

Recent Observations on the Undifferentiated Attock Group*

R. A. Khan
Tahirkheli

Abstract

Under the light of recent investigations the Attock Slates are found to contain five distinct lithological units which are easily differentiated in the field and belong to different ages. Three of these units are dated to be Upper Mesozoic, one is assigned a pre-Cambrian age and the fifth unit is still under observation and is tentatively placed in the Paleozoic. The argillaceous part of the Attock Group which was previously, considered to be one homogeneous unit is split into two divisions and named "Manki Slates" and "Dag Slates." The later contain fossilized bands of limestone and on the basis of diagnostic fossil (Cerithiopsida), have been dated to be Upper Cretaceous age. These two slates have got tectonic contact and the older Manki slates are found to have thrust over the younger Dag slates.

Introduction

The 'Attock Slates' occupy a prominent place in the stratigraphy of Indo-Pakistan subcontinent. Wynne first described these slates in 1873 and assigned them a Pre-Cambrian age. These slates are named after the historical town of Attock on the left bank of the Indus, where these rocks are well exposed in the road cutting along both the banks of the river.

Middlemiss (1896), Holland (1926) and Cotter (1953) followed Wynne and on the basis of lithological characteristics correlated them with the Hazara slates which unconformably underlie the Infra-Trias. Almost all the geologists who succeeded Wynne in mapping the Attock slates, followed his classification and mapped them as a single undifferentiated unit composed of dominantly pelitic facies. The description of these slates as given in the lexicon is as follows:—

"Named by A.B. Wynne (Mem. Geol. Surv. Ind., Vol. 9, p. 33, 1873) after the town on the Indus (33°53', 72°17'). Unfossiliferous dark or black slates, limestones and sandstones of an olive, some times liver colour are also with intrusions and inter-bedded trap. They are identical with the slates series of

* A new terminology for the Attock Slates adopted by the stratigraphic Committee of Pakistan.

Hazara (Men. Geol. surv. Ind., Vol. 26, p. 10, 1896), where they underlie the Infra: Trias of Hazara with marked unconformity and are now regarded as probably part of the Purana Group.”

The present geological investigations on the Attock Slates were started in August 1964 and most of the work was confined to their type area in Peshawar District (topo. Maps 380/13, 43c/1). The extent of the area under study is delimited by the river Indus in the East and Pabbi — cherat road in the West. Towards the south the investigation is extended to the northern fringe of Nizampur valley. The isolated hillocks exposed along the northern bank of Kabul river are also included which form the northern limit of the area. A total of some 200 square miles of the area was brought within the fold of this investigation.

The purpose of the present study was to gain detailed information on the general setup of the various different lithological units comprising the Attock Slates. This problem required a close examination of each unit in the Attock Slates to see whether it is possible to differentiate it in the field and plot it on the map as a separate mapable unit.

The work on the Attock Slates is still in progress and this paper is intended to provide preliminary informations on the problem. A more detailed report is to be published after the completion of the work.

Topography

The area under investigation lies in Peshawar district and constitutes the eastern limit of Peshawar valley where Kabul river joins the mighty Indus. The area is rugged and criss-crossed by numerous Khawars which yielded a badland topography. A few of these nallas have perennial flow which support isolated hamlets in the mountains.

The mountains are parallel with a general trend to east west direction. The river bed near Kund Rest House is 233 feet a.s.l. and the adjoining plain with numerous isolated mounds, composed of Pleistocene and Recent formations, rises to over 200 feet near the foot-hill. The highest peak in the range is over 3300 feet a.s.l. and local relief is usually over 2000 feet.

The Kabul river flows along the strike between Nowshera and Akora Khattak. About a mile upstream of its confluence with

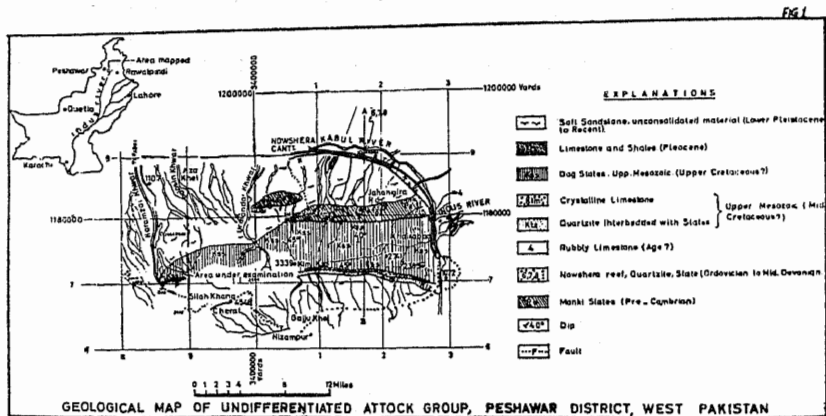
the Indus, the rocks comprising the oldest member of the Attock Slates (Pre-Cambrian) traverse the valley oblique to the course of the river. Numerous heaps of river gravels located near the mountain slopes, point out the former course of Kabul river, which used to flow along the foot-hill of these ranges.

Geology

The Attock slates and the rocks outcrop along the northern bank of Kabul river are separated by an alluvium belt 3-5 miles wide, which cover their contact plain. So far these two groups of rocks were treated separately by the previous workers. But the recent studies have revealed that at least one member of the Attock group, the oldest formation comprising slates and phyllites which have been subjected to intrusions, is closely associated to the rock outcrops exposed in these hillocks.

The Kabul river exposures are developed in four isolated hillocks with a general east-west strike. A complete succession is not encountered in most of the exposures. Hence for convenience, only one section near Akora Khattak village is described here and work is under way to measure these sections and prepare a stratigraphic column for correlation.

In the Attock group, the pelitic facies which are dominantly developed, belong to two different ages. These can be differentiated in the field on the basis of distinct lithological characteristics and also due to dolerite sills, which are present in one of them. The fossilized limestone bands are also recently discovered in the younger slate member which further authenticated the distinguishing characteristics of these two slates formations. These two formations combined, together, constitute over three-fourth of the exposed outcrop. Due to intense folding and faulting, the thickness of these beds are exaggerated at most of the sections.



A geological map (1 inch = 4 miles) and a section (Figs. 1,2) included in this paper will throw some light on the general set up of various lithological facies and their structural relationship. A few of the lithological units, shown on the cross-section could not be represented on the geological map because they are not of adequate thickness to be commensurate with the scale of the map. However a large scale map is being prepared to plot these units individually which will be published in the near future.

Stratigraphy

Present investigation has revealed five distinct lithological units which compose the undifferentiated Attock group. These units are being closely examined to see whether any further sub-division is possible. All of these members are consistently exposed in the area, easily differentiated in the field and occur as distinct mappable units. The limestone band, which separates the two slate formations is the thinnest unit in the group with a thickness of about 40 feet, which can be plotted on a large scale map.

Along the northern bank of Kabul river, the isolated hillocks show three (?) major lithological formations. Among them, the limestone constituting Nowshera reef has been dated on the basis of diagnostic fossils.

The following lithological units are differentiated in the Attock group, when traversed from South to North.

- | | App. thickness. |
|---|-----------------|
| 1. Grey, white, pink and brown flaggy quartzites intercalated with slaty shales and slates. Decomposed limonite and pyrite specks are common in quartzite. | 400 feet. |
| 2. Yellowish brown crystalline limestone with numerous thin wavy veinlets of calcite and quartzite: Calcareous shales and carbonaceous pockets are recorded near the top. | 200 feet. |
| 3. Light and dark grey slaty shales intercalated with brownish and greenish siltstone. Bands of light to dark grey and brown limestone with numerous calcite veinlets are present. Thin stringers of quartz veins are sporadically distributed. Limestones are sparingly fossiliferous. | 5000 feet. |

Unconformity

4. Light to dark grey crystalline limestone weathering yellow brown and containing specks of limonite and pyrite. Surficial rubly texture is conspicuous. 50 feet.

Unconformity

5. Light and dark grey slate and phyllite with bands of dark crystalline limestone. The limestone weathers to yellow and brown. Specks of decomposed pyrite and limonite are also recorded. Carbonaceous horizon is very conspicuous and sills of dolerite occur as intrusions. 1500 feet.

The rock types encountered in the outcrops exposed north of Kabul river near Akora Khattak is as follows:—

6. Grey, pink and brown quartzite intercalated with slate and phyllite. Igneous intrusions are common. 300 feet.
7. Slate and phyllite interbedded with thin calcareous bands, 1 to 3 inches thick. Igneous intrusions are present. 70 feet.
8. Light and dark grey crystalline limestone with disturbed contact plane. Igneous intrusives are recorded near the base. 40 feet.

Lithology

1. Quartzite intercalated with slaty shales and slates are developed along the southern fringe of the Attock group in Nizampur valley. Their base is not exposed. These rocks gradually wedge out as one follows them from east to west along the strike. The quartzites are thin bedded and contain specks of decomposed limonite. The colour is usually brown and pink which are usually associated with the weathered surface. Grey and white bands are also prominent. White quartzite is feldspathic and at places, due to decomposition of feldspar, could be disintegrated with a touch of finger's tip.

The argillaceous bands occur as intercalations and near the junction of quartzite, they appear to be silty. Slaty cleavage though developed at a few sections is not common. At one section quartzite is folded into an anticline and slates are found occupying

the core of the fold. The slates are light to dark grey and also contain decomposed specks of limonite. The average dip in these rocks is 40° North.

2. Grey and brown crystalline limestone conformably overlies the abovementioned formation. Near the base the limestone is silty. Numerous thin wavy veinlets of quartz and calcite are the characteristic feature of these limestone. It is thin bedded and contains partings of calcareous shales also. Carbonaceous pockets are present near the top. Encrustation of alum is particularly noticed wherever the water oozes out from these beds.

3. The slaty shales comprise the thickest unit of the Attock Group. The siltstone which occurs as intercalations are most conspicuous in the outcrops exposed towards south and south west of Manki and Ziarat Kaka Sahib, respectively. Siltstone is grey and greenish grey when fresh, whereas the weathered surfaces yield deep pink and brown colouration. In this section the siltstone is made up of very fine angular grains of quartz, and cementing material is largely argillaceous. The western extension of these beds continues as far as Dag village, on Pabbi - Cherat road, where they are underlain by the Paleocene formation. The author first studied these slates at Dag which exposes a good section along the road cutting and are well conversant with the distinguishing characteristics to separate them from older Manki slates. Therefore, the name Dag slates is considered to be more appropriate for these beds:

Dag slates are less metamorphosed and retain sedimentary character which is one of the major factors for separating them from Manki slates. The limestone bands present in Dag slates are also less crystallized. The slaty shales are light to dark grey and on weathering split into splintery pieces. Due to intense folding the beds are squeezed and fractures are well developed.

During author's traverses, fossilized limestone bands were discovered in Dag slates which are now being examined for diagnostic fossils. M. W. A. Iqbal from Geological Survey of Pakistan, who is working on these fossils, has reported presence of Cerithiopsida, whose geologic time range is from Cretaceous to Early Tertiary. A few samples have also been sent to M.A. Latif, Department of Geology, Punjab University, whose results are still awaited.

From the stratigraphic position of these beds at Dag village, where they underlie Paleocene formation coupled with the range of

diagnostic fossil identified by Iqbal, Dag slates are tentatively placed in the Upper Cretaceous. Work on the fossils is being pursued for more authentic evidences in favour of this age.

The junction of Dag slates at the northern contact with rubly limestone and Manki slates is faulted where the later two beds are usually seen overlying the former. This thrust fault is more conspicuous near Ziarat Kaka Sahib where displacement is more intimately observed.

A cursory examination of a few sections in Hazara district for correlation purpose revealed that Dag slates extend farther and are developed in the ranges of southern Hazara. One such section is exposed in Rehana village south east of Haripur - which exposes Dag slates. This find is very important because a thorough check is needed to separate these beds from the Hazara slates.

4. A limestone band about 50 feet thick usually separates the Dag slates from the older slates and phyllites. This limestone bed is the thinnest in the Attock group, but is consistantly developed.

The limestone looks yellowish grey on the surface and is dark grey to black on the fresh faces. A peculiar surficial rubly texture is observed in this limestone which helps in its diagnosis. Decomposed specks of limonite and pyrite are usually found over the surface. The type section for examining this limestone is over a hillock in Ziarat Kaka Sahib village and another exposure at an easy access is in a nala about a mile east of the village. This limestone bed is thoroughly investigated but so far no fossils are discovered.

The surface look of this limestone indicates that the elongate rubbles are the result of an autoclastic texture in which the dense limestone inclusions are sheared and orientated in accordance with the stress. The fresh faces of this limestone is however, homogeneous which show the rubby texture is confined to the surface only.

5. Slates and phyllites with bands of yellowish brown and dark grey crystalline limestone are the oldest member of the Attock group. Unlike the other members of the group, this formation has revealed to contain numerous sills of igneous intrusions. The type section of this formation is Manki, where these rocks are well exposed in an isolated hillock which gradually terminates at a point about 2 miles west of the village. The bed strikes to east-west direction at Manki which gradually swings to NE-SW at the road cutting near Kund Rest House. The dip varies from 35° to 60° to the north and north-west direction.

The slates are light to dark grey, well cleaved at a few sections and split into rectangular chips of various sizes. The weathering product of these slates are quite distinct from Dag slates, which considerably help to distinguish them from each other in the field. Slates are quarried at Manki and Ziarat Kaka Sahib, but due to fractures developed in them, the large slates are not extractable. Pockets of soapstone also occur in these slates and a mine behind Kund village is already under operation, but from the output it appears that the deposit is not economical for large scale operation.

Carbonaceous horizon in these slates is also very pronounced which extends laterally and at one section exposed about 4 mile south of Kund, it was measured to be over 20 feet thick.

No fossil has been located so far in this bed. The samples collected from carbonaceous bands were also examined by Dr. Faridi, Chairman, Department of Botany, Islamia College Peshawar, who did not find any remain of living organism. The limestone bands in these slates formations show higher grade of metamorphism which considerably obscured their original texture. Specks of decomposed limonite and pyrite are also common in these rocks. In one slate specimen, specks of over 1 inch diameter were frequent in number.

Quartz veining is also a characteristic feature of this formation. The vein are thick and a few of them have cut across the structure.

The slates as discussed before are well exposed in an isolated hillock near Manki which is also easily accessible. Thus these rocks are named Manki slates for giving them a separate entity in the Attock group.

As no fossils are recorded from Manki slates, a pre-Cambrian age to these beds is consonant to the present findings. Thus the Kabul river outcrops of lower Paleozoic age unconformably overly the Manki slates.

These slates when followed along the Indus river upstream of Attock are exposed in the bold ridges around Tarbela and Amb with a general north — south strike. These slates continue farther north and about two miles upstream of Takot in the merged Hazara Tribal area, Manki slates come in contact with the Hazara slates which crosses the Indus with east-west strike and extend into the lower Swat.

6. Thin bedded quartzite: brown, pink, grey, and interbedded with slate and phyllite are exposed at the base in the hillock north of Akora Khattak. From the ripple marks and cross bedding, the sequence here appears to be normal and hence quartzite are the oldest member of this succession. The lithological characteristics of quartzite are identical to the one discussed in the Attock group, except that the later is not associated with any igneous activity whereas the former contain numerous sills of dolerite. The argillaceous intercalations in quartzite at Akora Khattak are also more metamorphosed and slates are frequently recorded. The strike of the bed is east-west with dip varying between 40° to 65° towards North.

7. The quartzites are overlain by slate and phyllite, interbedded with thin bands of limestone and calcareous shales, 1 to 3 inches thick, which revealed a few shells of mega — fossils of no diagnostic value. Quartzite bands are present near the top. This horizon appears to be the passage zone between quartzite and overlying limestone.

8. Light to dark grey, crystalline limestone, is the youngest member in this succession exposed north of Akora Khattak. Their thickness at this section is over 20 feet and the beds are slightly disturbed. Igneous intrusions are very common near the base of this outcrop. The dip varies from 55° to 70° north. The contact relationship of these limestone with the underlying bed appear to be normal.

Igneous sills

As mentioned elsewhere, the igneous sills in the oldest member of the Attock group, the Manki slates, were very helpful to distinguish the two slate members, because both of them previously were considered to be homogeneous and were assigned a pre-Cambrian age en masse. Similar sills are of frequent occurrence in all the outcrop encountered along the northern bank of the Kabul river.

The sills are yellow and brown, medium to fine grained which usually cut across the structure. The sills are usually metamorphosed and partly or completely decomposed. Under the microscope the minerals identified are anhedral to subhedral plagioclase (49.5 %), monoclinic pyroxene in the form of anhedral augite (40.0 %) whereas magnetite and ilmenite, (8.5 %) occur as accessory minerals. Both augite and plagioclase are altered. Iron oxide also shows alteration and iron stained grains are fairly abundant.

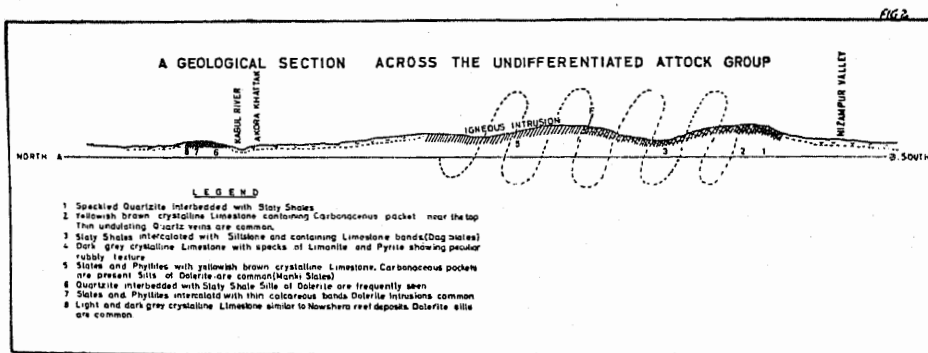
Olivine and kaolinite (2.0 %) are identified as secondary minerals. From the texture and composition the rock has been identified as dolerite.

These sills may be correlated with the Swabi intrusives — which are located at a distance of 20-25 miles north of these outcrops.

Structure

Structure in the Attock group had created problems for discerning the facts in the field. The two slates members, being incompetent rocks comparatively yielded more to the movements which resulted in squeezing and juxtaposition of these beds. The section exposed along the road cutting on both the banks of the Indus near Attock throw enough light on the structural implications which made separation of the two slates members difficult.

The Dag slates at Dag section dip under Paleocene formation in south east direction whereas farther east, the dip in all the members of Attock Group, including the lower Paleozoic beds of Kabul river, is towards north. The Manki slates show a swing in the strike which is east west near Manki and north east — south west on the G.T.S. road near Kund Rest House. The slates are tightly folded and fractures are developed which are more pronounced in the Dag slates. From the ripple mark, cross bedding and cleavages, it appear that the beds are repeated. The folds are generally isoclinal with their oblique axis dipping, between 45° and 55° towards north.



A major fault running east-west direction divide the Upp. Mesozoic beds from the Pre-Cambrian and the lower Paleozoic outcrops of Kabul river. This fault appears to be the result of overfolding of an anticlinal structure where the Dag slates are thrust over by the older rubly limestone and Manki slates respectively. This thrust has been traced to the west as far as Khyber Pass—where the Dag slates, west of Jamrud are seen underlain

by the older massive and dark coloured crystalline limestone. In the Attock group, this fault is more pronounced in a section about two miles east of Ziarat Kaka Sahib.

Conclusions

1. Most of the previous workers have correlated the Attock slates with the Hazara slates. The author was associated with the later for a couple of years while conducting geological investigations on the feasibility of the Tarbela Dam site and during this work many common characteristic features were recorded which bring these two slates formations close to each other. Moreover if one follows these slates east-ward from Attock, north of Hassanabdal, one can clearly see the syntaxial bend which have changed, the strike of the Attock slates from east west to north south direction, and with this strike these slates extend along the Indus valley upto Jijal, a village about seven miles down-stream of Pattan in Swat Kohistan. The Hazara slates are, homotaxial to the oldest member of Attock group, the Manki slates, consisting of slate and phyllite which has been assigned a pre-Cambrian age.

The Khyber slates have also come to the limelight and recently this name is very frequently used by the geologists and a few have given them a separate entity in the stratigraphy of Pakistan. The author investigated these slates also to see whether these are homotaxial to the Attock slates.

The Attock slates when followed westward continue as far as Dag and the last outcrop is exposed about half a mile south west of the metalled road, in a nala. Beyond this point the Attock slates extend underneath the Murree formations and the thick mantle of recent alluvium, until they crop out again in the hill ranges of Khyber Pass.

As mentioned elsewhere, the slaty shales exposed east of Jamrud Fort at the entrance to Khyber pass are identical to Dag slates which are overlain by the older, dark and massive crystalline limestone. The pre-Cambrian outcrops equivalent to Manki slates are exposed at Landi-Kotal which could be followed eastward as far as Torkham Post. These two slates are separated by a thick crystalline limestone formation which occasionally show rubly texture and the cursory examination of a few sections along the road brought to light beds which could be correlated to rubly limestone of the Attock group on lithological grounds. Thus it is preferable to conduct detailed investigations of the Khyber Pass out-crops for correlative purposes than to assign them a separate entity in the stratigraphy of Pakistan. In the Khyber Pass atleast three members of the Attock group are recorded.

2. The Attock slates outcrops as mapped by the previous workers as a single undifferentiated unit is very much disputed under the light of the author's recent observations. To apply a pre-Cambrian age to these slates en masse is also not conformable to the present findings.

Nowshera reef in the Kabul river outcrops had already been dated to be Silurian — Devonian in age on the basis of diagnostic fossils located and examined by Teichert and Stauffer. More fossils have also been collected by the author from the limestone beds in the other isolated hillocks which are now being examined. The quartzites at Akora Khattak and in the other exposures apparently underlie, the other formations and thus form the oldest bed exposed north of Kabul river. These quartzites, as would be discussed later, are correlated with the quartzite outcrops exposed upstream of the Tarbela Dam along the eastern bank of Indus.

In the earlier stages of investigation the igneous sills and the lithological characteristics of the rock assemblages played greater role to distinguish various components of the Attock group. But the recent discovery of fossilized limestone bands in the slates by the author, was a landmark in the stratigraphical history of Indo-Pakistan subcontinent which helped to change the whole conception about the Attock slates. The argillaceous component of the Attock group, which covered extensive portion of these outcrop around Attock for which they won their name (Attock slates) were previously considered to be occupying one stratigraphic horizon and were assigned a pre-Cambrian age en masse, But now the field investigations authenticated by the discovery of fossilized bands and identification of Cerithiopsida among the fossil assemblages by Iqbal clearly indicate that the slates of Attock group are of two different ages and that one which is younger in age (Dag slates) is extensively developed than the other. The time range of family Cerithiopsida is Cretaceous to Early Tertiary and then at Dag section the Dag slates are also found underlying the Paleocene formation. These factors are undoubtedly in favour of assigning these beds an Upper-Cretaceous age.

The Manki slate is the only member of Attock group, which has been placed in the pre-Cambrian. These beds did not reveal any fossil yet and moreover the presence of igneous sills, unlike the other members of Attock group, is also suggestive of the fact that they are the oldest. The swing in the strike of Manki slates to NE-SW direction near Kund Rest House, throw ample light on the lateral continuation of these slates. If this strike direction is followed upstream of Attock along the Indus, it coincides with the strike



of the metamorphosed outcrops of Hazara. In other words as explained earlier, the Manki slates structurally also merge with the Hazara slates outcrops exposed along the Indus river near Tarbela Dam.

The thinly developed rubly limestone band separating the two slate members of the Attock group is also devoid of fossils. In the normal sequence this band should be younger to the Manki slates and older to Dag slates. This sequence is also further confirmed by studying the igneous sills — which throughout along the contact plan, did not show any association with the rubly limestone. Thus the age of rubly limestone should be post Mid-Devonian and most likely Upp. Paleozoic. This limestone band may easily be correlated with the rubly limestone of Khyber pass where it shows a thick development. The thinning out of this limestone in the Attock group may be attributed due to tectonic causes

The quartzites intercalated with slaty shales and the crystalline limestone developed along the Northern fringe of Nizampur valley also did not yield any fossil yet. The Mid-Cretaceous outcrops in the Nizampur valley exposed farther south of the present area contain adequate development of arenaceous facies consisting of quartzite and quartzitic sandstone. An attempt is being made to correlate these quartzites with these outcrops. Hence these quartzites including the crystalline limestone are tentatively placed in the Mid-Cretaceous.

3. During the present studies some knowledge is also gained on the outcrops of quartzite exposed between Tarbela and Dal Darra upstream of Tarbela Dam site along the eastern bank of the Indus in Hazara. Previously these rocks have been designated as Tanol formation by Wynne in 1879, who placed them as Infra-Trias. Ch. Mohd Ali from the Punjab University has further investigated these quartzite in 1962 and produced a detailed description on lithology and structure.

These quartzites on the basis of lithology and igneous intrusions appear to be more closer to the quartzites exposed in the hillocks along the northern bank of Kabul river. From the stratigraphic position they occupy, their age may be lower Silurian or Ordovician. The swing in the strike of Kabul river quartzites, like Manki slate, is also conformable to the exposure upstream of Tarbela Dam. Thus structurally they are also aligned.

4. The Dag slate outcrops extend eastward and as mentioned previously, a few sections examined in the southern ranges of Hazara, did confirm the presence of these slates.

The previous workers in most of this area, mapped these slates along with the Hazara slates. Therefore a thorough examination of this area is recommended to separate Dag slate from the Hazara slates.

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