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**Some Geological Notes and Problems on the Chitral
Valley (North-West Pakistan)**

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Geologia. — *Some Geological Notes and Problems on the Chitral Valley (North-West Pakistan)*. Nota^(*) del Socio ARDITO DESIO.

RIASSUNTO. — Viene sommariamente descritta la composizione geologica della valle di Chitral nel Pakistan nord-occidentale e messe in evidenza le affinità di varie formazioni ivi affioranti con formazioni dell'alta valle Swat, di quella del medio Indo e delle valli di Yasin, di Hunza e di Shigar nel Karakorum.

The Chitral valley is watered by the river of the same name, which, together with the Mastuj, is the chief source of supply of the Kunar, in its turn a tributary of the Kabul (Indus basin).

It is a wide valley, originating at the confluence of the Mastuj and the Lutkho, and closes in a gorge below Mirkhani. The road that links Nowshera, situated on the great Islamabad-Peshawar artery, with Chitral, ascends the Dir valley and surmounts the range of the Hindu Raj at the Lawarai pass (3110 m), then descending the valley of the Ashret as far as the confluence with the Chitral at Mirkhani.

I first passed through the Chitral valley many years ago (1955), following the Mardan-Dir-Chitral-Mastuj route, through the Shandur Pass, Gupis (Yasin) and Gilgit. During the following period I was engaged upon other researches in the territory situated further west. Only three notes appeared on the Chitral area: one deals with the fossil-bearing Cretaceous outcrops of Kring, Nal and Dundi Gal (Desio, 1959), together with that of Yasin (130 km further east); another is devoted to the Devonian outcrop of M. Shogram (1966) near Reshun; the third to the glacial deposits of the valley of Chitral and Dir (1961).

In the meantime, studies were made of the rock samples and fossils collected. The latter were also described in monographs by A. von Schuppé and Vandercammen (1965), regarding the Devonian fossils, and by M. B. Cita and M. A. Ruscelli (1959) and by C. Rossi Ronchetti (1965) regarding the Cretaceous fossils of the above-mentioned localities.

Few other geologists had passed through the Chitral valley before me. In particular, mention should be made of H. H. Hayden, who in 1914 followed the same route as myself as far as Mastuj in the Chitral valley and published a very interesting but somewhat summary report (1916). A few other data have been added by G. H. Tipper (in E. H. Pascoe and L. L. Fermor, 1924).

The road that approaches from the south enters the Chitral valley at the Pass, where a gabbro-dioritic complex outcrops with frequent noritic types that here make up the two opposite sides of the range of the Hindu Raj. On the north slope may also be noted belts of amphibolite associated with hornblendite with foliation dipping north-west and inclined at 50-70°. Much further north, in the Laspur valley, between Chitral and Mastuj, the amphibolites are much more developed and better exposed (Desio, 1966), and for this reason I have assigned the name of *Laspur Amphibolite* to this

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lithostratigraphic unit. Perhaps it is to be correlated with the "Askore Amphibolite" of the Shigar Group of Cretaceous-Eocene age (Desio, 1963). On the Lawarai Pass and for a few kilometres to the south of it emerges a leucogranite mass which sends out apophyses into the above-mentioned rocks and may represent the most recent granite type of the Karakorum and Nanga Parbat of the Neogene age (Desio, 1964).

The complex of above-mentioned basic rocks closely recalls that group of basic rocks that outcrops widely in the middle Indus valley and which have called the *Middle Indus Noritic Group* (Desio, 1974), which, in its turn, appears similar to the "Upper Swat Hornblendic Group" of Martin, Siddiqui and King (1962). If this interpretation is exact, a vast area between the Nanga Parbat and the Kunar valley (and perhaps even beyond it) would appear to consist of the Noritic Group of Cretaceous-Eocene age and this could not but be of palaeogeographical and geotectonic significance.

Proceeding northwards down the valley one comes to a group of calcareous-chloritic rocks mainly consisting of grey and white calc-schist with interposed layers of saccharoid white marble, green quartzous-chloritic dolomitic calc-schist, and arenaceous chloritic-schists and calc-schist with intercalations of amphibolite. I have assigned the name of *Ashret Schists* to this complex, which we shall find again further to the north, with some variations. The layers follow a rather irregular trend but, as a whole, they plunge eastwards with inclination of about 45°. The Ashret Schists show some similarities with the Baumatharel Schists of the Shigar Group (Desio, 1963).

About a mile downstream from the town of Ashret, there outcrops a layer of laminated plagioclastic blastomylonitic tonalite, passing into highly compact quartzitic porphyrite, which constitutes the whole spur of the Mirkhani confluence, deeply cut by the river.

Emerging from the Ashret valley one enters the Chitral valley and here, in contact with the Mirkhani porphyrite, there is a complex of volcanic tufa, lava and conglomerate in which—in the Dundi Gal locality just below Drosh—is enclosed a strip of *Orbitolina* limestone, mentioned by Hayden (1916) and also briefly described by myself (Desio, 1959).

The *Dundi Gal Volcanic Agglomerate* with the *Orbitolina* limestone and Rudistes, and the porphyrites represent the Yasin Group and belong to the Lower Cretaceous (Aptian). The layers trend in a NE-SW direction and dip fairly steeply north-west, ascending the Shishi valley, which is developed along a fault. Much further north-east, in the upper Laspur valley, near Harchin, reappears a calcareous-arenaceous-conglomeratic complex, which, although somewhat different in composition from the previous complex, should also be linkened to the Yasin Group. Moreover, it seems to be on the continuation (in direction) of the Drosh outcrop and of the Shishi valley.

The course of the Chitral above Drosh cuts the strike of the layers obliquely. At the sides of the road the various formations making up eastern limb of the Chitral anticline follow one another fairly regularly.

After the Ashret Slates one comes to a pack of dark grey quartzous-felspathic conglomeratic gneiss in sub-vertical layers oriented NE-SW, which we may call *Kesu Gneiss*, from the locality of that name where they outcrop, and immediately afterwards one reaches a thick complex of ash-grey and black veined and zoned saccharoid marble of the "cipolline" type, which Hayden called *Gahiret Limestone* which crosses the Chitral valley obliquely.

Further on, there is a belt of green schists, which stretches for over fifty kilometres NNE and is crossed, much higher up, between Koghozi and Maroi, by the road that ascends the Mastuj valley. It deals with a complex of chloritic prasinite, actinolite schists, sericitic-chloritic-feldspathic-quartz schist that I called *Koghozi Schists*. They show similarities with Green Schists of the Upper Swat, the Shatial Formation of the Middle Indus, the Green Schists of the Chalt Group etc. The upper levels, in vicinity of the marbles, look like very similar to the Ashret Schists. One thus reaches the rocks making up the core of the Chitral anticline, which are represented by what Hayden calls the *Chitral Slates*. This is a very thick complex of grey and black siltitic slates associated with thin layers of quartzite and some layers of crystalline limestone interposed in the upper levels, which often show a lighter greenish tint and commonly turn into calcareous-chloritic slates similar to the Ashret Schists. Some dykes of microtonalite intersect the slates near Rog.

The axis of the Chitral anticline is oriented NNE-SSW and the layers, both of the core and in the limbs, are steeply inclined and often almost vertical. The core of the anticline, which has a width of about 14 km to the north of Chitral, gradually becomes narrower as it proceeds southwards, so that when it reaches Gahiret it has a width of only 4 km and probably disappears under more recent formations. Also to the north the outcropping of the slates of the core becomes gradually narrower between the course of the Mastuj and that of the Lutkho, which occurs not so much on account of the dropping of the fold axis towards the north as through the effect of a well exposed fault in the gorge in which flows the river Lutkho, where the river turns from an east-west to a north-south direction. The gorge is cut into the veined limestone of the western limb of the anticline, this limestone appearing to be cut, also to the west, by a fault that is clearly visible in the gorge. The same calcareous formation continues southwards and is recognisable in the upper valley of the Chitral Gol and in the middle reaches of the Bombret valley (Brumboret Gol, according to the G.S.P. map), though here it is divided into two layers separated by a belt of brown slates. This group of beds recall the Ganto-la Group of the Karakorum (Desio, 1963). Further up the same valley, this is followed by others slates and calcareous breccia of various types.

In 1973 I ascended the small Chitral Gol, because G. H. Tipper (in Fermor, 1924) had reported the presence of remains of *Spirifer*, of a small *Dielasma* and of corals of Upper Paleozoic in a calcareous layer interposed in the Chitral Slates. About a mile from the outlet I noted only a few vague

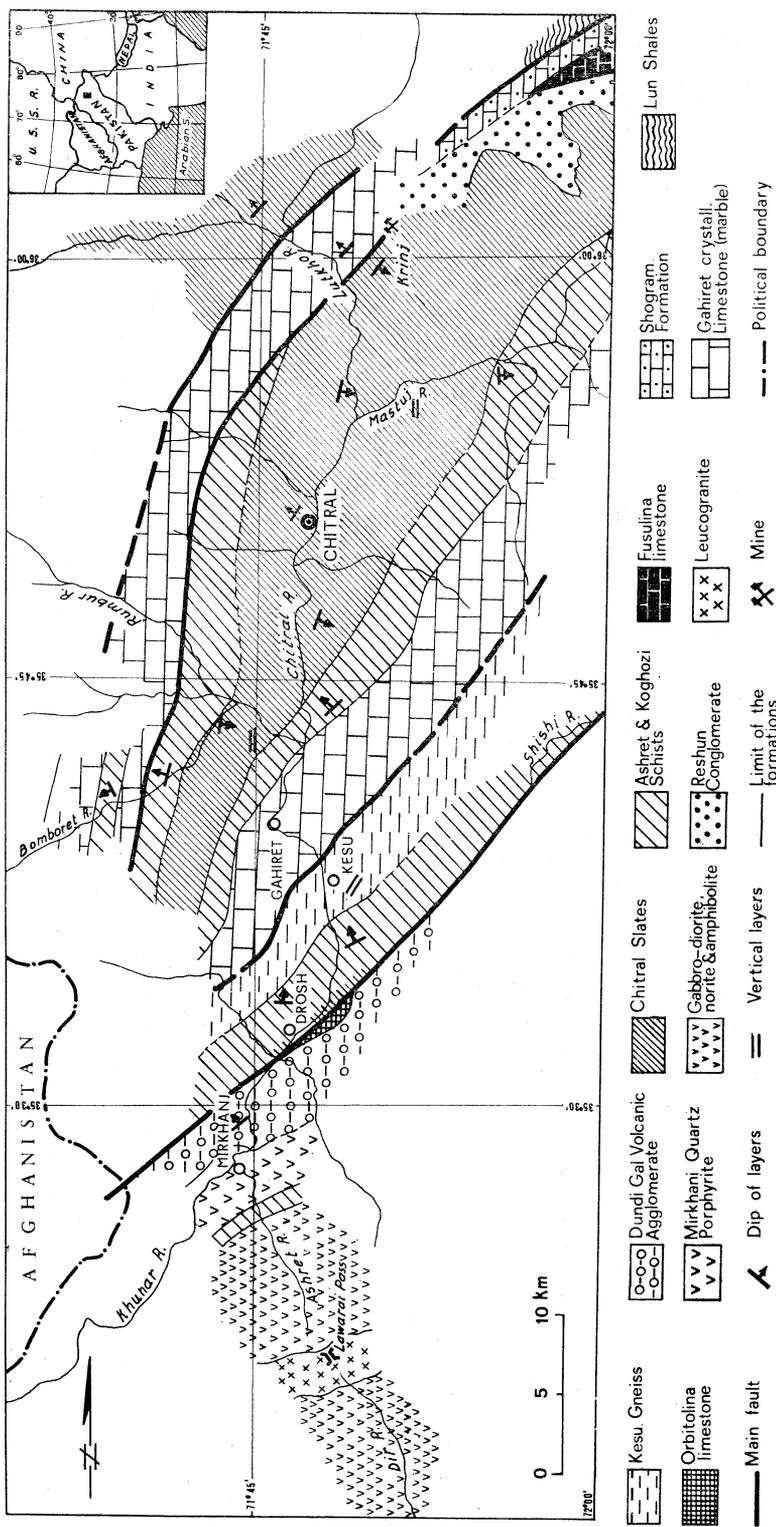
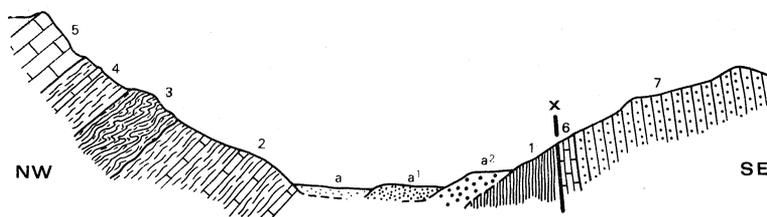


Fig. 1. - Geological sketch-map of the Chitral Valley (DESIO 1955).

traces of fossils in a thin bed of grey limestone contained in the blackish slates with intercalated brown quartzite, which, like the Lutkho veined limestone, cannot give any indication regarding age. Above the Bilphuk bridge (1760 m) there is the Krinj stibnite mine, which opens out at about 2440 metres above sea level at the (tectonic) contact between the Chitral slates and the grey and white vaxy limestone with intermediate layers of slate with *Orbitolina* and Rudistes of the Eocretaceous age, which I have already described briefly (1959).

I was not able to follow the fossil-bearing limestone from the mine as far as the bottom of the Lutkho valley, so that I am unable to say with certainty whether the limestone that outcrops below is the same, as would appear to be the case from the tectonic position and also from its outward appearance. The Krinj overthrust plane seems to proceed north-east, in the direction of Partsan and Reshun, in the vicinity of which outcrops the Mt. Shogram fossil-bearing Devonian formation mentioned by Hayden and later described by myself as Shogram Formation (Desio, 1966). On the geological map that accompanies that work of mine, representing the north-east continuation of the map shown in fig. 1, it is possible to recognise the north-easterly continuation of the anticline of the Chitral valley which passes along the bottom of the Mastuj valley to beyond Barenis and then disappears under the transgressive *Orbitolina* limestone of the Nal area, which is covered, in its turn, by the Tertiary *Reshun conglomerate*, also transgressive. On the



1. Black and grey slates; 2. Chloritic and calcareous schists; 3. Gneiss; 4. Green schists; 5. Marbles; a. Actual alluvial deposits; a¹. Pleistocene fluvio-glacial deposits; a². Fluvio-glacial and glacial deposits.

Fig. 2. — Geological section across the Chitral valley near Drosch, from a sketch of Desio's note-book (1955).

western side of the Mastuj valley, above Barenis, this conglomerate directly covers the Chitral slates, but higher up there emerge from the conglomerates both the Permian *Fusulina* limestone and the Devonian beds of Mt. Shogram and, still higher, the Krinj *Orbitolina* limestone (Desio, *op. cit.*). The tectonic disturbances that accompany the overthrust are numerous and can be recognised both in the lower Lutkho valley and in the Mastuj valley, and not only on its western slope but also on the opposite slope (fig. 2).

As regards the age of the Chitral slates, there is no doubt that they are pre-Cretaceous, though I am unable to find the evidence, reported by Tipper, of a presumably Permian age. However, this would appear to be contradicted by the fact that just above Reshun they lie below the (tran-

sgressive) beds of the Devonian. The transition from the hard limestone, with brachiopod sections, to the Chitral slates is marked by beds of quartzitic arenaceous rocks passing below quartz pudding-stone, which in fact represents the base of the transgressive Devonian sequence. On the basis of this observation, the Chitral slates should be pre-Devonian.

If the presence of the calcareous interbeds of the Permian in the Chitral Gol were confirmed, in order to reconcile these discrepancies it would be necessary to assume that the facies of the Chitral slates is repeated at different stratigraphic levels, which in fact is not exceptional. In order to settle this question, further studies would have to be carried out, especially in the Chitral Gol.

It is worthy of summarising here some preliminary conclusions on the correlations suggested in the present note. The major part of the formations outcropping in the Chitral valley show, in fact, affinities with formations known in the surrounding areas. I list below some of them.

a) *Gabbro-dioritic and noritic complex of Hindu Raj* around the Lawarai Pass and the upper valley of Dir=Upper Swat hornblendic Group (Martin *et al.*)=Middle Indus noritic Group (Desio)=Epidiorites and basic intrusiva (Wadia)=Norite and hyperstene diorite (Misch)=Twar Diorite (Desio e Zanettin). Age: (Cretaceous) Eocene.

b) *Koghozi Schists* (Ashret Schists?)=Green Schists of the Lower Swat Buner Schistose Group (Martin *et al.*)=Shatial Formation of the Middle Indus (Desio)=Green Schists of Nanga Parbat (Misch)=Green Schists of the Chalt Group in Hunza valley (Desio)=Baumaharel Schists of the Shigar Group in the Shigar valley (Desio e Zanettin). Age: Cretaceous-Eocene.

c) *Laspur Amphibolite* = Askore Amphibolite=Mesozonal Amphibolite of Nanga Parbat (Misch).

According to Misch in the Nanga Parbat area the formations a) and b) represent the sinorogenic metamorphic norite.

d) *Dundi Gal volcanic agglomerate* (Desio); with lenses of *Orbitolina* limestone=Agglomerate slates of the Chalt Group in the Hunza Valley (Desio)=Yasin Group=Cretaceous volcanic series of Burzil Pass (Wadia) with lenses of *Orbitolina* limestone=Dras Volcanics (De Terra) (= Dundi Gal volcanic agglomerate-Mirkhani Porphyrite). Age: Cretaceous.

e) *Chitral Slates*. Many formations of different ages, made up prevalingly of black slates with quartzite and marble intercalations can be correlated with these slates. From the nearer areas I remind the Misgar Slates (Desio), the Pasu Slates (Schneider) from the Hunza valley, the Skoro Lumba Slates of the Shigar Group (Desio e Zanettin), etc.

It should be possible to report here many other formations correlatable with those of the Chitral valley, but it is not in the purpose of the present preliminary report to extend these comparisons. I like only to emphasize

the great affinities of sequences of similar lithotypes of the Chitral valley with other sequences of near and far areas, like those of Swat, Middle Indus valley, Nanga Parbat, Hunza valley, Shigar valley, etc. This fact is easily understandable if we take into account the distribution of those formations and groups along the strike of the tectonic belts (Desio, 1965, 1974).

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