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Note on the "Attock slates" and their probable geological position, *by* Dr. W. Waagen.

In the Records of the Geological Survey of India, Vol. XII, pt. 2, there is a paper by Mr. Wynne, entitled. "Further notes on the geology of the Upper Punjab," which bears a special interest on account of the general views on the geology of that country. As many of the points treated of in the paper are yet to be considered as open questions, it seems not advisable to pronounce any opinion on them until further materials have been collected, but it may not be useless to notice some points which might be of value towards the elucidation of the questions discussed by Mr. Wynne.

There is before all the age of the "Attock slates." Mr. Wynne is quite right when he considers the evidence upon which the opinion of their being of silurian age is founded very scanty indeed; and only the absence of any other clue towards the determination of the age of those slates could at the time justify the opinion expressed in our joint memoir on Mount Sirban, that the occurrence of lower silurian fossils in gravels in the Kabul river, which lay approximately in the strike of the "Attock slates," would make a silurian age probable also for the latter.

It is very much to be regretted that to the careful search of Mr. Wynne the slates have proved absolutely unfossiliferous up to the present. Yet this sterility in fossils seems not to prevail at all localities. Among the materials which have been most liberally sent to me by the Geological Society of London, there are about a dozen specimens of a Spirifer, which bear, however, only the label "Punjab." These specimens are preserved in a black slate, which, if the specimens came really from the Punjab,—and there is no reason why this should be doubted,—must have belonged to the Attock slates, as there is no other rock known to me in that part of India which would bear similar petrographical characters, and from which the specimens could have come.

Though these fossils are more or less deformed by oblique pressure, yet the species can without difficulty be determined. All the specimens belong to one and the same species, and cannot be distinguished from *Spirifer keilhavi*, Buch., (*Sp. Rajah*, Salt.). As this species is one of those most characteristic of the carboniferous formation in the Himalaya, and as thus the determination of the age of the rocks from which these fossils came considerably differs from the age hitherto attributed to the Attock slates, it is necessary to be doubly cautious in accepting the current opinion regarding these slates.

The rock in which the fossils are preserved is, as stated above, a black, not very hard slate, such as I have seen to occur at many places in the Attock slates; but there are also outside of the Punjab some localities where similar slates occur. I have myself seen similar slates from the Milam pass which seem also to belong to the carboniferous formation, and seem to be there inferior to white limestones, also full of carboniferous fossils, the latter, however, of a much more recent type. Similar slates have been described by Lydekker from Eishmakam in Kashmir, whilst at other places in the same territory the carboniferous formation is composed nearly entirely of thick limestones. The slates of Eishmakam have been compared by Lydekker to the "Kiol group" and the limestones to the "Great limestone" of the outer Himalaya. Thus it might be very possible that in the Himalaya the carboniferous formation should present two sub-divisions, one older slaty, and one younger calcareous sub-division. This, however, does not prevent that at many localities the whole formation might be made up of massive limestones.

If, therefore, the fossils under consideration did not come from the Punjab, they might have come from several parts of the Himalaya. There is, however, no reason to doubt their coming from the Punjab. There exists in the Punjab a great amount of rocks perfectly similar in appearance to the rock in which the specimens occur, and if these rocks up to the present have proved apparently unfossiliferous, this does not exclude the possibility that there exist localities where fossils do occur. That all these fossils belong only to one species already goes far to prove that the slates containing them are not very rich in fossils. How much it depends on circumstances whether one does meet with certain fossils is also exemplified by the fact that I as well as Mr. Wynne have been searching in vain in the Salt-range for determinable plant remains, and yet there are several beautifully preserved plant remains from the Salt-range in the Geological Society's collection.

Thus we may fairly accept the indications of the label attached to these specimens of *Spirif. keilhavi* as correct; and from this it would follow, that the Attock slates will have to be considered in future as belonging very likely to the carboniferous period.

If we accept this view, one of Mr. Wynne's remarks becomes of special importance; this is that the limestones of Gandgarh remind one more or less of the great limestone of the Jamu hills. This would fit entirely into the state of things observed elsewhere, and the discrepancy, at least in the carboniferous formation, between Kashmir, Jamu, and Hazara would no longer be so striking as is supposed by Mr. Wynne. These limestones are entirely absent in the

neighbourhood of Mount Sirban, and this absence possibly might account for the marked unconformity there between the Attock slates and the more recent formations.

But also for these latter the determination of the Attock slates as of carboniferous age would have a deciding influence, as then the geological horizon they occupy might approximately be fixed. In the little memoir on Mount Sirban, Mr. Wynne and I have distinguished a group of rocks as "Below the Trias," consisting chiefly of cherty dolomite, to which are subordinate red sandstones and quartzites. We have separated these rocks from the Trias for the simple reason that there existed no proof of any kind that they belonged to that formation, and as we then considered the Attock slates as of silurian age, the number of formations to which those strata "Below the Trias" could have been assigned, was so very large, that it seemed only prudent not to express any definite opinion as to their age. Now the case is quite different: these beds would rest unconformably on the carboniferous Attock slates, and be succeeded conformably by upper triassic or rhætic strata; thus it becomes very probable that the strata "Below the Trias" represent the Lower Trias, *viz.*, Muschelkalk and Buntsandstein formations.

In his more recent memoirs Mr. Wynne introduces the designation of "Infra-triassic group" for these strata, and most recently he considers this group as identical with his "Tanol series," which is extensively developed in the northern part of Hazara; but such a homotaxis can hardly be maintained. Wynne's "Infra-triassic group," or the group "Below the Trias" of our joint memoir on Mount Sirban, consists chiefly of cherty dolomites, and exhibits sandstones and quartzites in a subordinate manner only, whilst according to the sections published by Mr. Wynne, the Tanol series consists chiefly of slates, sandstones, and quartzites, to which the dolomitic limestones are subordinate.

Besides this the thickness of the group "Below the Trias" and that of the Tanols is so enormously different that a comparison between the two is barely possible.

The only formation to which the Tanol series seems to bear some resemblance is the silurian of the more central parts of the Himalaya (Milam pass, Niti pass), where the fossiliferous beds consist also of white sandstones.

The apparent superposition of these Tanol rocks over the carboniferous Attock slates can be no reason for the rejection of such a parallelisation. Before it is possible to accept Wynne's view that the Tanols are more recent than the Attock slates, and pass upwards into the gneiss which composes the central Himalayan chains, much stronger proofs, stratigraphical as well as palæontological, than those published in his memoir must be adduced; and until decisive materials are available, it will be much more prudent to consider the whole silurian Tanol series as overthrown and faulted against the Attock slates. Then the riddles of the geology of Hazara will easily be solved.