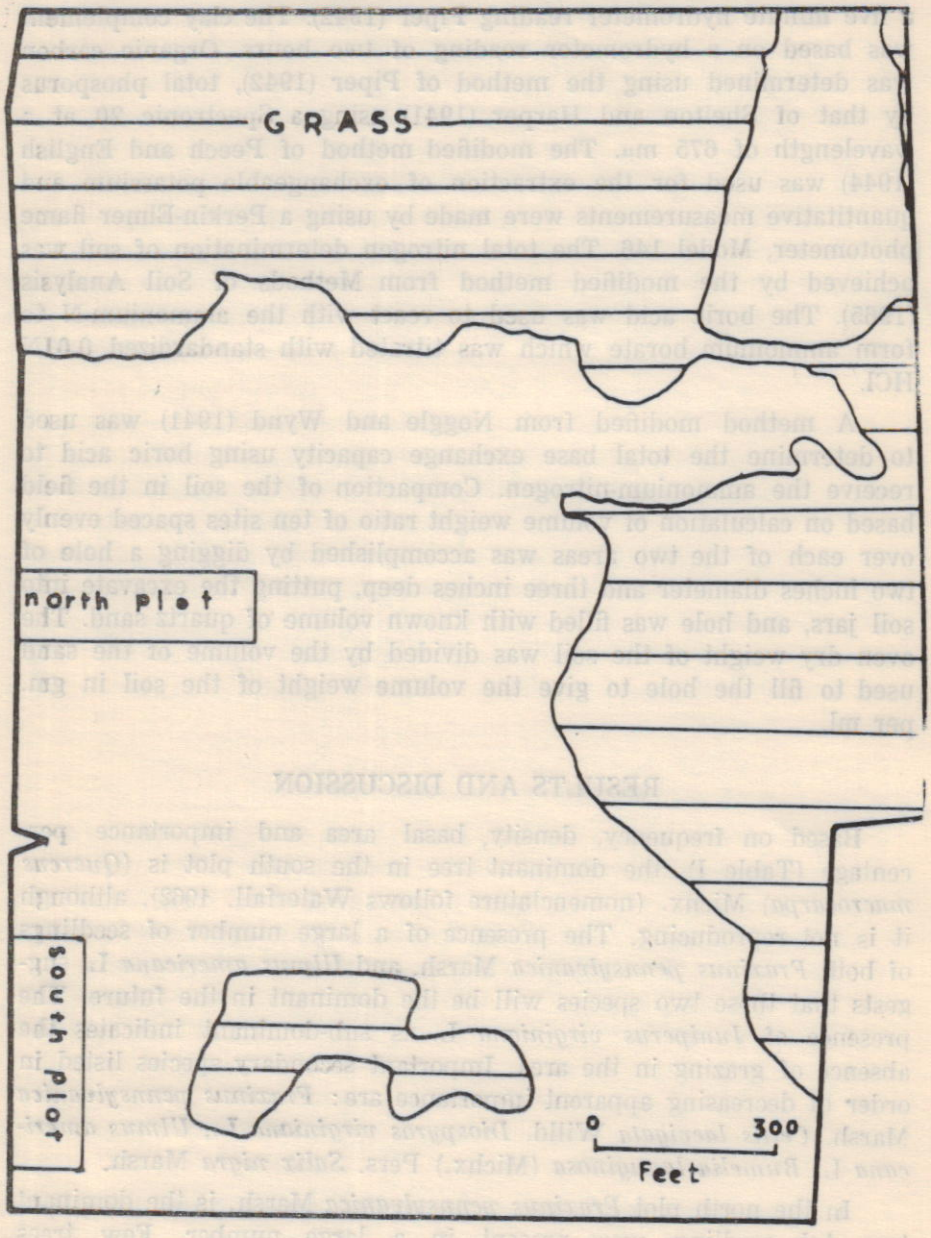
Bouyoucos (1936). Determination of sand complement was based on a five minute hydrometer reading Piper (1942). The clay complement was based on a hydrometer reading of two hours. Organic carbon was determined using the method of Piper (1942), total phosporus by that of Shelton and Harper (1941) using a Spectronic 20 at a wavelength of 675 mμ. The modified method of Peech and English (1944) was used for the extraction of exchangeable potassium and quantitative measurements were made by using a Perkin-Elmer flame photometer, Model 146. The total nitrogen determination of soil was achieved by the modified method from Methods of Soil Analysis (1965). The boric acid was used to react with the ammonium-N to form ammonium borate which was titrated with standardized 0.01N HCl.

A method modified from Noggle and Wynd (1941) was used to determine the total base exchange capacity using boric acid to receive the ammonium-nitrogen. Compaction of the soil in the field based on calculation of volume weight ratio of ten sites spaced evenly over each of the two areas was accomplished by digging a hole of two inches diameter and three inches deep, putting the excavate into soil jars, and hole was filled with known volume of quartz sand. The oven dry weight of the soil was divided by the volume of the sand used to fill the hole to give the volume weight of the soil in gm. per ml.

RESULTS AND DISCUSSION

Based on frequency, density, basal area and importance percentage (Table I), the dominant tree in the south plot is (*Quercus macrocarpa*) Michx. (nomenclature follows Waterfall, 1962), although it is not reproducing. The presence of a large number of seedlings of both *Fraxinus pennsylvanica* Marsh. and *Ulmus americana* L. suggests that these two species will be the dominant in the future. The presence of *Juniperus virginiana* L. as sub-dominant indicates the absence of grazing in the area. Important secondary species listed in order of decreasing apparent importance are: *Fraxinus pennsylvanica* Marsh. *Celtis laevigata* Willd, *Diospyros virginiana* L., *Ulmus americana* L. *Bumelia lanuginosa* (Michx.) Pers. *Salix nigra* Marsh.

In the north plot *Fraxinus pennsylvanica* Marsh. is the dominant tree. Ash seedlings were present in a large number. Few trees of other species are present in the area. The secondary species are: *Populus deltoides* Marsh., *Diospyros virginiana*, L. *Ulmus ameri-*



Olivers wood wildlife Preserve

cana L. and *Salix nigra* Marsh. The presence of very few large cottonwoods and willows suggests that the cottonwood-willow forest was the immediate predecessor of the oak-ash-elm community in the area.

The water table in the north plot was 5-12″ deep and more than 24″ in the south plot. This may explain the presence of large numbers of green ash and American elm seedlings in the north plot as compared with that in the south plot. Ash is known to form new roots in poorly aerated media, in addition to the adventituous roots. Willow and cottonwood produce adventituous roots, and American elm can withstand inundation for a short time. Hosner (1962) stated that poor aeration due to prolonged saturation of soil with water during the growing season is characteristic of many bottomland areas, and the growth of certain bottomland trees is better under saturated soil conditions compared with better drained conditions. Kramer (1960) stated that root injury occurs in soils having poor aeration, or soils which do not allow free diffusion of gases. de Gruchy (1956) stated that green ash trees can withstand water inundation of 30 inches for 17 month, a mass of adventituous roots developing from the cambium layer just below the water line. American elm can withstand inundation for only 3 to 5 months. Hosner (1958) reported that willow seedlings survive 32 days in flooded areas. Most ash and cottonwood survive 16 days in complete submergence. Hosner (1959) reported that growth and survival of cottonwood is directly related to the formation of adventituous roots; whereas ash, in addition to the formation of adventituous roots, produces new roots in poorly aerated media. This suggests that the oxygen or oxidized substances may be translocated through the shoot to the roots.

EDAPHIC FACTORS

The pH of the soil was generally above 8.0 at both 0-6 and 18-24 inch levels in both plots increasing down the profile. Sabrahmanyan (1927) reported that waterlogging for short periods may decrease the acidity of the soil and increase the availability of certain minerals. Hosner (1962) reported that manganese and iron may become more available over longer periods of water-logging. Kramer (1951) reported that the mineral absorption was reduced when the roots of loblolly pine were immersed in a CO_2 saturated solution. Plants producing adventituous roots received less injury and showed a greater degree of recovery.

The organic carbon, phosporus, potassium, nitrogen and base exchange capacity decreases down the profile. The C/N ratio was approximately the same for both levels in each plot, but was higher in the south plot (Table II). Hosner (1962) reported that the dry weight of the American elm was depressed by soil saturation. However, saturation increases the dry matter of willow by over 100%, but cottonwood and ash increased in dry weight to a lesser degree. Seedlings of ash, willow, and cottonwood grown in saturated soil showed a higher content of nitrogen, phosporus, potassium, calcium and manganese than similar seedlings grown in non saturated soils.

There is some correlation between percentage of sand and organic carbon, phosporus, potassium, nitrogen and base exchange capacity between the two levels of each plot; the more the sand, the less the percentage of the factors listed above. The higher the percentage of clay loam, the more organic carbon, phosporus, potassium, nitrogen, and base exchange capacity, but there was no correlation between the two plots. Soil compaction was approximately the same in both plots and the level of significance was above 0.1 and below 0.2.

There was no correlation between the type of vegetation and the soil factors analyzed. The best correlation was between waterlogging and the vegetation type.

TABLE I

VEGETATION ANALYSIS

South Plot

	B.A./Acre	≠/Acre	Re.B.A.	Re.D.	I.P.
Quercus macrocarpa Michx.	8419.02	37	46.77%	30.33%	38.55%
Fraxinus pennsylvanica Marsh.	2940.44	28	16.34%	22.95%	19.64%
Celtis laevigata Willd.	3014.57	27	16.74%	22.13%	19.43%
Diospyros virginiana L.	1628.68	21	9.05%	17.21%	13.13%
Ulmus americana L.	1762.54	5	9.79%	4.10%	6.97%
Bumelia lanuginosa (Michx.) Pers.	195.96	3	1.09%	2.46%	1.77%
Salix nigra Marsh.	38.48	1	0.24%	0.82%	0.53%
Total B.A./Acre	17999.99	122			

	≠/Acre	Re.D.
Fraxinus pennsylvanica Marsh.	4459	62.74%
Ulmus americana L.	2371	33.29%
Juniperus virginiana L.	234	3.1%
Crataegus viridis L.	50	0.68%
Carya illinoensis (Wang.) K. Koch	17	0.23%
Total ≠/Acre	7341	

North Plot

	B.A./Acre	≠/Acre	Re.B.A.	Re.D.	I.P.
Fraxinus pennsylvanica Marsh.	13191.84	101	88.84%	92.66%	90.76%
Populus deltoides Marsh.	1513.63	1	10.17%	0.91%	5.54%
Diospyros virginiana L.	108.11	6	0.73%	5.50%	3.11%
Ulmus americana L.	36.32	1	0.24%	0.91%	0.57%
Total B.A./Acre	14849.90	109			

Seedlings and saplings per acre	≠/Acre	Re.D.
Fraxinus pennsylvanica Marsh.	21042	88.30%
Ulmus americana L.	2756	11.65%
Populus deltoides Marsh.	33	0.14%
Total ≠/Acre	23831	

*B.A. = basal area
Re.D. = relative density
I.P. = importance percentage
Seedlings and saplings per acre (D.B.H. less than 1 inch).

TABLE II

EDAPHIC FACTORS OF FLOOD-PLAIN FOREST
IN OLIVER'S WILD-LIFE PRESERVE

	% sand	% silt	% clay	pH	% organic carbon	% Total phosporus	% Total potassium	% Total nitrogen	mg/100 gm. soil total base exchange capacity	C/N. ratio	vol./wt. ratio (comp.)
North 0-6	29.80	24.2	46.0	8.1	1.956	0.0715	0.1525	0.23	34.9	8.5	0.94
North 18-24	36.88	18.92	44.2	8.4	0.666	0.08475	0.0072	0.081	27.81	8.2	
South 0-6	38.32	22.16	39.52	8.35	1.443	0.05975	0.0168	0.16	26.12	9.0	1.04
South 18-24	54.00	20.4	25.6	9.5	0.41	0.0434	0.00825	0.044	15.23	9.3	

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خلاصـــة

لقد درست علاقة توزيع المجاميع النباتية في غابة اوليفر في اوكلاهـوما بعوامل التربة التالية : تركيز ايون الهايدروجين ، الكاربون العضوي ، مجموع النايتروجين الكلي ، الفسفور الكلي ، البوتاسيوم الممكن احلاله ، قابلية تبادل الايونات القاعدية وصلابة وقوام التربة لاعماق تتراوح بين صفر الى ٦ ثم ١٨ – ٢٤ انجا • ونتيجة لدراسة التردد ودليل التردد والكثافة والنسبة المئويـة لاحتمال انتشار النباتات وجد أن نوع الاشجار المسيطرة للمجموعة النباتية في المساحة الجنوبية هي اشجار البلوط ، اما الاشجار المسيطرة في المســاحة الشمالية فهي اشجار لسان الطير • هذا وقد وجد بان التربة تميل الى القاعدية بصورة عامة ولا علاقة بين نوع المجاميع النباتية في هذه الغابة وعوامل التربة المدروسة ولكن العلاقة واضحة بين طول فترة غمور سطح التربة بالماء ونوعية النباتات •

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