CHAPTER VIII

R E S U M E

GENERAL

The Bhimtal area comprises the south-eastern extremity of the Krol Belt of Auden (1934). It forms a part of the Krol Nappe, lying very close to the Krol thrust (Main Boundary Fault). The rocks of the area make a large anticlinal structure which for its most part in the area extends NW-SE. The core of this anticline is occupied by the basic rocks which are famous as Bhimtal traps. To the west and northwest of the anticline, occurs a complete and unbroken sedimentary sequence that has been correlated with

Infra Krol-Krol. The absence of this sequence on the north-eastern limb has been explained by the existence of a thrust (Ramgarh Thrust).

As regards the stratigraphic ages of the various formations of the Bhimtal area, are concerned, most of the previous workers have considered them equivalent to Nagthat. The rocks to the north and northeast of Bhowali, right upto the South Almora Thrust, have been taken by most previous workers to be a rather much folded Nagthat sequence within which occur a thrusted slice of older (? Chandpur) rocks. Merh (1968) however, has ruled out the existence of any major fold or thrust here, and according to him the entire sequence which 'youngs' northeastward is broadly equivalent with the Jaunsar. All previous workers have considered the quartzite rocks of Bhimtal and Bhowali to be equivalent to Nagthat.

To the west, these quartzites are overlain by a sequence of quartzites and slates which have been taken as Infra Krol.

In the course of last 4 years, Devendra Pal (1973), Shah C.P. (1973) and the present author, have mapped

the terrain around Nainital, Garampani and Bhimtal, and have concluded that the quartzites of Bhimtal-Garampani appear to be comprising the lowermost formation of the massive sedimentary Krol group sequence extending upto Naini Tal (? equivalent to Blaini).

STRATIGRAPHY

The stratigraphy, as worked out by the author is somewhat different from that suggested by most of the earlier workers. Structurally, the rocks form an anticline, the north eastern limb of which is truncated by the Ramgarh Thrust. On synthesising the sequences on the two limbs, the following depositional sequence has been worked out.

BHIMTAL-BHOWALI GROUP	Purple slates and quartzites
	Trap flow
	Quartzites with grey, green slates and lenses of limestones
	Trap flow
	Pebbly and gritty quartzites, (Sub graywackes) with thin brown slaty (tuffaceous) layers
	Bouldery quartzites
BHIMTAL TRAPS	Foliated traps (Spilites)
----------? Unconformity----------	
RAMGARH GROUP (Patel J.P.,1971)	Sheared and mylonitised granites, granophyres (within slaty and quartzite layers)

On the basis of the findings of various previous workers (see Chapter IV pages 73-78) and the present investigation, the author has correlated the rocks of the Bhimtal area as under:-

BHIMTAL-BHOWALI GROUP	Purple slates and quartzites	Uppermost part of Blaini or Infra Krol (Permian)
	Trap flow	
	Quartzites with grey, green slates and limestone	Blaini (Permo-Carboniferous)
	Trap flow	
	Pebbly and gritty quartzites (sub-graywacke) with thin brown tuffaceous layers	
	Bouldery quartzites	
BHIMTAL TRAPS	Spilites, Tuffs and Tuffites	Pre-Blaini (? Lower Carboniferous)
----------? Unconformity----------		
RAMGARH GROUP	Sheared granites and granophyres within phyllites and quartzites	Jaunsar (? Ordovician to Devonian)

So far as the sheared granites and granophyres that lie to the NE of the Ramgarh thrust are concerned, they might be representing late intrusions into the metasedimentaries of Ramgarh group. The author is not in a position to assign any conclusive age to these

rocks, but it is quite likely that these represent Tertiary acid igneous activity (Pre-Krol Thrust) to which belong the granophyres and granites of Amritpur-Ranibag in the south.

STRUCTURE

The present investigation has for the first time provided a fairly clear picture of the structural geology of the Bhimtal region. The area has been affected by three fold episodes and one thrust. The structural pattern worked out by the author fully fits in with the regional picture. The main structural feature of the area is the big distorted Bhowali-Bhimtal anticline. This structure (F_1) is seen refolded by a late (F_2) E-W fold (Bhowali-Ghorakhal Antiform). The Ramgarh thrust that extends NW-SE in the north-eastern part of the study area is seen truncating this F_2 structure, and it is thus most obvious that this dislocation developed after the E-W folding. The mapping has also revealed that the entire area, including the Ramgarh thrust, was subjected to yet another folding(F_3), which has given rise to the numerous NE-SW open flexures, imparting a certain waviness to the strike trends.

TRAPPEAN ROCKS

The metabasics occurring around Bhimtal comprise an important formation of the Kumaon Himalaya. They occur within the core of the Bhowali-Bhimtal anticline.

Recent works of Varadarajan (1973) and the present author, have for the first time revealed the true nature of these trappean rocks. The latter has collected ample evidences to show that these feebly metamorphosed basic rocks of spilitic affinity formed an integral part of the volcanism associated with the geosynclinal history in this part of the Himalaya.

The present study has revealed that these rocks comprise a spilitic suite, which on the basis of mineralogy and texture, could be classified into the following three main types:

1. Spilitic diabase
2. Spilitic basalt
3. Tuffs and Tuffites.

Of the above three, the diabse and basalt are characterised by the constant presence of sodic felspars. The distinction between the two types is mainly based on the grain size and texture. The coarser rocks have been

called "diabase" while the finer varieties have been termed as "basalts". Of course, no clear cut demarcation exists between the two types, and a number of occurrences of intermediate variety could be taken either as diabse or basalt. The third type comprises tuffs and tuffites. These are obviously derivatives from the above two and are typically layers of volcanic ash and fragments. The subsequent deformation and metamorphism have considerably altered their original tuffaceous nature. The tuffs and tuffites are difficult to separate megascopically.

The spilites have been extensively cleaved, as a result of which they have developed strong foliation at many places. Wherever the deformation has brought about cleaving, the resulting rocks resemble green schists, and in such deformed spilites, it is sometimes difficult to recognise their original nature. Under the microscope, these cleaved traps reveal a somewhat parallel network of fractures along which chlorite and uralite minerals show preferred orientation. The portions enclosed between these cleavage fractures, occasionally show the original igneous textures. The degree of cleaving is variable, and in highly cleaved samples, the rock is almost wholly consisting of foliated mass of chlorite and/or uralite and streaks of finely granulated quartz.

The chemical composition of the trappean rocks - both coarse and fine grained varieties, fully support their spilitic nature, showing a high Na_2O and low K_2O percentages as compared to the normal basalts.

The spilitic rocks of Bhimtal indicate that their mineralogy and textures are typically primary. It is further concluded that the spilitic basalts and diabases together with the associated tuffs represent volcanism that formed a part and parcel of the geosynclinal event that gave rise to the overlying sedimentary sequence. In the early stages, the volcanism and sedimentation took place simultaneously. To begin with, the volcanism was dominant, but with passage of time, the deposition of graywackes predominated. It is thus obvious that this volcanism represented by spilites heralded the depositional processes that in subsequent times gave rise to the enormous sedimentary sequence (equivalent to the Krol group) of this part of Kumaon.

LAKES

Of the four lakes situated in the Bhimtal area, two, viz. Bhimtal and Nakuchhiyatal are more prominent and occupy the main Bhimtal valley, while the two smaller ones, viz Sat-tal and Punatal occur at a higher altitude.

The present author found it rather difficult to fully understand these intriguing lakes. Taking into account the entire Bhimtal-Nakuchhiyatal depression, it hardly suggests any choked or dammed river valley. The rocky barriers to the east and south do not show any evidences of an erstwhile river. Secondly, the Sat-tal and Punatal though situated so closely to the Bhimtal, do not form a part of the main depression. They are at distinctly higher level and unconnected with Bhimtal. It is very difficult to explain the nature and existence of Sat-tal and Punatal by assuming the Bhimtal valley to be an early river.

The present author does not rule out original glacial action as the main agent of carving these depression. He is of opinion that further and extensive investigations in this direction might reveal new facts hitherto unknown. There is a fairly strong case for believing that the valley was originally formed by glacial action and was subsequently modified by the joint effects of frost, landslides, small faults and minor river action.

CONCLUDING REMARKS

In the foregoing pages of this thesis, an attempt has been made to present an integrated geomorphic and geologic picture of the Bhimtal valley. Though easily accessible, the area suprisingly remained uninvestigated. Perhaps it was the poor degree of exposures that failed to attract geologists in the past. Or may be the nearby Naini Tal area with its fascinating problems relegated Bhimtal to background!

This neglect perhaps caused a big gap in the geological knowledge of this area. One hardly realised that a proper understanding of the geology of Bhowali-Bhimtal area would provide a key to the correct structural and stratigraphic interpretation of this part of Kumaon.

The present study, as the reader will have found, comprises a modest effort to throw some light on the problems of structure and stratigraphy of Bhimtal-Bhowali region. Of course the author must confess that he might not have succeeded in tying down all the loose ends, and perhaps there still remain many unanswered queations. But he has made a beginning and it is hoped that future work will show how far the findings of the present author are valid.