STRATIGRAPHY OF THE OUTCROPS EXPOSED ALONG THE EASTERN BANK OF THE INDUS AT ATTOCK, WEST PAKISTAN,

BY

R. A. KHAN TAHIRKHELI

ABSTRACT

The outcrops exposed on the eastern bank of the Indus at Attock are examined to establish time - rock sequence for correlation. The rocks exposed here represent a typical Mesozoic sequence. No rocks older than upper. Triassic (Kingriali Formation) are exposed in this area.

INTRODUCTION

During an attempt to geologically map the various divisible units of the Attock Slate series - the outcrops exposed along the eastern bank of the Indus at Attock were also investigated to establish the time - rock sequence for correlation and better understanding of the regional geological history. The former investigators had included these outcrops in the Attock Slate series which were assigned a Precambrian age.

The area under investigation is about 40 square miles and is situated along the eastern bank of the River Indus in Attock district. These outcrops are the continuation of the Cherat - Attock range - which swings to the east and is bifurcated to form prominent ridges across the Indus for a stretch of 5 to 6 miles; the last remnant of this chain being a small isolated hillock exposed near Kamra village. Beyond this till Hassanabdal the stretch is covered by alluvium. The highest peak in the area attains an elevation of 2079 feet and the local relief is around 1000 feet. The general trend of the ridges coincides with the strike of the beds, which is mainly east - west.

STRATIGRAPHY

The rock formations described in this area range in age from upper Triassic (Kingriali Formation) to Paleocene. The yellowish green friable shales (Chichali Formation) and marl beds (Kawagarh) are reported for the first time in this part of the Attock Group. The Manki Slates - which are the oldest formation in the Attock Group (lower Paleozoic) occupying prominent position on the other side of the Indus, is not exposed in this area.

The lithologies, in order of abundance, consist of shales (slaty shales, calcareous shales, and marl), limestone, dolomitic limestone, and gritstone - which suggest that the larger part of the sediments was deposited under deep marine environment. However, the ripple marks, cross-bedding, and thin development of the coarser sediments recorded in some of the beds is suggestive of periodic cycles of shallow marine conditions lasting for short durations.

Structurally the area is very much disturbed and the major problem is created by the incompetent yellowish green friable shales which are disrupted and localized and at places are found interfingered with the older Attock shales.

The succession established by the author is as follows:—

D. Paleocene	8. gray and yellowish brown limestone and shales.
	7. Gritstone.
	.....*Pisolitic lateritic band*.....
C. Cretaceous	6. White to light gray calcareous shale and marl.

5. Yellowish green friable sandy shales.

4. Yellowish brown argillaceous limestone with rare fossils

B. Jurassic

3. Light to dark gray splintry slaty shales with pinkish brown siltstone containing discontinuous band of impure argillaceous limestone with pelecypod and gastrapod shells.

2. b. Purple to light gray calcareous shales and marls with carbonaceous pocket.

a. Thin bedded dark gray to black fine textured rubbly limestone with marbalized bands.

A. Upp. Triassic

1. Thin bedded light greenish gray dolomitic limestone.

A. Upp. Triassic

Lithology

It consists of brittle dolomite and dolomitic limestone which elsewhere- (other side of the Indus) also contains friable calcareous shales and marls. It is thin bedded and is cut across by mumerous fractures - which on weathering yield small rectangular chips. Fresh faces are light green to greenish gray - whereas common colours displayed by weathered surfaces are light gray, yellowish gray and greenish gray. Manganese denderites are commonly recorded in these rocks.

Thickness and distribution:

Due to overfolding and faulting this formation is apparently distributed in three isolated outcrops along the southern fringe of the area under study. Its maximum thickness in this area is around 250 feet.

Topographic Expression:

Among the three isolated outcrops two form ridges and the third one which is more extensive in development occupies the core of an over - folded anticline. A complete section of this formation is exposed along the river cutting and the Dakhner Fortress, now abandoned, is built over dolomitic limestone. This formation on the other side of the river forms thick and prominent outcrop.

Contact:

Dolomitic limestone is associated with the Attock Shales (Mid. Jurassic to Cretaceous) and other cretaceous formations. Its contact with the younger formations is sharp. The southern limbs are overfolded and usually show thrust faults whereas along the northern contact normal sequence is exposed.

Age and Correlation :

Dolomitic limestone is the oldest formation in the suites of the rocks exposed along the eastern bank of the Indus River at Attock. No fossils have been found in this area. From its lithological characteristics this bed is correlated with the Kingriali Formation which is upper Triassic in age.

B. JURASSIC

Two distinctive lithological facies of Jurassic have been recognised in the area by the writer, namely ;

1. Attock Shale which is dominantly argillaceous.
2. Rubbly limestone which is dominantly calcareous.

Therefore the Jurassic rocks of this area are described under these different facies.

RUBBLY LIMESTONE,

Lithology:

This name is tentatively assigned to a limestone formation of typical character, which as discussed in my previous publications has got an unconformable tectonic contact with the Manki Slates which is the oldest formation in the Attock group.

This limestone is thin bedded and contains white marbalized bands. Rubbly texture which earned it this name is very conspicuous. Fresh faces appear homogeneous and the rubbly texture is confined to the surface which may be autoclastic. Calcite and quartz veins cutting both across and along the bedding planes are common. The limestone is very fine in texture and the fresh faces are dark gray to black. Thin yellowish brown argillaceous streaks are common on the weathered surfaces which usually surround the rubble. Intact as well as decomposed crystals of limonite are common.

The upper part of this limestone is argillaceous and marly with occasional thin carbonaceous bands. They usually display light - gray, yellowish gray, greenish gray colours with conspicuous pinkish brown tinge. They form highly folded belt and are locally squeezed.

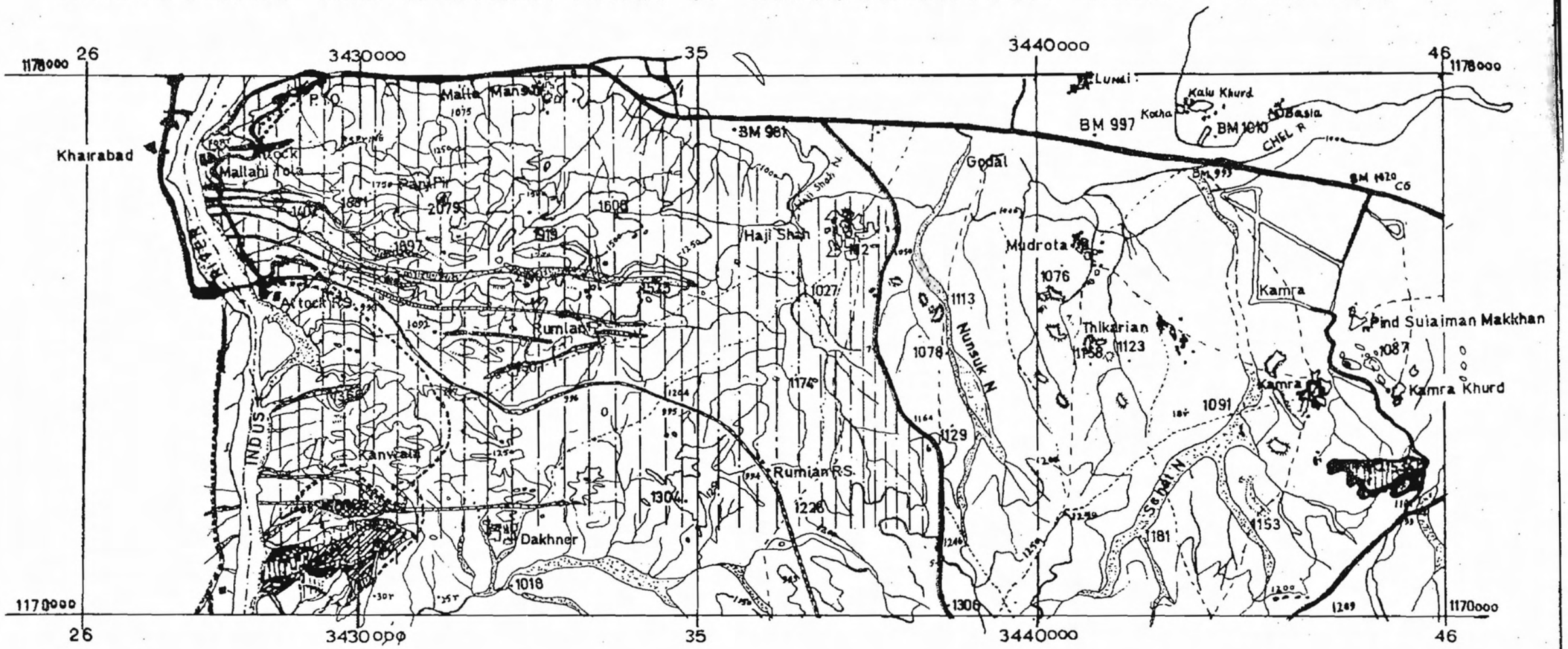
Thickness & distribution :

Rubbly limestene is confined to the northern part of the area of investigation. Strike and dip faults have effected this formation. The thickness of Rubbly

TOPO. SHEETS - 43 C/1 & 43 C/5

MAP SHOWING DIVISIBLE UNITS OF THE ATTOCK SLATES

SERIES ALONG THE EASTERN BANK OF INDUS AT ATTOCK WEST PAKISTAN.



limestons may range from 50 to 300 feet. The associated shales and marls which show great variation in thickness may measure 45 feet in the thickest section.

Topographic Expression :

Rubbly limestone, because of its hard nature, forms ridges and escarpments in this area — which are very distinctive topographic features of the area.

Contact :

The contact of this formation whith the younger Attock shales is erosional and contains ferrogeneous shales and marls marking an unconformity. One such well marked unconformable horizon is noticed in a nala about half a mile east of Rumia village. The northern contact of most of these outcrops expose normal sequence whereas the southern limb is overfolded and reveals thrust faults.

Age & Correlation :

No fossil has been recorded from this formation. The previous workers had studied these limestones along the northern fringe of Cherat hill and on the basis of lithology had assigned them a lower Jurassic age.

Rubbly limestone underlies the Attock Shales which on the basis of fossils has been assigned a Mid. Jurassic to Cretaceous age. On the basis of its stratigraphic position the present survey will tentatively place this formation somewhere below the Mid. Jurassic and over the Kingriali Formation which is upper Triassic in age. Rubbly limestone and Kingriali Formations are also found in contact with each other on the western slope of Cherat ridge—where they show gradational contact.

ATTOCK SHALES

Lithology :

Dominantly argillaceous component of the Attock Slate series was first differentiated by the author in 1965 and was tentatively named Attock Slates. It consists of slate and splintry slaty shales with intercalations of siltstone. It also contains thin bands of yellowish brown argillaceous limestone which are discontinuous and contains fossils. Quartz veins are present. Slates are locally developed at these sections where, due to squeezing, beds have become indurated. Fresh faces are light to dark — gray and with weathered surfaces purple, red and yellowish brown colours are commonly associated.

Carbonaceous bands are also recorded in this formation. Sedimentary structures, such as ripple marks, and current beddings are commonly noted. Gray calcareous bands of earthy brown heamatite concretions are seen occasionally.

Thickness & distribution :

In the Attock slate series, this formation is the thickest and is also widespread in distribution. In the area under study its thickness may vary between 200 — 250 feet.

Topographic Expression :

Attock shales form low flat topped ridges which give a monotonous topographic feature. Due to isoclinal foldings its actual thickness is not clearly ascertained in most of the sections.

Contact :

Attock Shales have got a sharp contact with the overlying yellowish brown limestone and yellowish green sandy shales. At many sections the younger yellowish green sandy shales (Chichali Formation) are assimilated with the Attock shales and thus give heterogenous lithological characteristics. One similar case is noted in the isolated hillock near Kamra village — which is composed of Attock Shales (dominant) and yellowish green sandy shales, mostly squeezed, localized, and developed along the foothill — toward south and south west. The previous workers have not differentiated these two types of formations in this section. A thick quartz vein occurs near the contact of the two rock types along the western slope of Kamra hillock.

With the underlying Rubbly limestone — Attock Shales have got erosional contact. The southern limb of Rubbly limestone also shows thrust faults.

Age & Correlatoin :

The argillaceous part of this formation did not yield any fossil yet, but the yellowish brown impure limestone band — in the Attock Shales is fossiliferous and contains shells of pelecypod and gastrapod. Dr. Norman Sohl, a specialist of U.S.G.S., Washington has studied these samples and on the basis of internal structure of the chambers of nerineid considers a probable age range somewhere between Middle Jurassic and Cretaceous

The author on the basis of its lithological characters and fossil evidence tentatively correlates the Attock Shales with the Spiti shales which are well developed in the south and north of Hazara. Their orogenic trend is also suggestive of their extension eastward and it is more probable that they ultimately merge with the Hazara facies. Work is also in progress to geologically map the intervening area for more authentic field evidence.

C. CRETACEOUS

Cretaceous system is represented here by three distinct lithological facies which are described below :-

3. Calcareous shale and marl.
2. Yellowish green friable sandy shales which may be equivalent to Chichali Formation.
1. Yellowish brown argillaceous limestone with rare limonitized shells.

ARGILLACEOUS LIMESTONE

Lithology :

Yellowish brown colour is common both on fresh and weathered surfaces. It is thick bedded to massive, medium to fine — grained and partly crystalline. Marl and calcareous shales seldom occur in association. Limonitized patches — which appear to be of shells are also noted. This limestone bed is not continuous in occurrence and sometime gives a look of pockets. The important sections where it is studied is one near the Attock Fort on the eastern side of the metalled road. Another outcrop occurs about one and half miles west of Dakhner village (foot hill of elevation 1872), where it has yielded an ammonite fossil.

Topographic Expression :

This limestone is usually found forming isolated ridges — but the one west of Dakhner Fort occurs along the foothill of the ridge.

Contact :

Its contact both with the underlying Attock Shales and overlying yellowish green sandy shales is sharp. Due to overfolding one limb of this outcrops shows thrust fault.

Age and Correlation:

This limestone is tentatively placed in the lower Cretaceous. It is also suggested here to correlate it with the impure limestone which usually overlies the Spiti shales.

YELLOWISH GREEN SHALES

Lithology:

These shales were first identified and separated in section (ridge 1872) about one and half mile east of Dakhner village - where a complete section is exposed along the slope. As mentioned elsewhere, due to folding and faulting this incompetent bed has yielded more and become squeezed and localized. Thus the first look of these shales is always deceptive. It appears to have interfingered with the Attock Shales mainly due to tectonism.

These consist of calcareous and arenaceous thin bedded friable shales, where squeezed become indurated, with typical yellowish green colour.

Topographic Expression:

In the less disturbed section they are well displayed along the slopes of the ridges, otherwise in disturbed area - they usually form pockets and appear interfingered with the Attock Shales.

Contact

Their contact is sharp with both the overlying marls (Kawagarh) and the underlying impure limestone and the Attock Shales.

Age and Correlation:

These shales are first reported in this area. So far no fossil evidence is in hand but from their lithological character and the stratigraphic position they occupy, they appear to be similar to Belemnitebed (Chichali Formation) which are lower Cretaceous in age.

CALCAREOUS SHALE AND MARL

Lithology:

Dominantly argillaceous; consisting of soft, thin bedded friable calcareous shales and marl. White to light gray, with conspicuous pinkish brown tinge.

Thickness and distribution:

This bed is also not continuously traceable and its thickness fluctuates from place to place. Due to its soft nature, in the disturbed area this bed is squeezed localised and disrupted. In Rumia section, where it was first distinguished, its thickness may be around 20 feet. Farther south around Kanwala, about one and half mile west of Dakhner village it is well developed and is around 25 feet in thickness.

Topographic Expression.

This bed is soft and has yielded to the tectonics. It is mostly exposed along the steep slopes of the sharp ridges underlying competent limestone.

Contact:

Its contact with the older formation is sharp and well defined. The top of this bed is associated with the lateritic horizone (Paleocene unconformity).

Age and Correlation,

On the basis of lithology this bed is tentatively correlated with the Kawagarh Formation of Kala-Chitta which is considered to be upper Cretaceous in age.

LATERITIC HORIZON

This horizon is very conspicuous in this area and forms a well defined unconformity between Kawagrah Marl? (upp. Cretaceous) and Paleocene Formation. It consists of pisolitic lateritic band - ranging in thickness from a few inches to 4 - 5 feet, and is not contitinuous in development. It is usually squeezed and appears as isolated pockets.

PALEOCENE

Paleocene is represented in this area by two distinct lithological facies, namely.

1. Dominantly arenaceous (gristone)
2. Calcareous and agillaceous (limestone and shale)

GRITSTONE

Lithology:

Thick bedded to massive, medium to very coarse grained and containing small iron modules. It is composed of angular to subangular quartz (dominant) and chert, cementing material being siliceous. In colour it is white to rusty brown.

Thickness & distribution :

This bed is developed under light gray nodular limestone, It has got a limited distribution and is confined to the southern part of the area under study. Its thickness varies from a few inches to 3 feet.

Topographic Expression :

This bed is usually exposed along the slopes of sharp ridges.

Contact :

Its contact with both the overlying limestone and underlying lateritic band is sharp and well defined.

Age & Correlation :

No fossil has been recorded from this bed — but its association with foraminiferal limestone and lateritic bed is suggestive of lower Paleocene age.

LIMESTONE

Lithology :

Overlying the gritstone are dark gray to black limestones which are fine grained, hard and compact. They are thick bedded to massive and weather into round nodules. They contain calcite veins and are fossiliferous.

Besides in the Paleocene succession, impure argillaceous limestones are also encountered which are yellowish brown on both fresh and weathered faces. They are thick bedded to massive and give surficial brecciated look. These limestones at places, also contain thin marly bands. Both of these limestones occupy separate horizons but in some sections are found together; argillaceous limestone underlying the dark gray variety.

These limestones are overlain by yellowish green, soft, friable shales which are fossiliferous and contain calcite veins. Due to their soft nature, they have been severely affected by the tectonics and appear as discontinuous squeezed bands.

Thickness & distribution :

The Paleocene limestones are exposed throughout in the area under study — but they show development in the south. Their thickness may very from 20 to 80 feet.

Topographic Expression :

Due to their hard nature, most of them are developed along the skyline of the narrow ridges.

Contact :

Their contact with the gritstone bed is sharp. Where gritstone is not developed these limestones are found in direct association with the underlying lateritic unconformity, with it they also show sharp contact.

Age & Correlation :

On the basis of fossils these limestones are assigned Paleocene age. Light to dark gray variety of limestone is tentatively correlated with the Lockhart limestone of Kohat.

CONCLUSIONS

The earlier workers had considered the whole sequence exposed in the area under investigation as a part of the Attock slate series which were placed in the Precambrian. The present investigation considers the rock types exposed here to represent a typical Mesozoic sequence which appears to form a link between Kohat and the Hazara facies lying toward the west and east respectively.

The Manki Slates (Lr. Paleozoic ?) which form prominant outcrops overlooking the Kabul river on the other side of the Indus are not exposed in this area. It is suggestive of the fact that this formation has got different orogenic trend which confirm its alignment with the Gandghar Range extending upstream along the Indus — in the westren Hazara.

The Attock Shales, name given to sooty splintry and friable shales are more extensively developed in

this area, and continue eastward with east west strike. In this area, these shales have yielded typical lithological characters which help in correlating them with the Spiti shales of Hazara.

The yellowish - green friable sandy shales placed in the lowera Cretaceous are described for the first time from this erea. In lithology they are similar to the Davies Belmnites bed of Kohat, which in the new terminology is called Chichali Formation. This bed is well developed in the two sections, about one and half mile west of Dakhner village, where it was first diagnosed and differentiated from the Attock Shales. This bed being soft - has yielded more to the weathering agents and tectonics with the result that it has become squeezed and localized. At many sections it appears to have either interfingered with the Attock Shaels or overlying them.

The area under study is being mapped on a 4 inches to 1 mile map - which will yield more informations and the results will be published in the ensuing Bulletin.

REFERENCES

1. Ahmad, Mesbahuddin, 1965. Personal communication.
2. Cotter. G. de P. 1933. The geology of part of the Attock District West of longitude 75° 45' E; Mem G.S.I.,P. 63-161, pt. 2.
3. Middlemiss, C.S. 1896, The geology of Hazara and Black Mountains, Mem. G. S. I., 26 pt. I, 1-290.
4. Mohammad Ali, Ch. 1962. The stratigraphy of the southern Tanol Area, Hazara, W. Pakistan Geol. Bull. Panjab University 2, 31-40.
5. Tahirkheli, R.A. Khan, 1966. Recent observations on the undifferentiated Attock Group, ZMAKA, Geological Bulletin, Department of Geology, University of Peshawar. p. 10-23
6. Tahirkheli, R. A. Khan, 1968. Present status of the Attock Slate series. Symposium held at the University of Sind Hyderabad, in the press.
7. Wynne, A. B. 1873. Notes from progress report on the geology of parts of the upper Panjab. Recd. G.S.I., p. 59-64, pt. 3.