CAPE OF GOOD HOPE.

DEPARTMENT OF AGRICULTURE.

ELEVENTH

ANNUAL REPORT

OF THE

GEOLOGICAL COMMISSION.

1906

Presented to both Houses of Parliament by command of His Excellency the Governor.

1907.

CAPE TOWN:
CAPE TIMES LIMITED, GOVERNMENT PRINTERS.

1907.

[G. 10.—1907.]
£83-5-5.

B.979.1400.07.
C.T.Ltd.—B.1207.

ELEVENTH

Annual Report of the Geological Commission,

1906.

CONTENTS.

GEOLOGICAL SURVEY

OF

PARTS OF BECHUANALAND AND GRIQUALAND WEST.

BY

A. W. ROGERS.

The spheroidal lumps of iron ores were observed in unusually coloured limestones on Mount Carmel, and again, during the previous year, on the Enkelde Wilgeboom inlier on the Orange River. In both these cases their position is within a few feet of the top of the series.

Water in the Kaap Plateau.

The dolomitic limestones of the Kaap are traversed by many narrow passages, along which water may still flow. The remarkable spring at Kuruman, which yielded, according to a measurement made by me in September 1906,[1] 5¼ million gallons a day, issues from the base of a low krantz of limestone, but it receives additions from springs which rise from the sandy

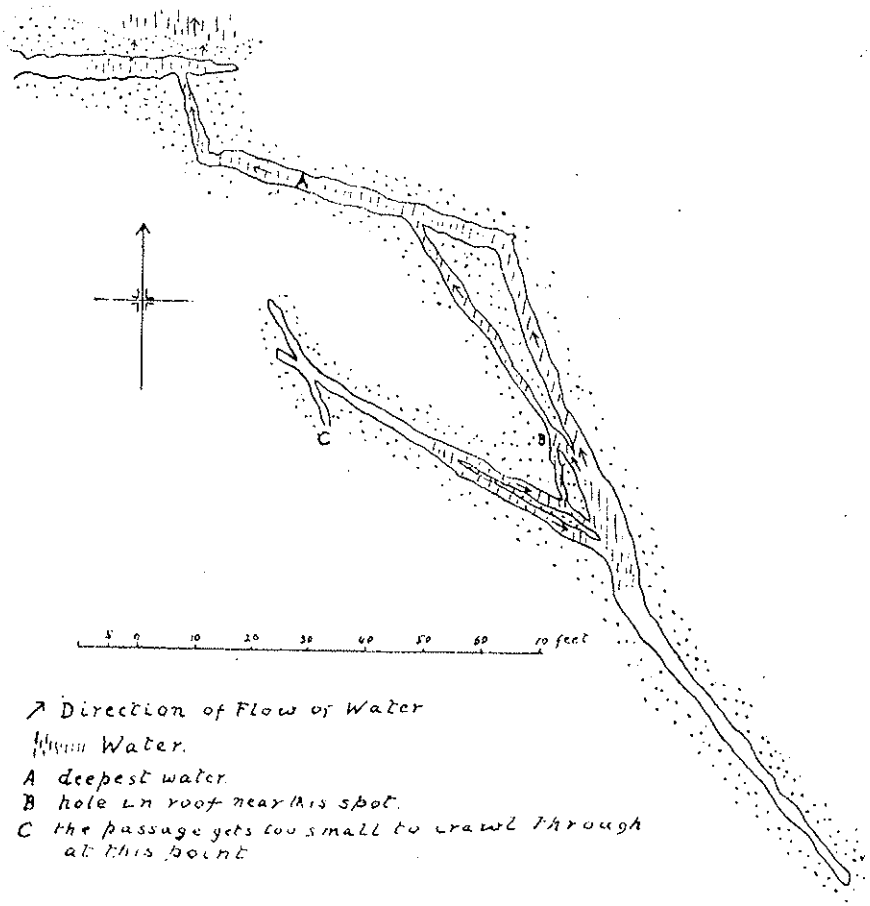

FIG. 2. Plan of Kuruman Cave.

bottom of the pool below the krantz. There is a hole on the west side of the mass of limestone forming the krantz, down which one can drop into a passage behind the krantz. A plan of the passages (Fig. 2) was made by means of a compass and

[1] The measurement was made by timing floats over 68 feet of a recently-cleaned part of the furrow on erf No. 17, some 700 yards below the drift at Kuruman.

tape, and the annexed diagram is a copy of it.[1] A considerable part of the passages is dry at the present time, and, judging from the amount of earthy matter lying on the dry floor, some considerable time may have elapsed since water flowed over these parts. Neither the floor nor the roof maintains the same level for any considerable distance. At the point marked A, the floor is lower than elsewhere, for the water is four feet deep there; from this point the floor rises in each direction. The roof is not far from the surface of the ground; at a spot near B daylight is visible through it. In other places the roots of bushes hang down from the roof, or have entered the passages through joints in the limestone. The plan of the cave shows clearly enough that the passages are merely widened joints. The width of the passages varies considerably, and at most is about 8 feet. Though the walls, which have an inclination towards the south of west, are in many places coated with a deposit of carbonate of lime, there are few well-developed stalactites; those which were once there have been broken off.

There are said to be other caves or passages in the Kaap Plateau, on the Kono Reserve and Kogel Fontein. The strong springs which issue from the level ground on the Manyeding and Groot Vlak Fontein Reserves, and on Bothetieleletsa, may well come from similar fissures in the limestone. Near Geluk there is a well-like hole through shaly limestones, in which water stands at a level of about 17 feet from the surface. The supply was maintained when 270,000 gallons a day[2] were being pumped out.

Springs are more numerous and yield a larger volume of water in the Plateau than in any other part of the area between the escarpment and the Langeberg range. In several places I was assured that these springs do not yield as much as they did a few years ago, and on several farms the springs marked on the Divisional map were not flowing in 1906. With regard to the Kuruman spring, there is no evidence to decide whether the flow is less than in former years. The people in Kuruman say that the flow is constant throughout the year, and from year to year also. There is, however, a dry channel, not long deserted, at a slightly higher level than the present exit of the main spring, and unless the water which once flowed along the higher channel has found a lower exit, the flow must have decreased.

The Kuruman spring issues at a spot which lies at a comparatively low level, and its position is such that it would be possible for the water which falls on a very large part of the Kaap Plateau to find exit there. The geological structure of the country is also such that the limestone strata, so favourable to

[1] I was kindly assisted in making the plan by Mr. J. H. E. Mayne, Magistrate's Clerk at Kuruman.

[2] This figure was taken from an engineer's report shown me by Mr. Abt.

the development of underground channels of considerable width, dip gently towards the Kuruman hills from the east; therefore, if there were any obstacles, such as impervious beds, faults, dykes, or vertical masses of chert, which impede the flow of water westwards under the Kuruman hills, it would issue on the east side of those hills. My survey failed to discover any such impervious body of rock or dislocation likely to intersect the westward flow of the water from the Plateau, and so I cannot assign a reason for the occurrence of the spring at the particular spot where it issues. There can be little doubt, however, that the water at Kuruman and the other smaller springs on the Plateau comes eventually from rainfall on the Plateau. All these waters are very hard; their temperature is above the air temperature on a cold day and below it in hot weather; at Kuruman, the water was at 64° F. at the drift in July and November.

There is no such strong spring as the Kuruman fountain at any other place on the east flank of the Kuruman-Asbestos range, though small springs are not infrequent. Near Daniel's Kuil there are dykes of dolerite traversing the dolomite approximately parallel to the strike of that rock. These dykes (possibly the isolated outcrops belong to one and the same dyke) are probably responsible for the appearance of the fairly strong supply of water at the surface at Daniel's Kuil village. In this part of the Plateau the drainage lines run eastwards, towards the escarpment on the Vaal River valley, and the conditions are therefore less favourable to the occurrence of a large quantity of water than at Kuruman. The springs and wells near Daniel's Kuil were plainly showing in 1906 the effects of deficiency in rainfall during the past ten years.

The hole in the ground from which Daniel's Kuil got its name may originally have been similar in nature to the water-hole (called the Wondergat) at Geluk; but the Daniel's Kuil is dry, and there is no record of its ever having had water in it. Both holes certainly owe their existence to the removal of rock by solution. In the case of Daniel's Kuil, the limestone is no longer visible in the hole, which is now about 15 feet deep, and in process of being filled up with rubbish; the walls are made of a reddish earthy material, and they recede some feet from the opening, which is through a hard ferruginous gravel.

(b) The Maremane Anticline.

This area of the Campbell Rand series occurs along the crest of a broad anticline, which has been traced from the south of Hay in a north-north-easterly direction to the neighbourhood of Klipfontein (north of Postmasburg), and thence in a north-north-westerly direction to Kathu. The dolomitic limestones first appear at the surface between Wolhaars Kop and Sweet

Fontein, on the Postmasburg River, and they are constantly seen as far north as the dry valley which traverses the anticline from the Khosis Reserve to Gamagara. North of this valley the Campbell Rand beds were not seen, but there can be no doubt that they underlie the country between Kathu beacon hill and the north end of the Gamagara ridge, for the calcareous tufa or surface limestone becomes very thick in that area, and the dip of the Griqua Town beds on the Kathu beacon hill is directed away from this tufa-covered ground.

In general appearance this dolomitic limestone area resembles the Kaap Plateau[1]; the character of the vegetation is the same and large parts of the surface are very rough in detail, though, disregarding the hills of Blink Klip breccia, the whole looks flat. The ridges and outliers of Blink Klip breccia are, however, very characteristic of this anticline, whereas a precisely similar rock does not occur in the Kaap.

On the east the Campbell Rand limestones dip at low angles under the Griqua Town beds of the ridge which extends south-eastwards from Kathu beacon to the neighbourhood of Riet Fontein, in Barkly West, and thence south-westwards past Postmasburg. This boundary shows very distinctly the rather extraordinary bend which all the main structural lines take in southern Bechuanaland and the north of Griqualand West.

The southern extremity of the limestone disappears under surface deposits east of Wolhaars Kop, but its approximate position is not difficult to lay down on the map, because there are outcrops of the younger beds in suitable places. From Wolhaars Kop northwards to M. 93, the limestone dips at low angles under the Griqua Town beds, which there form a low ridge. An outlier of the latter beds, or an extension of a band of them lying south of the Vlak Fontein syncline,[2] partly separates the limestone of the western border from that of the main area, but the surface deposits conceal the details of the structure between this patch of Griqua Town beds (on M. 80 and M. 93) and the south end of the Gamagara ridge. The dolomitic limestone crops out west of that ridge, between it and the Ongeluk beds of the Vlak Fontein syncline; but there must be faults here, in addition to the Paling fault, the existence of which is greatly confirmed by the results of last year's work. The position and nature of the subsidiary faults must remain uncertain for the present, owing to the general thick covering of surface deposits and the lack of artificial exposures. From the south end of the farm Paling to the westernmost corner of Sekgame, in the Kuruman district, a distance of about 34 miles, the limestone

1 The name Kaap Plateau seems now to be confined to the country east of the Kuruman—Asbestos range, but on some of the original diagrams of farms in the Hay portion of the Maremane anticline, *e.g.*, Klipfontein, the farm is said to lie on the Kaap Plateau or range.

2 See Ann. Rep. Geol. Comm. for 1905, p. 188.

area is bounded by the Blink Klip breccia of the Gamagara ridge. The condition north of Kathu will probably remain unknown for a long time, for the country there is covered with a thick deposit of tufa, and the two dry valleys leading northwards to the Kuruman River through this neighbourhood are not excavated deeply enough to expose their bed rock, or, more probably, they have been filled in with tufa too deeply to allow the rock to appear below Cowley in one case and Gamagara in the other. The Paling fault probably extends some distance north of Sishen. The downthrow is to the east, though at an earlier stage it must have been to the west.

In character the Campbell Rand beds in this area are very like those in the Kaap Plateau, and there is no need for a special description of them. The upper beds are not so well exposed here as on the Gamohaan and Daniel's Kuil hills. As a whole, this area is less well watered than the Kaap; there are considerable springs at Postmasburg, which issue near the outcrop of a dolerite dyke, though this dyke appears to terminate some hundred yards from the springs. Further down the Postmasburg River (dry), there are also strong springs rising from the calcareous tufa, which, to a great extent, hides the underlying rock in that neighbourhood. The wells on the Maremane anticline are not numerous, and there have been several failures amongst the few sunk. The depth to which they have been sunk is not great, not more than about 60 feet. Boring for water has not been attempted, so far as I know. There can be little doubt that water will be got by boring, though, as the area has a smaller catchment than the Kaap, and as the beds are in the form of an anticline, the quantity available is almost certainly less than in the latter district. I have left out of account the possibility of some of the water from the Kaap flowing under the wide syncline of the Kuruman hills, etc., for the level of the surface west of the syncline is only slightly lower than that of the Kaap, and its rocks form an arch which is separated from the possible source of supply, not only by the syncline but also by a large area of the Ongeluk volcanic rocks. The structure under this volcanic area is not known, but it is not improbable that there are dykes or other bodies of igneous rock which may interfere seriously with the movements of water underground.

At the present time the limestone areas have a bad reputation for stock farming, but when the farmer can properly guard against "lamziekte," the great possibilities in the way of underground water supply in these areas will attract people. Boring operations will not be easily carried out, for the difference in

hardness between the dolomitic limestone and the chert, which will almost certainly be met with in the greater number of holes, will make difficulties, as will also the hollow spaces dissolved out of the limestone by the underground water.

Volcanic Rocks in the Campbell Rand Group.

In the 1905 Report, p. 247, Mr. du Toit describes some lavas at the top of the Black Reef beds near Vryburg. Similar lavas were found on New York, lying above the Black Reef beds, and separated from them by several feet of thin dolomites and dark shales. This band of volcanic rocks was not seen on Mooi Fontein or Geluk, nor further west. Its thickness is probably under 100 feet. The rocks are very like the lavas below the Black Reef.

Though they lie on a somewhat higher horizon, judging from the lithological character of the sedimentary rocks, these lavas are almost certainly a continuation of the belt mapped last year.

C. The Griqua Town Series.

The past year's work has made it advisable to extend the meaning of this term so as to include both the Ongeluk volcanic group and certain sedimentary rocks overlying these in the north-west of Hay and the south-west of Bechuanaland.

In the Report for 1905 it was stated that the sedimentary rocks west of the Lucas Dam syncline belong to the upper part of the Griqua Town series, but I was then under the impression, owing to a strong lithological resemblance between the two sets of rocks, that these western beds were merely a repetition of the beds seen east of the supposed syncline, and that there was an overfold here. An examination of the northward continuation of the same belt of country has shown that the views expressed in that Report are wrong, and a re-examination was made of part of the belt seen previously in Hay. This has shown that the view now adopted is very probably correct, and the new view clears up several difficulties that were not met by the old. The error was corrected too late to be made good in the text of the 1905 Report, but a fly-sheet, dated October 15th, 1906, was printed for distribution with the Report, and the error is pointed out therein.

The reasons for thus enlarging the Griqua Town group will be apparent from the facts described below.

The Griqua Town series occupies a wide area in this district. It first occurs in the long line of hills called the Asbestos and Kuruman ranges, the eastern limb of a wide syncline in this group. The western limb gives rise to the lower range stretching from Kathu, past Khosis, to near Postmasburg, where it is

limestone crops out; this rock differs in no way from the surface-limestone which appears in almost all parts of the Kaap and the Maremane anticline.

The Put Pan cutting gave me the impression that the limestone has been deposited within the sand, and that to a certain extent it pushes aside the constituents of the sand during its deposition. The materials thus pushed aside seem to be chiefly iron oxide and clay, and also much of the sand, but rock fragments larger than 1-10th of an inch or so, and many grains of sand very much smaller than these are included by the limestone.

Near the water-hole there is no limestone, and the sand there is much thinner than elsewhere. The cutting runs north-eastwards towards lower ground, and the surface deposits as a whole become thicker in that direction—in other words, they tend to level up the slope formed by the hard rock below. The limestone does not behave uniformly in the same fashion, its total thickness at any point is not necessarily greater than at another place nearer the water-hole, and it may be altogether absent.

Red sand is abundant on both sides of the Kuruman-Asbestos range; towards the Langeberg the sand becomes paler in colour. To a certain extent the distribution of the red sand is obviously connected with that of the ferruginous rocks of the Griqua Town series, but the Ongeluk beds (Middle Griqua Town) are very often accompanied by sand almost as deeply coloured as that on the Lower Griqua Town beds.

Near the Langebergen the valleys are usually found to be more or less deeply buried under sand, but its depth is difficult to ascertain. It wraps round the north end of the range, and the transverse valleys south of Olifants Hoek are so filled with sand that the mountains rise very steeply from an apparently flat plain from one to four miles wide without definite stream beds traversing them. In nearly all parts of the Langeberg the mountain side rises abruptly from a sandy plain, which abuts against the mountain so as to hide from sight the lowest 300 feet perhaps of the rock slope. This plain slopes very gently towards the nearest valley-line.

In the Koegas Field-Cornetcy there is much sand banked up against hills made of Griqua Town and Matsap beds. On Stink Water there is a ravine showing a section eight feet deep in the red sand; there is enough clay and iron oxide in the sand to give it strength to stand in vertical walls, which are due to a strongly marked jointing; it contains a few small pieces of rock, lava, and jaspers from the neighbouring Griqua Town beds. In the wide sandy country north-east of Piljaars Poort there are sand-hills which trend south-east, and are slightly concave to the north-east.

On the west side of the Langebergen the country is very sandy; the usual colour is yellowish or light red, but the re-

markable sand hills of Witsands are almost white. These hills occur in an area about eight miles long and five wide; rocks of the Matsap group crop out at the summits of the highest hills and of some of the lower ones; the presence of the Matsap ridges is certainly an important factor in bringing about the accumulation of the sand, which rises to a height of from 100 to 200 feet above the surrounding country. The trend of the main sand hills within the group is N.N.W., and their steeper side is on the E.N.E. The two questions concerning Witsands that are difficult to answer are why the sand gathers in that spot, and why it is so white; the third question, the reason of the occurrence of water in several places, usually excites most interest and wonder, but, as will be pointed out presently, the presence of water is not very difficult to explain.

The accumulation of the sand round the Witsands kopjes has not been explained, and at present the local circumstances are not well enough known to allow the matter to be fairly discussed. The whiteness of the sand is due to the removal of the small amount of iron oxides which give the yellow and red tints to the sand of the surrounding country. In parts of the white sand area the removal of sand by wind has laid bare banks of cellular ironstone just like that found on the Cape Flats and many other parts of the Cape Colony; it differs from the ironstone of the Kuruman hills, etc., in being less compact and in containing no fragments of rock larger than sand grains. It seemed to me that the ferruginous colouring matter from the local sand has accumulated in this cellular ironstone, owing to the long continued action of the water which saturates the lower lying sand in the small area (8 by 5 miles) of Witsands. There were no clear sections which showed how thick the ironstone is or whether it occurs in beds within the sand or in a layer always near the bed-rock, but the exposures favour the view that it is in irregular layers within the sand and at a considerable height above the bed-rock, *i.e.*, that it occurs similarly to the layers of limestone in the Put Pan cutting. The outcrops are quite 18 inches thick, and loosened masses of that size lie near the outcrops.

An accurate survey of the area, combined with precise levelling, would be necessary to decide the cause of a constant supply of water within the sand area. The water is found at a depth of a few feet below the surface on flat places just within the outer groups of sand hills. People told me that it could be got anywhere near the hills, but I do not think that can be the case, for if it were the farmers who live there temporarily or permanently would not go to the trouble of fetching water from spots half a mile from their houses across very heavy sand. From enquiries made from people who have known Witsands for a long time I gathered that the level of the water rises regularly after rain and that it gradually sinks during the drought. After

plentiful rains it stands above the surface in certain of the hollows. Though there seem to be always some hundreds of small stock watered daily at Witsands, as well as a small number of cattle, there never seems to have been a severe strain put upon the water supply. At the time of my visit (October, 1906) the water was 4 feet, 3 feet, and 2 feet below the surface at the three water-holes seen by me; it is fresh.

The quartzites of the Matsap series crop out at several places round the white sand area, and the intervals between the outcrops are covered with sand; the locality gave me the impression that there is either a rock basin or a rock valley dammed up by impervious surface deposits and filled with sand, which becomes saturated with water to a level depending upon the abundance of rain. The sand protects the water from evaporation to a certain extent, and hitherto this water has not been known to be exhausted during the severest drought. The rainfall of this district has not been recorded, but from the appearance of the veld during two rather dry years (1905 and '6), I think it is almost equal to that of the Kuruman district. It has been supposed that the Witsands water comes from a strong spring, but the fact that the water level rises and falls each season shows that some of the water has a more local source. If the underground contours of the sand were such that they would allow rain-water to drain away quickly the water would not rise above the low spots as it does. In several walks to and from the water-holes I could not decide whether they were at a higher or lower level than the flat ground outside; the paths lead over sandy rises and across low ground.

Witsands has long been known as a locality where "lightning-tubes" or "fulgurites" occur.[1] During my visit there I could not find one of them, nor were two natives sent to look for them more successful. I was told that they are got after heavy rain or strong winds, and that they stand more or less vertically out of the sand. Mr. Jooste, of Koodoos Kloof, Hay, kindly gave me three pieces of the tubes, which he had picked up at Witsands. They are rough glass tubes with walls 1-2 mm. thick, with a vitreous surface inside and a dull exterior covered with partly fused sand grains. The walls have collapsed in places, so that the tube is irregularly closed, and the outer side is ridged, owing to the folding in of the wall on each side of a ridge, like the wrinkles on a dried grape. The colour of the tubes is whitish grey. Fragments under the microscope show that the greater part of the wall is made of isotropic glass containing numerous air-bubbles. Partly melted sand grains (of quartz) are abundant. These fulgurites are evidently very like those described from various parts of the world.[1]

[1] R. Marloth, Trans. S.A. Phil. Soc. Minutes of Proceedings, vol. VIII. p. lxx.