BUSHVELD SANDSTONE SERIES

and overlying Volcanic Rocks

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Note on the Correlation of the Bushveld Sandstone Series and the Overlying Volcanic Rocks (Read 27th May, 1907).

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It is only recently that the sandstones of Buiskop, near Warmbaths, and the Springbok Flats have been described in detail, and recognised as belonging to the upper portion of the Karroo System, as developed in the Transvaal.[1] The same sandstones were also found above the Coal-measure Series at Komati Poort,[2] and a series of red marls and sandy shales were detected between them and the coal-bearing rocks, both at Komati Poort and in the Bushveld. For this succession of red marls, shales, and the overlying fine-grained sandstones, the term *Bushveld Sandstone Series* was adopted.[3] This series is overlain by the amygdaloidal basalts of the Springbok Flats and Komati Poort, and varies in approximate thickness from 300 feet in the Eastern Low Veld to at least 800 feet in the Central Transvaal. It constitutes a distinct and important member of the Karroo System.

In the Report of the Geological Survey for 1905, attention was drawn to the very striking parallel between the succession in the Transvaal Bushveld and that of the Red Beds, Cave Sandstone, and Volcanic Group of the Stormberg Series of the Cape Colony, but definite correlation was not considered advisable without more reliable evidence, such, for instance, as palæontological data might supply, or a direct comparison of the beds of these widely separated areas in the field.

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[1] See Mellor, "The Sandstones of Buiskop and the Springbok Flats," *Trans. Geol. Soc. S.A.*, vol. viii., p. 33.

[2] Mem. Geol. Survey Transvaal, No. 2, "The Komati Poort Coalfield," pp. 8 and 28.

[3] Report Geol. Survey Transvaal for 1905, pp. 12 and 16.

During last month I had the opportunity of making an examination of the Stormberg Beds in the north-eastern portion of Cape Colony, and gave special attention to the admirable sections of the Red Beds, Cave Sandstone, and Volcanic Group, exposed in the immediate neighbourhood of Lady Grey, near Aliwal North.

As one travels from Aliwal North eastwards towards the spurs of the Drakensberg, one ascends gradually through the upper portion of the Burghersdorp Beds, at the top of the Beaufort Series, and traverses a somewhat monotonous stretch of country occupied by the Molteno Beds, and chiefly characterised by long lines of flat-topped hills, terraced by successive krantzes of grit, sandstone, and dolerite. The Red Beds commence about two miles west of Lady Grey, and the village itself lies in a narrow valley, enclosed by steep slopes of Red Beds, capped by Cave Sandstone. All the higher portions of the mountains east of Lady Grey consist of basic volcanic rocks, which rise to over 3,000 feet above the level of the village, and the whole succession has a gentle dip to the south-east. The deeply dissected character of the western edge of the plateau affords numerous and instructive sections of the beds below the volcanic rocks, the fine krantz of the Cave Sandstone forming the most conspicuous feature of the district.

The best points for an inspection of the sandstone are the upper portions of the steep ridges overlooking Lady Grey from the north and south, and the narrow gorge which has been cut deeply into the formation on the east. The section on the north side deserves a short description. The main bed of the Cave Sandstone is found here at about 540 feet above the village, and is underlain by a few feet of soft reddish sandy shales. It forms a perpendicular and sometimes slightly undercut krantz, rising in a sheer wall of about 80 feet in height, with well-marked vertical jointing, but without any sign of bedding planes. The undercutting of the lower portion is often very well marked, and thus tends to form hollows, rock-shelters, and shallow caves. Above the krantz, the sandstone is continued over a steeply sloping surface, above which it occupies the entire plateau-like summit of the ridge. At the eastern end of the ridge it is overlain by the volcanic rocks.

Even a superficial examination of the Cave Sandstone vividly recalls the Bushveld Sandstone of the Transvaal, but more thorough observations of the best exposures on krantz, slope, and plateau soon satisfied me that in every respect the one is the counterpart of the other. On the summit of the ridge just described, the resemblance is brought out in a most striking manner by the fact that the nature of the surface now affords a comparison under similar general conditions of outcrop. Every detail in the peculiar and characteristic weathering of the Transvaal rock is here repeated. We have the same hummocky and boulder-like masses, the rock surface being often corrugated and pitted, or weathered, so as to resemble sun-cracking. Basin-shaped hollows, or pseudo-potholes, are often found on the upper surface, a feature also frequently observed in the Bushveld Sandstone near Komati Poort, and on the lower slopes of Buiskop. There is the same development of all kinds of strange forms, so characteristic of the sandstone kopjes of the Springbok Flats, and the same tendency to the formation

of isolated rock-pillars and fantastic monoliths. Rudely oval or spherical concretions are also sometimes found, consisting of a hard quartzitic shell surrounding a softer interior, and resemble those observed in the Bushveld Sandstone on the Crocodile River, near Komati Poort.

On this side of Lady Grey the Cave Sandstone attains an approximate thickness of 400 feet. Although its lower portion is exceedingly massive, and apparently unbedded, a rude stratification is often clearly visible in the upper portion, and false-bedding was noticed at more than one horizon. The Bushveld Sandstone has the same massive character, being only bedded on a large scale, and shows the same tendency to split up along vertical joints. A slight degree of false-bedding has also been observed in it on Zebedela's Location.

Further, in their petrological characters, the Cave and Bushveld Sandstones are practically identical. They both have a very fine-grained and uniform texture, and vary in colour from white to pale yellow and cream colour, while pink, red, and greenish grey varieties are by no means uncommon. Under the microscope, the close resemblance between the two rocks is still maintained, though in the Bushveld Sandstone there is often more distinction between grains and matrix. Both rocks consist largely of quartz grains, which are for the most part angular and very uniform in size, though a certain proportion of well-rounded grains also usually occur. Felspar is common, and includes plagioclase, microcline, and probably also orthoclase. Grains of zircon are also present. The proportion of matrix varies, and appears to be higher in the rather finer-grained varieties from the Springbok Flats, and lower in the sandstone from the Bushveld, west of Warmbaths, while in the Cave Sandstone from Lady Grey the amount of matrix is very small. Small grains of brown tourmaline are also occasionally present in both rocks, but I did not observe any hornblende or white mica in either rock—these minerals being recorded by Mr. Schwarz from the Cave Sandstone of the Matatiele division in Griqualand East.[4]

From the above considerations, it must be acknowledged that the resemblances, both general and particular, between the Bushveld and Cave Sandstones are remarkably close, and almost sufficient in themselves, in view of the somewhat special characters of both rocks, to warrant correlation between them. But if these resemblances are taken in connection with the stratigraphical evidence, I am personally of opinion that correlation is no longer avoidable. Although this evidence has already been referred to,[5] for the purpose of this paper, however, it will be convenient to consider it again briefly, as follows:—

In the Cape Colony the Cave Sandstone is overlain by a great thickness of basic volcanic rocks of basaltic type, and is underlain by the Red Beds, a series of red, purple, and greenish, sandy shales, marls, and mudstones, alternating with a varying number of yellowish, and sometimes reddish, sandstones. This series varies very much in thickness, being at Lady Grey some 600 feet thick, but in Matatiele dwindling

[4] Annual Report Geol. Comm. C.C. for 1902, p. 96.

[5] Mem. Geol. Survey Transvaal, No. 2, p. 32; and H. Kynaston, "Geology of the Neighbourhood of Komati Poort," *Trans. Geol. Soc. S.A.*, vol. ix., p. 26.

down to 200 feet. The yellowish sandstones are intermediate in character between the grits of the Molteno Beds and the Cave Sandstone, and at Lady Grey appear to become gradually finer-grained, as one ascends in the series.

In the Transvaal the Bushveld Sandstone is likewise overlain by a very great thickness of basaltic lavas, which attain several thousand feet at Komati Poort, and underlain by a series of red, purple, and greenish sandy shales and marls. These latter are exposed near Komati Poort, and they may also be seen in the core brought up from the borehole on the farm Ludlow, on the Springbok Flats. The only difference between these beds and the Red Beds is that, so far, no intercalated yellow sandstones have been observed in them. Their thickness is about 200 feet on the Springbok Flats, but probably less than 100 feet at Komati Poort.

The volcanic rocks, which overlie the Bushveld Sandstone, are of the same type as those of the Drakensberg, and both show occasionally the characteristic "pipe-amygdaloid." At Komati Poort, however, they probably attain a greater thickness than the Drakensberg lavas, and are succeeded by the acid flows of the Lebombo Range, which are followed by a further succession of basic rocks in the Portuguese Territory further east. Further, the resemblance has already been pointed out between the intrusive rocks associated with the Stormberg Series of Cape Colony and those associated with the Karroo System in the Transvaal.[6]

These facts are sufficient to show that the essential features of the stratigraphical relationships of the two rocks are the same, and, taken in connection with the lithological resemblances already detailed, also constitute sufficient evidence, in my opinion, to warrant the conclusion that the Bushveld Sandstone Series and overlying amygdaloids of the Transvaal are the equivalent of the Red Beds, Cave Sandstone, and Volcanic Group of the Stormberg Series of the Cape, the Orange River Colony, and Natal.

It is certainly unfortunate that decisive palæontological evidence—that great want of Transvaal geology—is in this case not yet forthcoming. In the borehole core from the Springbok Flats a single specimen of what is most likely an Estheria was found by the late Mr. Dance, when geologist to the Irrigation Department, but I am not aware of any similar occurrence in the Cave Sandstone. Above the Molteno Beds, very few Stormberg fossils have been recorded at all, though some reptilian remains are known from both the Red Beds and Cave Sandstone. It is to be hoped, however, that before long further finds will be made in the Transvaal, which will further add to our knowledge of the Karroo System.

With regard to the nature of the Cave Sandstone—a subject of some discussion among Cape Colony geologists—I could see no evidence, during my examination of it, for regarding it as being of the nature of a semi-volcanic deposit, such as a tuff or mud-flow. On the contrary, its very uniform texture and composition and extensive distribution would seem to be opposed to this view, and in favour rather of normal

[6] Mem. Geol. Survey Transvaal, No. 2, "Komati Poort Coalfield," pp. 44 *et sqq.*

For Continuation see T. Saal Cobalt Lodes
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