IV.—ON THE CORRELATION OF THE PALÆOZOIC ROCKS OF SOUTH AFRICA.

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THE publication of the Annual Reports for 1898 and 1899 of the Cape Geological Commission, coupled with the recent account of the geology of the Transvaal Colony by Dr. Molengraaff, and of which a short abstract has appeared in this Magazine,¹ adds considerably to the knowledge of South African geology. The succession of the rock formations at the Cape has been constantly used as a basis of classification for the rock systems south of the Zambesi. In his recent paper Dr. Molengraaff correlates the formations of the Transvaal Colony with those met with in the south-eastern provinces of Cape Colony, and emphasizes the fact that the three stages of the Pretoria, Dolomite, and Black Reef series of the Transvaal Colony may be compared with the Witteberg, Bokkeveld, and Table Mountain Sandstone series of the Cape. It may therefore be of service to show on what grounds this supposed correlation is based. To do this the succession at the Cape of the formations below the Beaufort Beds in the typical region of the south-eastern province will first be given. The grouping adopted by the Cape Geological Commission² is in descending order of sequence as follows :—

TABLE OF STRATA BELOW THE BEAUFORT BEDS OF CAPE COLONY.

Ecca Beds	Sandstones and shales with <i>Gangamopteris</i> .
Dwyka Series	Conglomerates and interbedded plant-bearing shales. Included boulders of distant origin.
Witteberg Beds	Mainly quartzites. <i>Spirophyton</i> .
Bokkeveld Beds	Shales, sandstones, and greywackes. Fossils of a Devonian facies.
Table Mountain Sandstone	Sandstones and quartzites with occasional shales.
Great Unconformity.	
Malmesbury Beds	Non-fossiliferous slates, phyllites, mica-schists, and quartzites. Granite, quartz-porphry, and diabase as intrusive rocks.

From the Table Mountain Sandstone upwards there is no break in the succession of these deposits, which are several thousand feet thick and have been traced successively along a length of outcrop extending for over 100 miles; on the other hand, the hiatus between the Table Mountain Sandstone and Malmesbury Beds is unequivocal.

The whole series, excepting on Table Mountain and near the coast, are thrown into complex folds, admirably displayed in the Hex River Mountains and Klein Zwartebergen. Instances of complete inversion are not infrequent, and are particularly apparent north of the Zwartebergen. It is to the south of this range, in the Cango district, that some deposits of slates, dolomitic limestones, and sheared conglomerates and grits are met with overlying the Table Mountain Sandstone, but brought into this position by

¹ GEOL. MAG., Dec. IV, Vol. VIII (1901), pp. 475-8.

² Reports, 1897 et seq.

inversion. Their exact position in the sequence is somewhat doubtful, but in the account of the report for 1898 it would appear that these Congo rocks are to be regarded as being older than the Table Mountain Sandstone, but newer than the Malmesbury Beds. Mr. E. J. Dunn regarded them as the equivalents of his Namaqualand schists; that is, as belonging to a formation older than the Malmesbury schists. The task of unravelling the stratigraphy of this complicated region remains to be worked out when better maps are available. At present it is very unsatisfactory, especially when these Congo rocks appear to bear considerable resemblances to some of the deposits of the Transvaal Colony, which are considered by Dr. Molengraaff to be the equivalents of the Table Mountain Sandstone and Bokkeveld Beds.

Between the areas occupied by these older rocks in the southern provinces and the Prieska division (described in the report for 1899), south of the Orange River, a tract of country over 200 miles wide intervenes, of which the geology has not been reinvestigated. A large portion of this area is occupied by the Karroo formation, but the older rocks emerge from beneath it along the edges of the Karroo basin and have not yet been examined by the members of the Cape Geological Commission along their whole length. So far as Messrs. Rogers and Schwarz have examined the formations in the district of Prieska, they have determined the following descending sequence, naming the rock groups in accordance with the nomenclature adopted by Stow for the regions north of the Orange River in Griqualand West.

TABLE OF FORMATIONS IN THE PRIESKA DISTRICT.¹

Glacial Conglomerate and Shales				A coarse conglomerate resembling a grunde moraine. Overlying shales, carbonaceous and thin-bedded.
Great Unconformity.				
Matsáp Series	...	...	...	Quartzites and grits with pebbles of jasper rock. A sheared conglomerate at the base containing fragments of Griqua Town Series.
Unconformity.				
Griqua Town Series	...	...	...	Magnetic jasper rocks.
Campbell Rand Series	...	...	...	Limestones and quartzites.
Keis Series	...	...	...	Quartzites and mica-schists.

A granitic series is found in connection with the Keis group of rocks, but the relation of the two is uncertain. Messrs. Rogers and Schwarz state (p. 75 in report for 1899): "although the conclusion is mostly supported by negative evidence, it is probable that the whole granitic series was intruded among the Keis rocks, and that its gneissose structure was impressed upon it at the time when the dominant strike was given to the sedimentaries." The Campbell Rand and Griqua Town Series constitute a great mass of rocks, forming the Doornbergen and other areas in the district. Together with the Keis Series they appear to form an ascending sequence

¹ Report for 1899, Cape Geological Commission.

in the portion of the Doornbergen examined, but inversion due to overfolding occurs near Prieska Poort. The Matsáp Series are found lying in part unconformably on the dolomitic limestone and in part bounded by amygdaloidal lavas. The thickness of these beds is given by Messrs. Rogers and Schwarz,¹ as at least 3,000 feet, and the top is not seen.

The Glacial Conglomerate rests unconformably upon all the previous rocks. A description of this remarkable conglomerate has appeared elsewhere,² and need not be repeated. Stratification is generally absent and the boulders are of local origin; thus differing in a very marked manner from the Dwyka Conglomerate, with which, however, it seems to occupy a similar position in regard to the beds above, the conglomerate of both regions lying towards the base of the Ecça Series.

Such is the succession met with round Prieska. It is seen to differ materially from that of the southern provinces. Rocks resembling the Table Mountain Sandstone, Bokkeveld Beds, and Witteberg Series are absent, while the Glacial Conglomerate rests unconformably on a group of strata, of which the representatives may be found among the problematical rocks of the Cango district, and there only in a very imperfect degree.

In the south there is a great break between the Table Mountain Sandstone and Malmesbury Beds. Do these Prieska rocks bridge over the gap? It is interesting to find that the formations round Prieska have had intruded into them igneous rocks of pre-Karoo and post-Karoo ages. In all, Messrs. Rogers and Schwarz have detected five distinct types of igneous rocks, but their complete history has not been made out.

Considered as a whole, the geological record of the Palaeozoic formations of Cape Colony as at present determined is very incomplete. Excepting the sequence from the Table Mountain Sandstone up into the Ecça in the south, the formations are met with only in fragments, and the data necessary to piece them together are wanting or remain to be discovered. It thus happens that the sequence of rocks in the south-east cannot be satisfactorily compared with that in the north-west.

It is a matter for regret that the relationships of the Cango deposits, Malmesbury schists, Table Mountain sandstones, and of the Prieska rocks, with their igneous history, have not yet been clearly determined. The Prieska rocks strike across the Orange River and are typically developed, judging from Stow's descriptions,³ in Griqualand West, and with these the rocks above the famous 'Banket' formation of the Transvaal Colony have been compared.

¹ Report for 1899, p. 83.

² A. W. Rogers & E. H. L. Schwarz : Trans. Soc. Afr. Phil. Soc., vol. xi, pt. 2, pp. 113-120.

³ Quart. Journ. Geol. Soc., vol. xxx (1874), pp. 581-680.