



UNION OF SOUTH AFRICA
DEPARTMENT OF MINES AND INDUSTRIES

ANNUAL REPORTS FOR 1913

PART V

GEOLOGICAL SURVEY

[COPYRIGHT]

PRETORIA
THE GOVERNMENT PRINTING AND STATIONERY OFFICE
1914

U.G. No. 40—1914]
3430.—11/5/14 —1500.

CONTENTS

	PAGE
I.—DIRECTOR'S REPORT.....	13
IA.— „ „ (Dutch Translation).....	27
II.—THE GEOLOGY OF THE COUNTRY NORTH-EAST OF CAROLINA, by A. L. Hall (<i>Geologist</i>)	31
III.—THE GEOLOGY OF PORTIONS OF THE PIET RETIEF, WAKKERSTROOM, AND UTRECHT DISTRICTS, by W. A. Humphrey (<i>Geologist</i>).....	61
IV.—THE GEOLOGY OF A PORTION OF THE NGOTSHE DIVISION OF NORTHERN NATAL, by W. A. Humphrey (<i>Geologist</i>).....	69
V.—SUMMARY OF A GEOLOGICAL SURVEY OF PART OF NAMAQUALAND, by A. W. Rogers (<i>Assistant Director</i>).....	79
VI.—THE GEOLOGY OF MOUNT CURRIE AND UMZIMKULU (CAPE) AND ALFRED COUNTY (NATAL), by Alex. L. du Toit (<i>Geologist</i>).....	83
VII.—ADDITIONS TO THE LIBRARY.....	103

II

THE GEOLOGY OF THE COUNTRY
NORTH-EAST OF CAROLINA.

By A. L. HALL (*Geologist*)



THE GEOLOGY OF THE COUNTRY NORTH-EAST OF CAROLINA.

By A. L. HALL (*Geologist*).

I. INTRODUCTION.

THE field-work, on which the following report is based, forms the southerly continuation of mapping carried out north of the Delagoa Bay Railway during 1905, and continues in an easterly direction Dr. Humphrey's work west of the Carolina-Machadodorp main road during 1906.

The area belongs almost wholly to the Carolina District, and is bounded on the north by the Delagoa Bay Railway, on the west by that joining Machadodorp to Carolina, while on the south and east it is limited by a line drawn from Carolina along the Barberton main road to Hlom-Hlom on the Komati River, thence northward through Tafel Kop to the Devil's Kantoor; 838 square miles were examined, involving the tracing of 1150 miles of boundary lines.

The publication of the present report completes our geological information of the Transvaal System in the eastern and north-eastern Transvaal along a continuous belt of country from Haenertsburg southwards for some 150 miles as far as Carolina, where the present system passes unconformably beneath the Karroo.

2. PHYSICAL FEATURES.

The present portion of the Eastern Transvaal has a rather complex topography, since it includes both high veld and low country, which meet along the ridge of high ground that constitutes the southernmost portion of the Transvaal Drakensberg, while it is deeply cut by the powerful drainage system of the Komati and Elands Rivers. For these reasons one finds considerable contrast in elevation, ranging from nearly 7000 feet on the quartzitic plateau south-east of Waterval Onder down to 3000 feet in the Elands River Valley east of Godwan River Station. Some exceptionally wild and precipitous scenery is thus included along the valleys of the Komati and Elands Rivers.

(a) *General Surface Features.*

Running along the eastern side of the Carolina and Machadodorp Railway extends a narrow strip of country, composed mainly of shales and volcanic tuffs, which presents geographical conditions most nearly allied to *high veld*, though its average elevation is less than one generally finds over typical Transvaal high veld, while it also shows greater relief. On the other hand, east and east-north-east of Carolina true high-veld conditions prevail and extend to the limits of the Karroo Sandstone.

The above strip of country is defined on the eastern side by a very prominent line of high ground, which forms a most conspicuous feature in the scenery, when looking towards the south-east and east from Machadodorp and Elands Kop respectively. The latter point is a prominent sharply defined kopje about one mile from Zevenfontein Station on the Carolina Railway, capped by an outlier of diabase. This prominent ridge extends as a continuous feature across the area from the Delagoa Bay Railway south-westwards to the farm Twyfelaar No. 206, a few miles from Carolina. The crest line itself ends abruptly in Van Lennops Kopje, 5720 feet above sea level, close to and overlooking Waterval Boven from the south, where it passes through the western portion of the farms Nooitgedacht No. 242, Torburnlea, Uitkomst No. 138, Elandsfontein No. 49, Bloemfontein No. 101, and Doornkop No. 168. Still further south-west, as true high-veld conditions gradually become established through the greater development of the Karroo System, the ridge is topographically lost, while its formations pass unconformably beneath the younger sandstones. The average difference of level between this high ground and Machadodorp Station is about 1000 feet. The lower portion of a series of interbedded contemporaneous tuffs and agglomerates, intrusive sheets of diabase, and shales are the leading formations concerned

in this feature. Towards the west the latter is succeeded by extensive and fairly even slopes, bare of vegetation and continuing to the Thalweg of the valleys, draining either northwards to the Elands or southwards to the Komati River. Still further west, the ground rises steadily, though cut up into several shorter ridges and generally somewhat broken ground, through various tributaries of the Komati River.

The average elevation is somewhere near 4800 feet above sea-level, though in view of the considerable amount of relief, this is merely an approximation. This relief is further emphasized by a narrow tract of high ground, which runs across the country from Zevenfontein Station eastwards to join the high ridge referred to, and forms a watershed between the Elands and Komati River basins.

Hence from this divide there is a distinct fall of about 400 feet northwards towards Machadodorp, and of about 600 feet southwards towards Bonnefoi, as forcibly brought out during the railway journey from Machadodorp to Carolina.

East of the continuous ridge extending from Van Lennops Kopje south-westwards in the manner described above follows a broad belt of higher ground, constituting *middle veld* or *banken* scenery, and continuing as far as the Dolomite and Black Reef Series, which overlook and sharply define the western limit of the granitic low country. This middle veld portion has a width of about twenty-two miles in the north, but gradually narrows towards the south-west, partly owing to the increasing dip, but also due to the lesser sculpturing power of the tributaries of the Komati River and the gradual establishment of true high-veld conditions as one approaches the Karroo System round Carolina. Its general topography is very complex when examined in detail, while its scenery is in places highly rugged and precipitous, with considerable contrasts in elevation. The north-western portion of the farm Treurfontein No. 201 forms the highest portion in the whole district, with an elevation of 6950 feet above sea-level, due to the hard and resistant nature of the Daspoort Quartzites. Compared with this, Marola Siding on the Delagoa Bay Railway, in the Elands River Valley, is only 2888 feet above sea-level.

The *banken* scenery is geologically due to the presence of certain horizons of harder rocks in the middle and lower portion of the Pretoria Series, composed mainly of quartzites. Hence a linear element is characteristic of and widespread throughout the area, and further emphasized by the very powerful manner in which the surface has been deeply dissected and generally sculptured by the Elands or Komati Rivers with their numerous tributaries. The occurrence of several hard quartzites at the Daspoort horizon of the Pretoria Series accounts for the establishment of a high but dissected plateau-like stretch of country over the northern portion of our area. It is limited towards the west by the high ridge of tuffs and diabases, which are discussed above, while on the north it is defined by highly precipitous slopes with several kranzes, which overlook the Elands River from the south and form part of the very striking scenery familiar to the traveller on the Delagoa Bay Railway, from Waterval Boven to Airlie Stations. Similarly towards the south-east there is a sharp limitation of the plateau by steep and extensive slopes into the valley of the Komati River through the farms Elandshoek No. 233, Treurfontein No. 201, Schoonwater No. 6, Bermondsey No. 230, Boshhoek No. 11, and Gevonden No. 178. This high plateau consists mainly of a series of extensive dip-slopes due to the various beds making up the Daspoort horizon of quartzites and intrusive diabases, while the low dip and locally deeply dissected nature of the surface account for the occasional occurrence of kopjes of the Tafel Kop type, forming small flat-topped outliers capped by either quartzite or diabase. Such features are very clearly seen on Kaalbooy No. 144, Schoonwater No. 6, Weltevreden No. 17, Schoonspruit No. 18, and Elandshoek No. 233, some ten to sixteen miles east of Machadodorp. (See Map, Plate VII.) The whole of the plateau is essentially quartzitic, devoid of all tree-like vegetation, possesses a very high average elevation of 6000 feet, and is well watered (see below).

Towards the north-east the quartzitic plateau sends out a narrow spur in the form of a very sharply defined ridge along the common boundary of the farms Elandshoek No. 233 and Rietspruit No. 37, and emphasized by kranzes of the Dwaal Heuvel quartzite. The crest line of this ridge still shows traces of the old main road from Dalmanutha to the Kantoor. The formation pointed out above of outliers of harder rocks due to the low dip,

combined with prolonged and profound sculpturing processes, is again well illustrated over the plateau region, and nowhere more striking than in the case of *Schurwekop* (6250 feet above sea-level). This well-known landmark is an outlier composed of the Tunnel Quartzite, and lies along the common boundary of Bermondsey No. 230 and Boshhoek No. 11. It derives its name from the numerous large blocks and slabs of quartzite freely scattered in a rough irregular manner over its surface. The main road into the deep valley of the Komati River passes within a few yards of its eastern end before plunging into the valley along a very deep slope. Between the summit of *Schurwekop* and the Komati River the difference of level is approximately 1900 feet. The immediate neighbourhood of this point illustrates in a very forcible manner the powerful effects of the harder quartzite bands, by the formation of conspicuous vertical kranzes, or wide steep slopes, or by the abundance of narrow, elongated, wooded, and almost inaccessible kloofs, characterized by waterfalls, e.g. at Uitkomst No. 138, Bermondsey No. 230, Gevonden No. 178, and Bloemfontein No. 101.

Similar plateau-like distribution of high ground is noticeable on the south side of the Komati River over the farms Gevonden No. 178, Steenwyk No. 48, and Suikerboschfontein No. 139, though, owing to the absence of a powerful drainage line like the Elands River, the somewhat higher dip, and the gradual commencement of high-veld conditions further south, the plateau is less extensive and less sharply defined. A glance at the map accompanying this report will show how, in accordance with the low north-westerly dip, the outcrop of the Dwaal Heuvel Quartzite—that is, the edge of the northern plateau—turns to the west as it approaches the Komati River and at the same time falls to the level of that stream. In the same way the feature south of the river turns to the east and rapidly rises towards the common beacon of Gevonden No. 178, Gemsbokhoek No. 5, Steenwyk No. 48, and Waterval No. 97. Both plateaux are geologically continuous, though topographically distinct. South of the Komati River the quartzitic high ground, e.g. of Steenwyk No. 48, shows essentially the same features as before, and consists of wide dip-slopes deeply furrowed by numerous streams, draining the area in a north-westerly direction.

The Tunnel Quartzite forms a large flat outlier genetically identical with that which gives rise to *Schurwekop*, though much less well defined. On this outlier stands the common beacon of Steenwyk No. 48, Gevonden No. 178, and Waterval No. 97. The main band of the Tunnel Quartzite continues south-westwards and forms wider and gentle outcrops over the slopes of the plateau. As it crosses the numerous spruits on Waterval and Suikerboschfontein the quartzite causes well-defined steep kranzes on both sides of the minor drainage lines, thus giving rise to narrow kloofs, since the average fall of the spruits nearly coincide with the dip of the beds, so that the kranzes follow the sides of the minor valleys for some distance. The edge of the southern plateau is likewise defined by the Dwaal Heuvel Quartzite, but is not nearly so conspicuous as further north, since the fall of the general level of the country from the base of the lowest Daspoort Quartzite south-eastwards is much less here than in the portion north-east of *Schurwekop*, so that coinciding more or less with the main road from Carolina to the asbestos mine along the south-eastern portion of Suikerboschfontein No. 139, the edge of the plateau is marked by a continuous but not very striking ridge of Dwaal Heuvel Quartzite.

From the plateau region eastwards and south-eastwards there is a great and rapid fall, especially north of the Komati River, since the great preponderance of soft shales in the lower portion of the Pretoria Series has facilitated the powerful process of denudation over the basin of the Komati River. The edge of the northern plateau is thus followed by wide and steep fairly uniform slopes right down to the base of the Dolomite. The greater portion of these slopes is made up of shales, which usually develop smooth outlines in the scenery, but are relieved by slight and more conspicuous linear features wherever the harder beds like the thin Ongeluk quartzite or the various quartzites of the Timeball Hill horizon afford a break in the continuity of the slopes, as illustrated by the scenery over Elandshoek No. 233, Mamre No. 84, and Houtboschloop No. 90, or by the striking views seen along the main road which leads from *Schurwekop* down into the valley of the Komati River. Similarly, between the edge of the quartzite on the north and the Delagoa Bay Railway there is a striking drop into the Elands River Valley of over 3000 feet south

of Airlie Station—mainly over shales. South of the Komati River the fall in general level is not so striking, since there is a gradual rise towards the high veld, while the greater prominence of the various Timeball Hill Quartzites on Doornkloof No. 167, Suikerboskop No. 61, and Bergstroom No. 211 causes a subsidiary stretch of relatively high ground, so that the greater proportion of the fall takes place between these quartzites and the Black Reef Series. On the other hand, as pointed out above, over the north side of the Komati River the fall is practically continuous from the Daspoort Quartzite down to the Black Reef Series.

Excepting for the lower reaches of the Godwan River Valley and occasionally over the low-lying granitic area, the whole of the country shown on Plate VII is practically devoid of natural tree vegetation. Owing to the highly dissected character of the surface and its very high contrasts in elevation, the country offers great obstacles to transport, except in certain directions. This remark, of course, does not apply to the immediate neighbourhood of Carolina. The Elands River Valley is impassable between Machadodorp and Waterval Onder, but a road exists from here eastwards to the Kantoor, though the main valley is again impossible for transport east of the portion between the Godwan and Elands Rivers as far as Alkmaar Station. From Machadodorp southwards and south-eastwards the country is fairly well provided with roads, so long as one does not require to traverse the deep valley of the Komati River. The latter stream can only be crossed at two places, either by way of the bridge near Bonnefoi or on the farm Lekkerdraai No. 176. Into the Komati Valley proper there is not a single road via Schurwekop and Lekkerdraai No. 176 to Grootkop No. 173, and then more or less along the right bank of the stream to Hlom-Hlom on the Carolina-Barberton main road. A road has recently been made across the farms Welgelegen No. 33 and Bloemfontein No. 101, which crosses the ridge of tuffs and descends sharply into the Komati River Valley, but comes to a dead end on Gevonden No. 178 on the left bank of the river. All the means of communication leading from Machadodorp south-eastwards into the quartzitic plateau, however, come to a stop sooner or later, so that through transport from north to south is only possible along the main road to Carolina.

The *Valley of the Komati River* cuts across the area roughly from west to east and furnishes a most important and striking physical feature. From its source near Breyten as far as the neighbourhood of Bonnefoi the river runs along the floor of a wide, open, and shallow valley, but a few miles east of the Carolina Railway the river rapidly falls, and the valley gradually assumes the characters of a fairly deep gorge, until, when the crossing of the quartzites of the Daspoort horizon on the farms Waterval No. 97 and Gevonden No. 178, it passes for two or three miles along a much more confined gorge-like valley flanked by precipitous kranzes close to and on both sides of the river. In spite of the presence of several fairly thick hard quartzites of low dip, there are no definite waterfalls, but merely a series of rapids. Below this point the valley widens again and also becomes gradually deeper and flanked by steep extensive slopes. Still further downstream, where it cuts across the base of the Transvaal System, the quartzites of the Black Reef Series have even less influence in the character of the river bed than at the higher quartzite horizons. Finally, over the granitic country, the valley returns to wide open conditions.

The *Drakensberg* limits the eastern and south-eastern distribution of the Transvaal System, and also effects a fairly sharp transition from the middle veld with its banked scenery to the low-lying, gently rolling, granitic low country. It is conditioned mainly by the escarpment of the quartzites forming the Black Reef Series and stands out in the scenery as a well-defined ridge-like wall, traceable from the Kaapsche Hoop (Devil's Kantoor) through Tafel Kop south-westwards across the Komati River Valley to its disappearance below the Karroo High Veld some twelve miles east of Carolina. In the present area the Drakensberg forms merely the extreme southerly end of the long regular escarpment bearing the same name and extending northwards as far as the Wolkberg, east of Haenertsburg. The total length of the Transvaal Drakensberg thus amounts to about 180 miles. Throughout its length it is composed essentially of the Black Reef Series, though south of the Komati River the quartzite at the base of the Pretoria Series also has

some share and in the Drakensberg escarpment. From Tafel Kop northwards, through the Kantoor and further on towards Sabie and beyond, the very marked increase in the thickness of the Black Reef Series causes the main escarpment to assume increasingly greater prominence, culminating finally in the stupendous wall-like kranzes north of Belvedere. But from the Kantoor towards Carolina there is a very marked thinning down in the quartzites, so that the Drakensberg is not nearly so striking, though compared with the underlying somewhat monotonous granite country it still forms a well-defined feature. Locally, as within the actual valley of the Komati River and elsewhere along major tributaries, the feature is practically lost altogether.

From the Kantoor the Drakensberg escarpment continues due south for about eight miles in a very regular manner, but further south, owing to the prolonged backward corrasion of the headwaters of the Godwan and South Kaap Rivers, there is a marked gap in the continuity, since the entire thickness of the series has been cut through by these streams, and the quartzites removed by denudation. In this way Tafel Kop (6128 feet above sea-level) remains as a small circumdenuded outlier, separated from the main escarpment by a short neck. (See Plate VII.) Thus the Kantoor Plateau forms an incompletely circumdenuded geological peninsula, which in course of time is destined to vanish altogether as the result of more prolonged sub-aerial erosion. The triangular prolongation of the main outcrop of the Black Reef escarpment eastward across Mooifontein No. 98 towards Tafel Kop and the sinuous distribution of the basal quartzite of the Transvaal System generally over the farms De Goedehoop No. 114, Uitzicht No. 83, Doornkloof No. 115, and Coetzee-stroom No. 118, in the Godwan River basin, are clearly the result of prolonged sculpturing processes on a succession of slightly inclined beds, resting on a hard formation at the base, in a country of great topographical contrast.

The Godwan River Valley illustrates in a highly instructive manner the typical land-forms sculptured out of a region of gently inclined strata by the continued process of river erosion, and the delicate balance between the forces of denudation and the resistance offered by the hard stratum of quartzites at the base of the succession. The Godwan River rises near Tafel Kop in the south-eastern corner of Goedehoop, but soon receives a useful tributary from Mooifontein No. 98, after which it follows a northerly but highly meandering course to its junction with the Elands River. For some eight miles from its source the river has now cut down through the base of the Transvaal System so as to expose the underlying older granite in a kind of geological bay. From Mooifontein northwards the main outcrop of the Black Reef Series follows the left bank of the Godwan River, always keeping low down and close to it, so that a continuous kranz follows the stream northwards until its base crosses the river and becomes continuous with the bottom of the Black Reef Series coming down from the Kantoor Plateau. Further north, the fall of the river is so adjusted to the dip of the quartzite that the latter is cut through completely. In conformity with the westerly dip, the quartzite kranz runs sharply up the various tributaries, which join the main stream from the west—a point of great practical importance—to the road transport, which furnishes the only means of communication from the Guano Mine on Uitzicht No. 83 to Godwan River Station. The Godwan River Valley is exceptionally well wooded and presents magnificently wild scenery, as illustrated by the great differences in level, amounting respectively to 2400 feet and 3200 feet between the floor of the valley and the Kantoor on the east or the high ridges on the west.

From Tafel Kop the Drakensberg can be followed continuously south-eastwards, usually making a fairly distinct feature, but never so prominent as further north. Where the Black Reef Series crosses the Komati River Valley the escarpment almost dies out topographically. South of the Komati River, more or less along the common boundary of the farms Kalkkloof No. 250 and Alexandria No. 30, the Drakensberg rises into a very prominent feature in the conspicuous ridge which overlooks the Warmbaths on Badplaats No. 29 and forms a striking landmark in the scenery for many miles. From here south-westwards the actual edge of the escarpment is geologically composite, owing to the gradual establishment of an additional quartzite at the base of the Pretoria Series. It has been pointed out above that from north to south there is a marked thinning down in the Black Reef Series, and the same also applies to the Dolomite Series. Unlike other areas in the

central or eastern Transvaal, where the Transvaal System is well developed, the base of the Pretoria Series south of the Komati River shows a very well-marked cherty quartzite (see below), and this fact, combined with the greatly reduced thickness of the underlying Dolomite Series, has resulted in the formation of a double escarpment running along the northern side of the Barberton-Carolina main road from Hlom-Hlom south-westwards until the Transvaal System passes below the Karroo High Veld. In this way the granitic slopes below the Drakensberg along the left bank of the Buffels Spruit are first limited in the upper direction by the first escarpment, due to the thin quartzite of the Black Reef Series, then follows a wider but gentle slope of the Dolomite Series, which is in turn defined by the second escarpment, caused by the basal quartzite of the Pretoria Series. Looking from the Warmbaths on Badplaats westward, these features are very clearly seen.

Just before passing below the Karroo rocks, the Black Reef Series becomes altogether insignificant as the geological cause of the Drakensberg escarpment, since its quartzites make hardly any feature along the higher slopes. The basal quartzite of the Pretoria Series is now the principal formative element in the ridge of high ground on the farms Rietfontein No. 70 and Victoria Poort No. 69, and has also given rise to very sharply defined circumdenuded outliers under the influence of the Zeekoe Spruit. This stream has a very fine waterfall on the last-named farm at a locality locally known as Kalkoenkranz. The fall takes place over the basal quartzite of the Pretoria Series. The scenery round here and over Rooihoogte where the Carolina main road descends from the high veld into the granitic valley of Buffels Spruit, shows very clearly how the complex of the basal quartzite of the Pretoria Series has taken the place of the Black Reef Series as the main geological element in determining the escarpment of the Drakensberg.

Along the northern limit of the present area runs the very striking valley of the *Elands River*. This stream rises a little east of the Belfast Monument and soon develops a conspicuous depression in the succession of shales, which are associated with the great fall in the level of the country, making the transition from true high veld around Belfast to the banked scenery in the Machadodorp neighbourhood. From its headwaters as far as the last-named locality, the Elands River keeps in a fairly well-marked, though still somewhat open, valley, which east of Machadodorp rapidly deepens, especially as one approaches Waterval Boven. The great prevalence of intrusive sheets of diabase hydrographically harder rocks gives rise to numerous rapids and high waterfalls, a feature which becomes very pronounced at a little below Boven itself. Owing to the thick massive Tunnel Quartzite, the valley a little below the last-named town becomes much constricted, and the waters finally plunge in a very fine fall over the quartzite into the gorge-like valley lower down, flanked on both sides by very high precipitous slopes, in which thick massive kranzes are a prominent feature, due mainly to the Dwaal Heuvel and Tunnel Quartzites of the Middle Pretoria Series. Some idea of the great contrasts in the resulting mountainous scenery will be gathered from the fact that between the floor of the valley below the fall and the summit of Van Lennops Kopje there is a difference of level of about 1600 feet. A short distance east of Boven the Tunnel Quartzite makes a small but distinct platform, from which a small circular portion has been separated as a little outlier (not shown on the map). From the Boven waterfall eastwards the floor of the valley continually falls, but without any sudden change in level, and gradually becomes more open; at the same time its sides get higher and higher in conformity with the prevalent westerly dip of the Transvaal System, until near Airlie and Godwan River Station the mountainous ridges over-towering the Elands River are quite 3200 feet above the floor of the valley.

(b) *Main Drainage Lines and Water Supply.*

The most important stream is the Komati River, and roughly five-sixths of the total present area falls within its hydrographic basin. The *Komati River* rises near Breyten, and after traversing high veld for some miles in a northerly direction, turns towards the east near Bonnefoi, and cuts across the middle and lower portion of the Pretoria Series along a deep valley associated with exceptionally fine and striking scenery, and finally enters the open rolling granitic country a few miles north-west of Hlom-Hlom. While remaining in the Transvaal System, it receives comparatively few tributaries of any size, the most powerful

addition to its supply being obtained from the comparatively short stream which runs from south-west to north-east across the farms Twyfelaar No. 206, Hebron No. 71, Doornkop No. 168, and Waterval No. 97. This tributary carries much more water than others do, and there are special reasons for this, as will be pointed out below.

The most important tributary of the Komati River within the present area is the *Buffels Spruit*, which rises on Bantjes Bult, east of Carolina, whence it flows over the granitic country in a north-eastern direction, more or less along the Barberton main road. On the farm Goedverwachting No. 32 the Buffels Spruit receives a powerful addition in the Zeekoe Spruit, the headwaters of which rise at the foot of the Dwaal Heuvel quartzite ridges, Verdrukking No. 210 and Leeufontein No. 130, north-east of Carolina. At Kalkoenkranz, on the eastern portion of Victoria Poort No. 69, the Zeekoe Spruit has a very beautiful fall over the basal quartzite of the Pretoria Series, as pointed out above.

Only a small portion of the *Elands River* basin falls within the present area. This stream rises a little east of the Belfast high veld and receives most of its tributaries from the north. On the south side its most notable increases are derived from Dawson's Spruit, rising in the higher ground near Zevenfontein, and from several tributaries draining the quartzitic plateau north of the Schurweberg. It is to these lesser streams, acting on the slightly inclined hard quartzites of the Daspoort horizon, that the kloof-like precipitous features of the minor valley south-east of Waterval Onder must be attributed.

The watershed between the Komati and Elands Rivers runs from Dalmanutha through Elands Kop and Zevenfontein eastwards to the northern corner of Elandsfontein No. 49, where it joins the high tuff ridge described above as running southwards from Van Lennops Kop; thence the divide keeps north-eastward along the north-western boundary of Schoonwater No. 6, crosses the northern portion of Treurfontein No. 201, and keeps along the narrow high ridge, in which the north-westerly beacon of Mamre No. 84 is situated. At this point the watershed turns south-eastward along the conspicuous spur of shales ending at the extreme westerly beacon of Mooifontein No. 98.

Practically the entire basin of the *Godwan River* falls into the present area and occupies about sixty square miles of country. The river rises on the high granitic ridge between Tafel Kop and the southern end of the Kantoor Plateau in the south-eastern corner of De Goedehoop No. 114, and, owing to the very favourable hydrographic conditions associated with the Drakensberg, carries an abundant and perennial supply, when compared with the feeble rivers over the higher horizons of the Pretoria Series round Machadodorp.

On the whole, the *water supply* is fairly satisfactory all over the country embraced in this report. Owing to the bare character of the surface and the great distribution of shales and slates, the run-off is comparatively large over the portion occupied by the Pretoria Series, at least as far east as the long ridge of tuffs above the Daspoort horizon, so that the various streams only convey a moderate supply.

Certain more restricted areas carry abundant water resources, on account of special geological and climatic conditions; these are the quartzitic districts both north and south of the Komati River and the shelving plateau on which Kaapsche Hoop is situated. The presence of fairly thick quartzites, whether belonging to the Pretoria or the Black Reef Series, inclined at low angles, tends to result in high ground, and after prolonged exposure to sub-aerial denudation, such strata behave hydrographically like sandstones in preserving the rainfall for longer periods. Hence these areas yield abundant water of excellent quality; their relatively high elevation also favours more abundant rainfall and the local prevalence of mist points likewise to another result due to the same causes, which are, moreover, reflected in the common occurrence of vleis of fern or heather-like vegetation, etc. The exceptional volume of water in the streams draining the Treurfontein plateau northwards to the Elands River, or the Steenwyk plateau north-westwards to a tributary of the Komati River, and referred to above, is thus accounted for. The exceedingly well-watered condition of the farm Weltevreden No. 17, twelve miles east of Machadodorp, provides an excellent illustration of the favourable hydrographic circumstances which the plateau region enjoys. These "mist-belt" characters are even more typically seen in the Kaapsche Hoop area. The village of Kaapsche Hoop lies on a slightly irregular plateau of Black Reef Quartzite gently inclined towards the west, while towards the east the plateau rises and is very sharply bounded by

the main quartzite escarpment (Devil's Kantoor) of the Drakensberg, from which a superb view over the De Kaap Valley towards the Barberton mountain land is obtained. From here there is an exceptionally steep and sudden drop of some 2000 feet to the granitic country traversed by the headwaters of the North Kaap River. The sharply defined features of the Drakensberg, rising like a great wall from the general level of the granitic low country, furnishes conditions eminently favourable to increased and more frequent rainfall, since the moisture-laden prevalent east winds are deflected upwards and precipitate their moisture on the Kaapsche Hoop plateau. The latter thus enjoys an abundant water supply and climatic conditions often like those of the temperate zone. Tree-ferns and similar vegetation are in thriving existence, the slopes facing eastwards are clothed with forests of ever-green timber, while prolonged mists are not infrequent. Those formations like the basal beds of the Dolomite Series and the diabase dykes, which react more easily to weathering agents, are sometimes thoroughly decomposed to considerable depths. These remarks apply not only to Kaapsche Hoop itself, but to the greater portion of the inclined plateau, which embraces the more elevated parts of Coetzeestroom and Goedehoop. The resulting conditions are essentially similar to those prevailing further north round Belvedere, north-east of Pilgrims Rest and north of the Olifants River as far as the Wolkberg and near Haenertsburg, which once more illustrates the continuity of the Transvaal Drakensberg both as regards its geology and its influence on the climatic hydrographic conditions of the "mist belt."*

Hot Springs.—Mineralized springs of warm or hot water are found at two localities within the present area—along the Carolina-Barberton main road on the farm Badplaats No. 29 and at Machadodorp.

On the Government ground *Badplaats*, about thirty-six miles east of Carolina, the spring is situated almost in the bed of a small tributary to the Buffels Spruit and about 300 yards north-west of the main road. It issues vigorously like boiling water from granitic rocks on the left bank of the little tributary at an unpleasantly high temperature, so that the waters of the stream have been deviated to cool down the temperature for bathing purposes. The waters of the spring are associated with a strong sulphur smell and said to be an excellent curative agent for rheumatic complaints. No structural features indicating faults or disturbances were found in this neighbourhood to afford a clue as to the mode of origin of the spring.

At *Machadodorp* several mineralized springs occur on the right bank of the Dawson Spruit a short distance south of the point where the stream passes under the Delagoa Bay Railway and about half a mile north-east of Machadodorp Station. The rock exposed in the bed of the river at the springs is an almost compact dark-coloured, apparently volcanic formation, probably forming a local phase in the eruptive activity which gave rise to the continuous band of agglomerates and tuffs, which is a conspicuous feature over the adjoining farm Rietfontein No. 232.

A series of springs are found in this locality all situated in close proximity to one another. Seven "eyes" have been suitably enclosed and roofed over to provide a kind of basin, from which bathing cells are fed. Outside the bathhouse two further springs are seen. From the report by Dr. Hahn the following particulars are extracted:—†

The temperature of the springs, which are mineralized and belong to the class of sulphur springs containing free sulphuretted hydrogen as well as sulphides, is about 82° F. In view of this fact and their radio-active properties, they may be described "Radio-active Thermal Sulphur Springs." The amount of sulphuretted gas at Machadodorp compares very favourably with that present in some of the famous sulphur springs on the Continent.

* Compare the Annual Report of the Geological Survey for 1906.

† Results of the investigations and analyses made of the Radio-active Thermal Sulphur Springs at Machadodorp, and report on the same. S.A. College, Capetown, January, 1913.

The following particulars of the spring in front of the bathhouse are of interest :—

Temperature of water..... 83.3° F.

	Grains.
Sulphuretted hydrogen, per gallon.....	.1428
Silica.....	1.76
Alumina and ferric oxide.....	.09
Calcium carbonate.....	2.08
Magnesium carbonate.....	.38
Magnesium sulphate.....	.49
Sodium chloride.....	6.13
Sodium carbonate.....	3.20
Sodium sulphide.....	.062
Potassium carbonate.....	.22
Lithium chloride.....	.16
TOTAL SALINE CONSTITUENTS, PER GALLON....	14.572

The amount of radio-activity is measured by the degree of electric conductivity acquired by air which has been shaken with water from the sulphur springs. The result obtained from the spring in front of the bathhouse is given in the following table, which also includes the corresponding values from some well-known sulphur springs for comparison :—

	Units.
Friedrichsquelle, Baden Baden.....	6.9
Schlossbrunnen, Karlsbad.....	8.9
Felsenquelle, Karlsbad.....	5.4
Kaiserbrunnen, Karlsbad.....	5.1
Stahlquelle, Freyensbach.....	7.3
Gastein Springs.....	39 to 149
Machadodorp.....	12.8

(c) *List of Principal Heights.*

In the following list the elevations in feet above sea-level at Delagoa Bay are given for the railway stations or sidings and a number of other useful landmarks. All the data have been obtained from aneroid readings, checked repeatedly at points where heights are accurately known, with the exception of railway and Trigonometrical Survey levels. The latter are marked with an asterisk and are the only reliable data. The exact positions of the various points are indicated on the map, Plate VII, which illustrates this report :—

	Feet above sea-level.
Treurfontein No. 201 on main road.....	6950
Summit of quartzite outlier on Steenwyk No. 48.....	6300
Schurwekop.....	6250
Top of ridge near western boundary of Torburnlea.....	6150
Tafel Kop.....	6128*
Weltevreden No. 17—homestead.....	6110
Highest point on Kalkkloof No. 250 (on the Drakensberg side, south of Komati River).....	6100
Homestead of Steenwyk No. 48.....	6000
Homestead on western portion of Elandshoek No. 233.....	5850
Van Lennops Kop south of Boven Station.....	5720
Elands Kop near Zevenfontein Station.....	5680
On main road past Schurwekop.....	5630
Devil's Kantoor.....	5520
Carolina Station.....	5440
Zevenfontein Station.....	5430