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THE SOURCE OF DRINKING WATER AT GOBABEB.

by

H.W. Stengel

Water Affairs Branch, S.W.A. Administration

SITUATION OF GOBABEB.

The Namib Desert Research Station Gobabeb is situated on the northern bank of the Kuiseb River about 70 miles to the east of Walvisbay in the Namib desert.

This situation is very favourable as three landscape zones meet there. The first zone is that of the Kuiseb River with its broad sandy bed and large strips of trees and bushes on the alluvial silt banks. The second zone is the shifting sand dune area stretching from the southern bank of the river in a southerly direction for hundreds of miles to the vicinity of Lüderitzbucht. The third is the stony and sandy plateau of the Namib north of the river, interrupted by rocky outcrops, hills and mountains.

Meteorological and climatological observations are very important in this Inner Namib desert area, while biological conditions afford a large area for studies. (See Fig. No. 1, map of Gobabeb).

THE KUISEB RIVER.

The most important feature of the three zones is the Kuiseb River with its underground water. Without sufficient drinking water a Research Station could not provide the required laboratory and domestic facilities for the scientists.

At Gobabeb the catchment area of the Kuiseb River is appr. 13,000 km^2 (± 5000 sq. miles). The origin of the Kuiseb is

Pls. note: Originals in Archive

eastern edge of the Khomas Highlands, about 20 miles (36 km) west of Windhoek. In the upper reaches, the Kuiseb flows during practically every rainy season, whereas lower down the rivel will flow only in good rainy seasons. In exceptional rainy seasons the river will flow to its mouth and into the Atlantic.

The upper catchment area of the river is mountainous country, mainly in mica schist formation. In the middle course the river has cut a deep canyon through the mica schist rock. The lower course lies in the Namib desert and Gobabeb is situated in this section, not far from the end of the canyon section.

The total length of the river is about 440 km from the origin to the mouth, which is a large delta stretching from Walvisbay to Sandwich Harbour.

The Canyon section consists of bare rock with a very shallow depth of sediments filling up the river bed. A deep and broad river bed with favourable water bearing sand sediments constitutes the section from about 25 km upstream of Gobabeb down to the Delta at the coast.

GROUNDWATER IN THE KUISEB.

At Gobabeb as also in other sites situated further downstream the river is blocked at certain depths by granite rock, forming a groundwater sill with an immense storage basin for groundwater. At these sites water supply possibilities are very favourable.

In such places the water level is only a few feet below river bed level. Primitive water holes, dug by the Hottentots in the shallow ground-water layers, can be seen here. These waterholes gave sufficient water for man and the small numbers of livestock in the area.

The flowing water in the sand bed of the river is of varying quality. Brack and fresh water will be found to occur in close proximity to each other. As a rule, fresh water will occur in the upper layers and more on the southern side of the river, whereas brackish and salty water will occur in the deeper layers and more on the northern or Namib side of the river.

The salt and brackish water is derived from the mist and the weathering of the rocks. The mist which is brackish due to the proximity of the coast comes in from the Atlantic, mainly in the winter and covers this area during the early hours of the day, precipitating its brackish moisture on the top soil over the whole area. The brack is washed down by rains into the river bed where it forms lenses and pockets in the immediate vicinity of the fresh ground-water, which originates from the infiltration of the fresh flood water. In addition evaporation takes place from the ground-waterturning the fresh water, which always contains some salt in solution, into brack water.

The most favourable sites for water supplies must be investigated by testboring and a great deal of systematic exploration of this nature has been done between Gobabeb and the coast.

The results of testboring for a water supply for Gobabeb, which took place in September, and October 1965 are indicated in figure 2 on which the cross section of the river, boring sites and water qualities are shown.

The best quality water is found on the southern bank of the river. Test borehole No. 8801 shows the most favourable results. The water quality ranges approximately from 300 - 1000 parts per million, total dissolved solids.

At the site of this borehole a tube well 12 inches in diameter has been developed and equipped with a submersible pump.

In accordance with the accepted practice in the Water Affairs Branch of the S.W.A. Administration drinking water should comply with the following in respect of total dissolved solids: -

Towns with population	10,000 t.d.s.	1500 p.p.m.
Towns with population	10,000 and official water supplies like Gobabeb	2000 p.p.m.

Farm units 3000 p.p.m.

Lesser salt concentrations are of course desirable as the following classification shows: -

t.d.s. p.p.m.	drinking water quality
300 - 500	very good water.
500 - 1000	good water.
1000 - 3000	progressively increasing taste of brack.

Not only do different water qualities occur in the sandy river bed, tut there are also great variations in grading or grain sizes of the sediments.

During test broring water and sand samples were taken at 3 - 5 feet intervals of depth.

The results of sand analyses, according to Fineness Modulus of the sand are shown in figure 3. Unfortunately they do not cover the whole section and only a rough idea is given of the complicated nature of the sand sediments and their characteristics. Fine sands have low Fineness Modulus.

The sand with a smaller Modulus lies more towards the surface, growing coarser and coarser towards the bedrock of the river, but great irregularities occur. (See figure 3). The grading of the sand effects both the specific yield and the rate of flow of ground-water.

CONSTRUCTION OF THE TUBEWELL.

As mentioned above the testhole No. 8801 gave the most favourable results in water quality. The site of this borhole is situated above river bed level on the bank of the river, but still in the range of the high flood. Furthermore it is situated on a buldge in the river bank where the danger of erosion and washaways is less than on the opposite side of the river.

The first water supply at Gobabeb was also a tubewell situated in the middle course of the river. It was destroyed by the big floods which occurred in January 1963.

Between 1963 and the completion of the new tubewell in June 1966 the water supply of the Research Station was an emergency one, consisting of a small concrete well, situated on the right bank near the line of test holes. The water tasted slightly brackish.

Methods which were evolved as a result of practical experience in the Walvis Bay ½ Swakopmund water supply scheme were applied successfully in developing the new tube well.

All pipelines, cables etc. were lain 5' 6'' (1.70m) below riverbed level. The steel casing of the tube well has a diameter of 12'' and is furnished with an Hagusta Filter with 1 mm slots. Thetop of the casing is embedded in a reinforced watertight concrete box in which the cable and pumping main are connected with the submersible pump. The concrete box with its manhole serves as an inspection eye and for repairs.

Above the manhole an intake well built from concrete blocks in dry stone masonry was erected to lend easy access to the manhole. (Fig. 4).

If a big glood occurs, which may inundate and eventually wash away the well no damage will be done to the concrete box, because the well is built of losely packed blocks.

The power for the submersible pump is generated by a Diesel electrical plant, which also provides domestic current for the station.

The yield of the tube well was determined by test pumping and was found to be 900 gall per hour ($\pm$ 4 · 0 m^3/h). The rate of pumping is 720 gall per hour and adequately covers the needs of the station.

ANALYSIS

Testhole Nr.	8801
Physical examination:	pH 7.8
Conductivity :	1200
Total Solids (180°C)	730
Sodium (as Na)	175
Potassium (as K)	16
Sulphate (as SO_4)	51
Nitrate (as N)	nil
Nitrite (as N)	nil
Silicate (as SiO_2)	25
Fluorine (as F)	0.4
Chloride (as Cl)	175
Total Alkalinity (as $CaCO_3$)	295
Total Hardness (as $CaCO_3$)	240
Calcium-Hardness (as $CaCO_3$)	175
Magnesium-Hardness (as $CaCO_3$)	65

ANALYSIS

Testhole Nr.	8801
Physical examination:	pH 7.6
Conductivity :	495
Total Solids (180°C)	290
Sodium (as Na)	36
Potassium (as K)	12
Sulphate (as SO_4)	29
Nitrate (as N)	nil
Nitrite (as N)	0.5
Silicate (as SiO_2)	15
Fluorine (as F)	0.5
Chloride (as Cl)	30
Total Alkalinity (as $CaCO_3$)	185
Total Hardness (as $CaCO_3$)	175
Calcium-Hardness (as $CaCO_3$)	130
Magnesium-Hardness (as $CaCO_3$)	45

ANALYSIS

Testhole Nr.	8801
Physical examination:	pH 7.95
Conductivity :	1160
Total Solids (180°C)	770
Sodium (as Na)	95
Potassium (as K)	16
Sulphate (as SO_4)	98
Nitrate (as N)	traces
Nitrite (as N)	nil
Silicate (as SiO_2)	25
Fluorine (as F)	0.3
Chloride (as CI)	135
Total Alkalinity (as $CaCO_3$)	345
Total Hardness (as $CaCO_3$)	410
Calcium-Hardness (as $CaCO_3$)	265
Magnesium-Hardness (as $CaCO_3$)	145

ANALYSIS

Testhole Nr.	88 01
Physical examination:	pH 7.4
Conductivity :	3000
Total Solids (180°C)	2366
Sodium (as Na)	413
Potassium (as K)	33
Sulphate (as SO_4)	912
Nitrate (as N)	4.6
Nitrite (as N)	nil
Silicate (as SiO_2)	30
Fluorine (as F)	2.2
Chloride (as CI)	390
Total Alkalinity (as $CaCO_3$)	235
Total Hardness (as $CaCO_3$)	730
Calcium-Hardness (as $CaCO_3$)	690
Magnesium-Hardness (as $CaCO_3$)	40

ANALYSIS

Testhole Nr.	8801
Physical examination:	pH 7.8
Conductivity :	1800
Total Solids (180°C)	1185
Sodium (as Na)	223
Potassium (as K)	22
Sulphate (as SO_4)	133
Nitrate (as N)	traces
Nitrite (as N)	nil
Silicate (as SiO_2)	25
Fluorine (as F)	0.4
Chloride (as CI)	330
Total Alkalinity (as $CaCO_3$)	355
Total Hardness (as $CaCO_3$)	480
Calcium-Hardness (as $CaCO_3$)	280
Magnesium-Hardness (as $CaCO_3$)	200

ANALYSIS

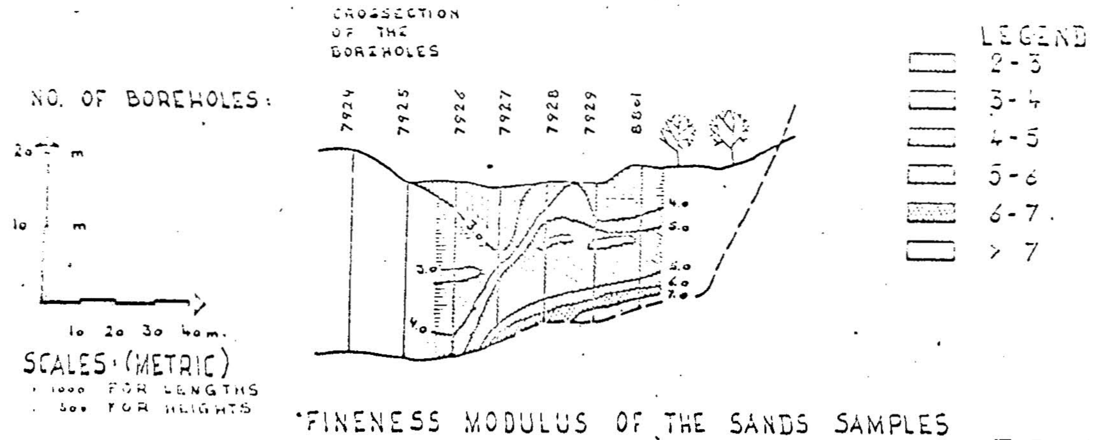
Testhole Nr.	8801
Physical examination:	pH 8.3
Conductivity :	1400
Total Solids (180°C)	839
Sodium (as Na)	228
Potassium (as K)	18
Sulphate (as SO_4)	88
Nitrate (as N)	1.0
Nitrite (as N)	nil
Silicate (as SiO_2)	20
Fluorine (as F)	0.4
Chloride (as CI)	210
Total Alkalinity (as $CaCO_3$)	315
Total Hardness (as $CaCO_3$)	215
Calcium-Hardness (as $CaCO_3$)	150
Magnesium-Hardness (as $CaCO_3$)	65

ANALYSIS

Testhole Nr.	7925
Physical examination:	pH 7.7
Conductivity :	8100
Total Solids (180°C)	5980
Sodium (as Na)	1719
Potassium (as K)	74
Sulphate (as SO_4)	983
Nitrate (as N)	2.9
Nitrite (as N)	0.2
Silicate (as SiO_2)	25
Fluorine (as F)	0.8
Chloride (as CI)	2405
Total Alkalinity (as $CaCO_3$)	605
Total Hardness (as $CaCO_3$)	1325
Calcium-Hardness (as $CaCO_3$)	500
Magnesium-Hardness (as $CaCO_3$)	825

ANALYSIS

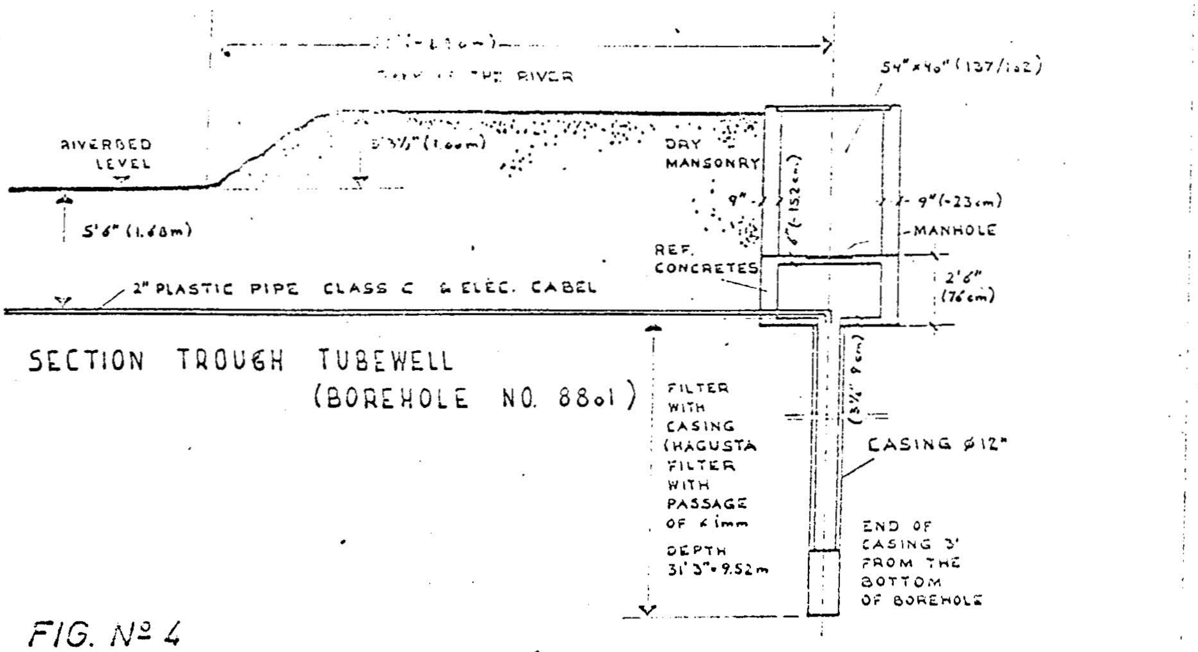
Testhole Nr.	7925
Physical examination:	pH 7.85
Conductivity :	2000
Total Solids (180°C)	1295
Sodium (as Na)	319
Potassium (as K)	26
Sulphate (as SO_4)	163
Nitrate (as N)	traces
Nitrite (as N)	0.2
Silicate (as SiO_2)	25
Fluorine (as F)	1.2
Chloride (as CI)	338
Total Alkalinity (as $CaCO_3$)	520
Total Hardness (as $CaCO_3$)	430
Calcium-Hardness (as $CaCO_3$)	230
Magnesium-Hardness (as $CaCO_3$)	200



FINENESS MODULUS OF THE SANDS SAMPLES IN THE KUISEB - RIVER AT GOBABEB

FIG. Nº 3

DATE 3/10/77



SECTION TROUGH TUBEWELL (BOREHOLE NO. 8801)

FIG. Nº 4

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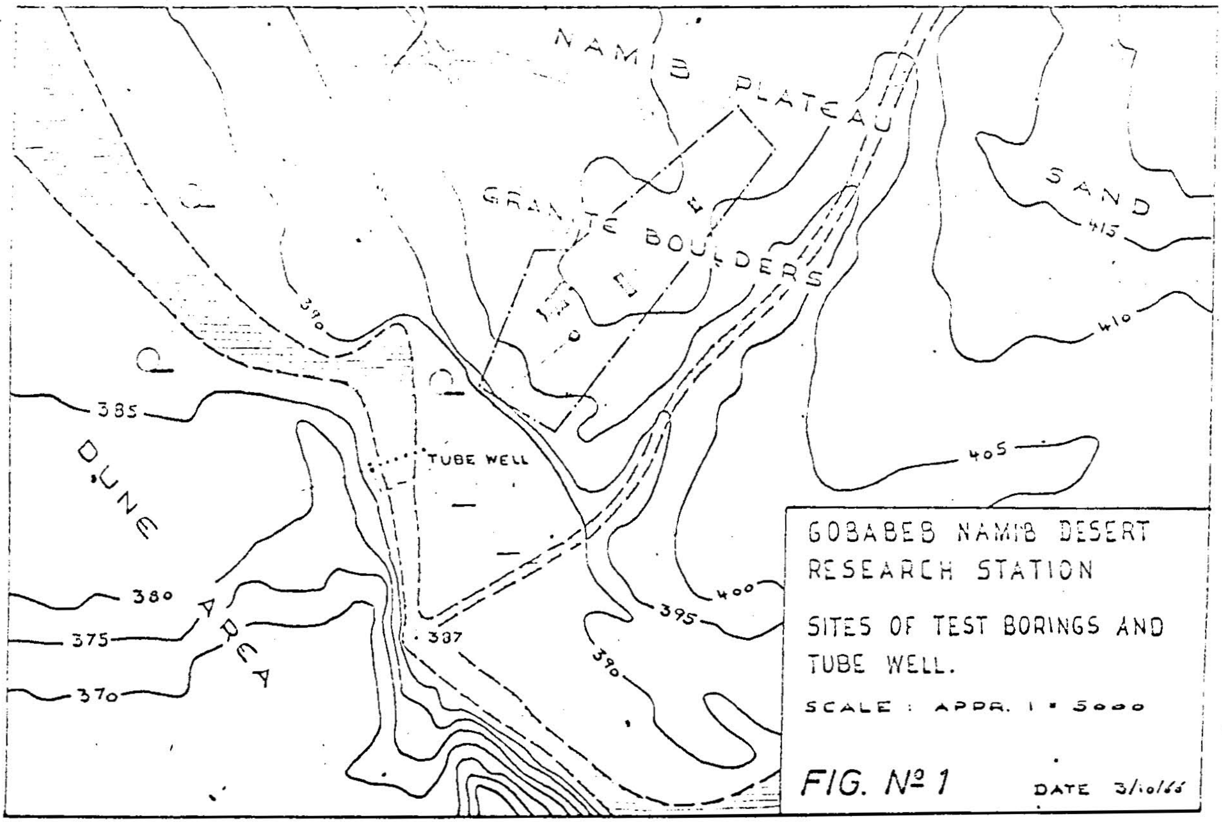

GOBABEB NAMIB DESERT RESEARCH STATION

SITES OF TEST BORINGS AND TUBE WELL.

SCALE : APPR. 1 : 5000

FIG. Nº 1

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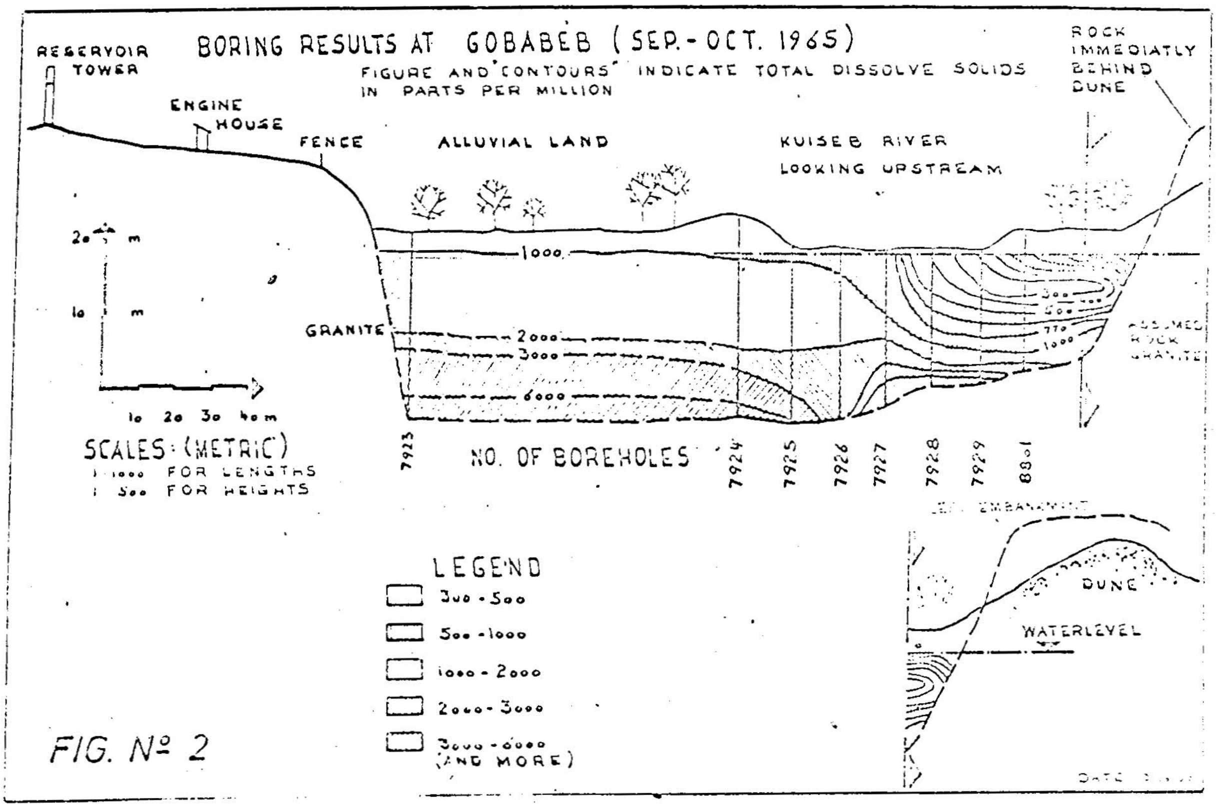

BORING RESULTS AT GOBABEB (SEP. - OCT. 1965)

FIGURE AND "CONTOURS" INDICATE TOTAL DISSOLVE SOLIDS IN PARTS PER MILLION

FIG. Nº 2