UNION OF SOUTH AFRICA
UNIE VAN SUID-AFRIKA

DEPARTMENT OF MINES — DEPARTEMENT MYNWESE

GEOLOGICAL SURVEY
GEOLOGIESE OPNAME

THE GEOLOGY AND MINERAL DEPOSITS

OF THE

GRIQUATOWN AREA, CAPE PROVINCE

AN EXPLANATION OF SHEET 175 (GRIQUATOWN)

MAP IN PRESS.

Compiled by
D. J. L. Visser

from reports by
L. G. Boardman, D.Sc., and D. J. L. Visser, D.Sc., F.G.S.

Met 'n opsomming in Afrikaans onder die opskrif:

DIE GEOLOGIE EN DELFSTOWWE VAN DIE GEBIED GRIEKWASTAD, KAAPPROVINSIE

Printed by and obtainable from the Government Printer, Bosman Street, Pretoria.

Geological map in colour on a scale of 1 : 125,000 obtainable separately at the price of 6s.

Gedruk deur en verkrygbaar van die Staatsdrukker, Bosmanstraat, Pretoria.

Geologiese kaart in kleur op 'n skaal van 1 : 125,000 apart verkrygbaar teen die prys 6s.

and they therefore presumably contain, in addition to carbon and hydrogen, also a small amount of nitrogen. It may therefore be suggested that some, if not all, of the nitrate may have been formed as a result of the special conversion of the nitrogenous matter present in the shale.

At the time when the Matsap Pan was being investigated, a few bore-holes were also drilled on Vaal Water O. 84 (A–B. 2) and on the adjoining part of Zaai Plaats O. 83 (A–B. 1–2), and brine of a composition similar to that of the Matsap Pan was obtained.

XII.—UNDERGROUND WATER

In this semi-arid area, with its low and uncertain rainfall, the question of water-supply is of utmost importance. There are no rivers or streams, and drainage-channels are as a rule ill defined and carry only an ephemeral rush of water after heavy rains, which are rare. Very few springs exist, with the result that the area is almost entirely dependent on underground water supplies.

A. Springs

The largest and by far the best known is the spring around which Griquatown has originated. Early in the 19th century it was already known to a missionary named Anderson, who persuaded a section of the wandering Griqua tribe, emigrating from the south, to settle in the vicinity of the spring. Under the beneficient missionary guidance the Griquas built up a flourishing settlement of some 2,000 people around the spring, which was then known as Klaarwater (clear water), on account of the pool of clear water at the eye of the spring. The Griquas have, however, almost died out and the site is today a predominantly European town, the seat of the magistracy of Hay and the centre of a flourishing stock-farming community.

The spring is situated on the eastward extension of a transverse fracture, where it cuts across a prominent drainage-channel leading from the north. The fracture can be traced from Taaibosch Fontein O. 2 (B. 3) across the Griquatown Townlands. The flow of the spring has fluctuated appreciably. Since the beginning of this century there has been a gradual decline. In the summer of 1924 exceptionally heavy rains in the catchment area to the north caused a flood which swept through Griquatown (the village is built partly in this drainage-valley) and continued for many miles towards the Orange River before being soaked up eventually. This flood brought about a rejuvenation of the spring, which was sufficient to meet the demands of a considerable amount of irrigation within the town area. Lately a succession of dry seasons has caused a marked decrease in the flow of the spring, especially since 1940. The main eye of the spring, which is just on the northern outskirts of the town, used to be marked by a large open pool of water, 400 to 600 feet across, of which today only a depression, overgrown with weeds, remains. This recession of the water has no doubt been accelerated by the drawing of water from municipal bore-holes which now supply the town and which have been drilled in the vicinity of the spring.

South of Griquatown, on the Driefontein Settlement (southern part of the Townlands), on Bont Heuvel O. 46 (B. 3–4) and on Kalkfontein O. 47 (B. 3–4), several springs are found at the base of an escarpment formed by hard surface-limestone. The springs are rather weak and are undoubtedly seepage-springs fed by water which flows along the floor of the depression in which the superficial deposits have accumulated. The depression extends northwards for many miles, roughly parallel to the Asbestos Hills.

On Elemshof O. 50 (B. 3–4) a spring is found in the dolomite along another transverse fracture which can be traced westwards up to and beyond Moosfontein O. 18 (B. 3), where there is another spring. The former has now subsided to below ground-level and is at present tapped by a shallow well. The spring on Moosfontein is situated at the point where the transverse fracture cuts across a prominent drainage-channel from the more elevated area to the north. This point is furthermore situated on the contact between the tillite and the Ongeluk volcanics. Three geological factors have therefore combined to give rise to the spring which is still flowing.

Springs which issue on the contact of dolerite dykes in the Dolomite occur on Kogelbeen O. 44 (A. 4) and Koekais O. 31 (B. 4) and Spoedaan O. 410 (B. 4).

On Witwater O. 23 (B. 2–3) and Taaibosch-Puts O. 26 (B. 3) springs issue from soft, porous surface-limestone in valleys. They are clearly seepage-springs which are fed by the water which drains from the surrounding hills into the valley, and which is forced to the surface by some underground barrier in the bottom of the valley.

The fresh-water spring on the edge of the Matsap Pan has already been mentioned. It is not a very strong spring, yet it yields a supply sufficient for local domestic use. It is apparently also a seepage-spring which draws its water from the area drained by the Postmasburg " Loop " and its numerous tributaries. On the edge of the pan this water is brought to the surface by impervious clay which has originated through the weathering of the Upper Dwyka shale.

In the deep gullies which drain the Langeberg small seepage-springs are occasionally found, e.g. on Paarde Kloof O. 219 (A. 1) and Roodemans Kloof O. 214 (A. 1). The water from these springs is remarkably fresh and pure, but very often dries up completely during the dry seasons.

B. Concentrations in Sheet-like Bodies

Wherever masses of rock have been shattered and rendered permeable, or where absorbent deposits, e.g. gravel, sand, or porous surface-limestone, fill depressions or valleys into which the run-off from the adjacent hilly areas is discharged, the underground water may be visualised as concentrated in sheet-like bodies. As example may be cited the valley south of Griquatown, which is deeply filled with scree and covered with porous vlei-limestone, and is fed by run-off from the adjacent Asbestos Hills and by seepage from springs higher up in the valley. From the southern part of Driefontein (portion of the Griquatown Townlands), across Bont Heuvel O. 46 (B. 3–4), and half-way across Kalkfontein O. 47 (B. 3–4) the valley is marshy and water at shallow depth is to be found anywhere along it.

In the broad valleys west of the Asbestos Hills the presence of surface-limestone, especially if accompanied by a growth of soetdoring trees, is always an indication of water at a shallow depth. Near the southern boundary of Merwehoop O. 6 (B. 3) there is a small patch of surface-limestone covered by a prolific growth of soetdoring trees. Strong supplies of underground water are struck at depths of 20 to 30 feet. On Taaibosch-Puts O. 26 (B. 3), Vlokspan O. 11 (B. 3) and Witwater O. 23 (B. 2–3) underground water is found under similar circumstances.

Where, however, these broad and shallow valleys are terminated and replaced by the deep and narrow gorges in the banded ironstone and jasper of the Lower Griquatown Stage, the underground water becomes scarcer and can only be obtained by deep drilling on dykes or shear-zones.

Farther to the northwest, on Lowlands M. 105 (A. 3), in the valley of the Gasip " Loop ", the presence of shallow, sheet-like bodies of underground water is indicated by dense thickets and groves of soetdoring trees.

On Lake Warren O. 88 (A–B. 2), just below the point of discharge of the various drainage-channels from the hills of Ongeluk lava to the east on to the sand-covered plain at their base, good supplies of underground water are struck at shallow depth.

Still farther to the west similar concentrations of water are found in the sand-filled valleys amongst the hills, and particularly along the Matsap " Loop ". Owing to the more arid nature of the country to the west, water along the Matsap " Loop " is usually struck at greater depth than in the eastern parts of the area. On Cone O. 82 (A. 1–2), for example, water is struck at 30 feet below the surface, on Witdraai O. 204 (A. 1) at 45 feet, and on O. 198 (A–B. 1), O. 199 (A–B. 1) and Brackenbury O. 185 (B. 1) at 60 feet. Although sufficient for domestic purposes, the supplies are usually somewhat weak and, in addition, usually brackish.

In the sand-filled valleys amongst the hills of banded jasper and ironstone moderate supplies of fairly pure water are invariably struck on the contact between the superficial covering and the underlying country-rock. On Lang Kloof O. 94 (B. 1–2), Water Kloof O. 95 (B. 1–2) and Nek O. 106 (B. 1–2) water was struck between 36 and 45 feet below the surface, on Paauwvlei O. 190 (B. 1) and Koodooskloof O. 96 (B. 1–2) at about 60 feet, and on Cairn Top O. 188, Westbourne O. 177 and Longland O. 176 at approximately 80 feet. During the last few years fairly strong supplies have been tapped in these parts by drilling, e.g. on Water Kloof O. 95, Koodooskloof O. 96, Paauwvlei O. 190 and Cairn Toul O. 189. At the Fainman Manganese Workings on the eastern part of Cairn Toul O. 189 a bore-hole, drilled to 230 feet, struck water in broken banded jasper at at 190 feet. The water is exceptionally pure, and the yield is 1,000 gallons per hour.

C. Concentrations along Linear Structures

Under linear structures are included dykes of dolerite and shear-zones which pass into small oblique faults.

In the dolomite terrain east of the Asbestos Hills it is significant that nearly all the farm-homesteads have been built, all the farm-roads located, and all the wells and bore-holes for domestic water-supplies sited on low, linear humps of surface-limestone, which also support a rather dense growth of tall, evergreen trees, e.g. the karree (*Rhus capensis*). Although they did not understand the nature of these linear humps, the local farmers had by experience become aware of the fact that underground water, readily available and in quantity sufficient for domestic purposes, is somehow associated with these structures. They are therefore referrred to as " are " (literally " veins "), or more specifically as " kalkare " (i.e. lime-veins) on account of the capping of surface-limestone on them. Whenever fresh supplies of underground water are sought, these structures are looked for and followed closely when they have been located. They represent, in fact, dolerite dykes which are decomposed to a fairly great depth and they serve as aquifers in the massive and comparatively impervious dolomite. Bore-holes and wells may therefore be sited on these " are ".

In the hilly country underlain by the Ongeluk lava to the west of the Asbestos Hills, weathered dykes are seldom associated with cappings of surface-limestone, but are however indicated by linear growths of tall, green trees which automatically suggest the presence of water underground. For this reason they too are referred to as " are ", or more specifically " bosare " (i.e. bush-veins).

In this part of the area, too, the dykes thus indicated, i.e. as " bosare " are usually extensively weathered and therefore serve as aquifers themselves. On the other hand, the dyke-rock may be comparatively fresh, but the adjacent country-rock (the Ongeluk volcanics) rendered more pervious by jointing and fissuring. The dyke then acts as a barrier to the flow of underground water, in which case a more luxuriant growth of vegetation will be confined to only one contact of the dyke and the country-rock. The result is, however, again a " bosaar " which generally leaves little doubt as to where wells should be sunk or bore-holes drilled. Practically all the bore-holes and wells in these parts have been drilled or sunk on linear structures of this type.

The local concentration of underground water along transverse faults and shear-fractures has already been discussed under " springs ". There are also smaller and less obvious linear structures, e.g. zones of prominent jointing and local brecciation, which often have to be resorted to in the search for underground water. These structures can frequently be detected only by studying the weathering of the rocks against hillslopes, because, representing zones of weakness as they do, they are exploited without fail by the agencies of erosion.

In the central, hilly part of the area, occupied by the Ongeluk volcanics, detailed mapping has revealed several linear valleys which without doubt follow oblique zones of fracturing. These zones have either passed into small faults, or dykes have been emplaced along them (cf. Chapter X–C). The valleys follow either a northwesterly direction, e.g. on Lafitte O. 111 (B. 2), and Hansberg O. 112 (B. 2), Goede Hoop M. 107 (A. 3) and Chavonne M. 108 (B. 3), or a northeasterly direction, as indicated by the lower part of the Gasip " Loop " and the valleys on Merwehoop O. (B. 3) and Doradale O. 9, southwest of Griquatown. The first direction is also followed by the prominent and remarkably straight valleys which breach the Asbestos Hills on Leeuwvlei M. 56 (A. 4), M. 114 (A. 4), Hopefield M. 116, Turksvyepan O. 52 (A. 3–4), O. 54 (A–B. 3) and on the southwestern part of the Griquatown Townlands. They have obviously been eroded along lines of weakness orientated in a northwesterly direction, and incidentally also parallel to the Taaibosch Fontein fault. These structural features resulted from the post-Matsap orogeny.

These remarkably straight valleys should only be considered as a general guide in the selection of sites for drilling or sinking wells. Favourable sites for drilling may be located in these valleys by taking into consideration also certain cross-cutting geological features, e.g. contacts, strike-faults or tension-fractures.

D. Quality of the Water

In view of the low annual rainfall all the underground water contains a considerable amount of dissolved mineral matter, most of which is lime. This is indicated by the accumulation of calcareous tufa in the immediate vicinity of springs and in areas where underground water is obtained at shallow depth. This does not, however, affect the quality of the water adversely, and as a rule it is quite suitable for human or animal consumption.

The concentration of dissolved mineral matter in underground water seems to be a function of the yield. Thus in the case of bore-holes yielding strong supplies, or of flowing springs, the water is usually fairly pure, whereas the concentration of dissolved mineral matter in the water from bore-holes with small yields is notably greater.

The principal impurity is bicarbonate of lime, but in the western part of the area, and in particular along the Matsap " Loop ", sulphates and chlorides are also present.

Exceptionally pure water issues from small, intermittent seepage-springs in the quartzite of the Upper Matsap Stage; the quantity is, however, hardly sufficient for local domestic use. During recent years fairly strong supplies of pure water have been struck in the broken, banded siliceous rocks of the Lower Griquatown Stage.

In regard to quality it is worth mentioning that the underground water in the northern and eastern parts of the area with higher rainfall is sweeter than that from the remainder of the area with lower rainfall, and that water from areas covered by the Dwyka tillite is distinctly saline. Bond (2) classes the waters of the northern and eastern parts of the area as temporary hard, carbonate waters, with total solids less than 80 parts per 100,000 and puts them in his group C. The waters of the southern and western parts of the area he classes as highly mineralised, chloride-sulphate waters with total solids more than 100 parts per 100,000 and puts them in his group A. Although this classification is somewhat arbitrary, it nevertheless coincides with areas of comparatively high and low rainfall respectively.