C. The Ugab River

1. *The rainfall conditions in the catchment area.*

The longest of the four rivers which drain the central part of the Atlantic area is the Ugab, with a length of 486 km.

It has its origin on the flats and mountain slopes near Otavi. The Otavi highlands is one of the highest rainfall areas in South West Africa, with an average rainfall figure of about 500 mm. Also the number of days of rainfall for the upper Ugab area is the highest, viz. 70 days p.a. on an average.

The following tables explain the rainfall in the catchment area of the Ugab, in relation to various localities situated on different altitudes above sea level, and the floods over a given period of years.

It was impossible to register exceptionally heavy rainfalls with a high degree of intensity on account of the great distances existing between the respective observation sites. However, rains falling in the Namib area appear to cause floods in the lower course of the river. Such rains are rare, but it is evident that heavy rains falling on bare ground or on ground with sparse vegetation cause a quick run-off and consequently high floods with large waves*.

* In this connection it may be remembered that the railway bridge at Swakopmund was destroyed by floods caused by heavy rains in the lower Khan area (the Khan river ist the biggest tributary of the Swakop). Also a few of the bigger floods that occurred in the lower Omaruru river basin 1962/63 originated from rainfall in the Black Spitzkopjie area.
Worth mentioning also in this regard are flood data on the Swakop river listed by Dr. R. Seydel in his publication 'Das Schwemmland im Swakoptal, 1915—1943'. In 1916 there occurred in the lower course of the Swakop such a big flood that in many instances garden soil was washed away and installations were damaged at Goanikontes, Brock and some other sites downstream up to the last settlement close to Swakopmund (Weule) where a windmill was washed away. According to this information (which I owe to Dr. Röning), a cloudburst occurred in the lower Namib near the railway siding Ebony and over Haigamklab, where the Khan enters the Swakop; this cloudburst destroyed a part of the station building and caused a high flood.

Observation site	Sorris-Sorris	Outjo	Otavi	Otjikondo	Omatjenne	Otjiwarongo	Erundu
Altitude above sea level, in m	540	1262	1420	1300	1381	1455	1444
Average yearly rainfall, in mm.	79.6	409.4	539.7	350.9	382.8	441.5	429.0
Period in years	3—5	49/53	38/42	24/26	14/15	33/38	22/24
Number of days with rain	17.9	39.8	76.6	35.6	40.9	43.7	38.3
Rainfalls when the flow did not reach the Atlantic (mm)							
1953/54	—	597.7	709.1	645.5	389.1	746.0	684.4
1956/57	—	400.7	628.1	337.2	327.5	354.5	314.9
1959/60	—	275.0	461.9	171.4	316.7	360.9	323.9
1963/64	—	365.9	503.3	—	262.7	426.5	337.0
Rainfalls which caused a flood to the Atlantic (mm)							
1933/34	—	1050.0	995.0	840.0	—	660.0	860.0
1950/51	—	525.9	467.1	615.7	—	582.0	455.1
1953/54	—	597.7	709.1	645.5	389.1	746.0	684.4
1960/61	—	385.7	472.3	320.0	—	416.8	273.3
1962/63		458.6	692.2	429.8	—	502.1	566.4

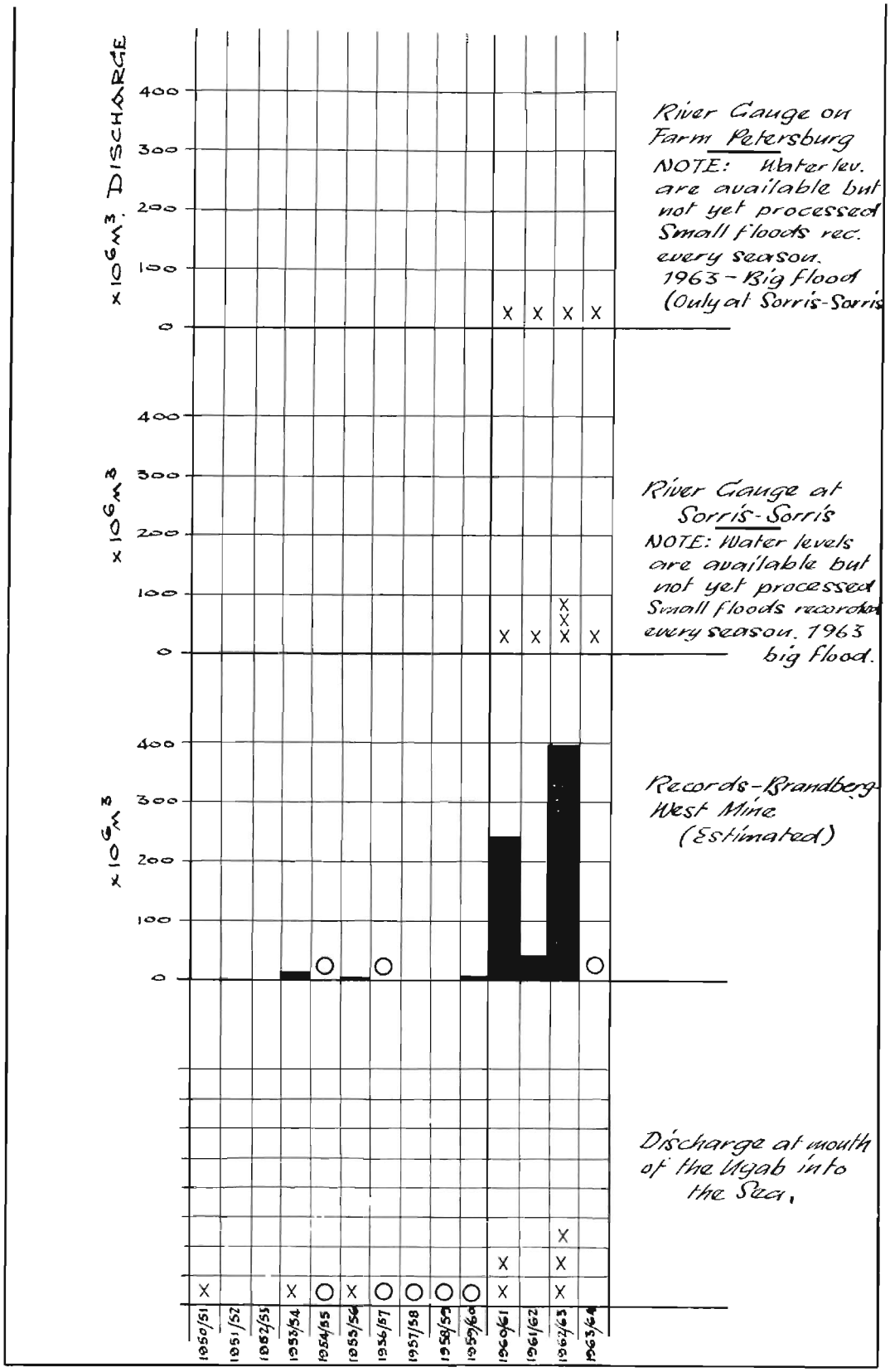

Fig. 12. Discharge data on the Ugab river.
*: Small flood reaching the Atlantic.
**: Moderate flood reaching the Atlantic.
***: Big flood reaching the Atlantic.
°: No flood, or no details available.

2. *Floods of the Ugab to the Atlantic.*

No precise information is available. Of the five years mentioned above, in which the river reached the sea, reliable records exist only for the rainy years 1960/61 and 1962/63. It can be assumed, however, that the river reached the sea also in the years 1933/34, 1953/54 and 1950/51, as this can be proved for the Omaruru river; it can furthermore be assumed for 1933/34 (known as the greatest rain and flood year), as was the case with all larger rivers, also the Ugab flowed to the sea.

In the upper course of the river on the farm Petersburg and near Sorris-Sorris, automatic water gauges have now been installed to record the floods on a scientifically exact basis. These records, covering the last four years, have not yet been analyzed and the floods are merely mentioned in the following diagram fig. 12. At the mouth of the Ugab a few salt mines are to be more intensely exploited, so future records can be expected also from this area.

Even less respective information is available about the rivers north of the Ugab. According to a few observations made by a prospector, all small rivers originating in the Namib and draining into the Atlantic came down in flood in 1933/34; from 1934 to 1963 their floods did not reach the sea. The Huab river was impassable on the coastal road in 1962 and 1963; in November 1963 a flood came down to within four miles of the coast. The Hoarusib river reached the sea in November 1963, as did the Hoanib river.

3. *The area of the river mouth.*

See map fig. 13 and diagrams figs. 14 and 15 at the end of the chapter.

The mouth of the Ugab is seldom visited; only anglers and prospectors pass a few days there once in a while. The entrance into the sea can be clearly seen, as well as a second and smaller branch leading into the sea, which is situated immediately south of the main branch and about 1.5 m above the level of the bottom of the latter. The second arm branches off the southern bank of the main arm about 3 km. from the coast; rocky outcrops on the southern bank prevent its deepening and also an eventual expansion of the mouth towards the south.

The northern bank is wide and shallow, rises gradually, becomes a sandy plateau merging into the shifting dunes. It is covered with large masses of drift-wood; from the state of preservation of the latter one may conclude that the deposit, which spreads over kilometres, occurred during an exceptional rainy season. This flood may have been that of 1934, since square, processed pieces of timber are to be found among the drift-wood; they lie so far inland that they could not have been washed up by the sea even during an exceptionally high springtide. But the flood of 1934 is understood to have done so much damage to farms lying along its upper reaches that the timber in question could easily have been washed down from those sites. Further deposits of drift-wood are found also on the strip of land between the two delta branches close to the coast. Farther inland there are some earth mounds, about three-quarters of a meter high, and formed by sedimentary layers of silt and sand; they may indicate remnants of an earlier river-bed which was situated about 3.5 m. above the present level of the river-bed.

At the Swakop mouth the high floods of 1934 carrying vast quantities of sand and silt, caused the river to expand its bed into the sea and through the action of the surf the mouth area was raised; the same could have taken place at the mouth of the Ugab during a season of such high floods. Thus it may be assumed that the whole river-bed was raised by sand and silt, while later floods eroded the bed into deep channels; with these conditions extending further inland, the present state of affairs could have developed.

A beach sandbank along the coast forms a lagoon at the mouth of the river, which is fed by waves breaking over this barrier. In the river-bed above the lagoon there is an area of reed intermixed with tobacco plants, which stretches over several kilometres.

4. *The groundwater in the lower course of the river.*

The Ugab originates on the slopes of the Usib mountains (1918 m) and has a length of 486 km and a gradient of 1:254, from this site to the Atlantic. As the Usib mountains rise like a wall above the Otavi plains, and if we accept the Goab gorge (1400 m) to represent the source of the Ugab, the average gradient of the river is 1:347, including its lower course (cf. fig. 16).

Down-stream to Sorris-Sorris the river is bordered on both sides by farms; here its course forms a terraced landscape of particular beauty. Further downstream as from the Brandberg West Mine (situated in the steep mountains of the escarpment) the course of river flows through the Namib desert.

For the purpose of investigating the groundwater conditions, two trips were undertaken by the hydrological section of the S.W.A. Water Affairs Branch in July and October, 1962, respectively. The general impression thus gained was very favourable. Open water pools were found in the river, in spite of the fact that the rainy seasons had been poor during preceding years; the same pools were still in existence on the occasion of the second trip, though of lesser extent.

Water samples taken in 1962 from the open water ponds in the river-bed gave the following results which are tabulated below, p. 22:

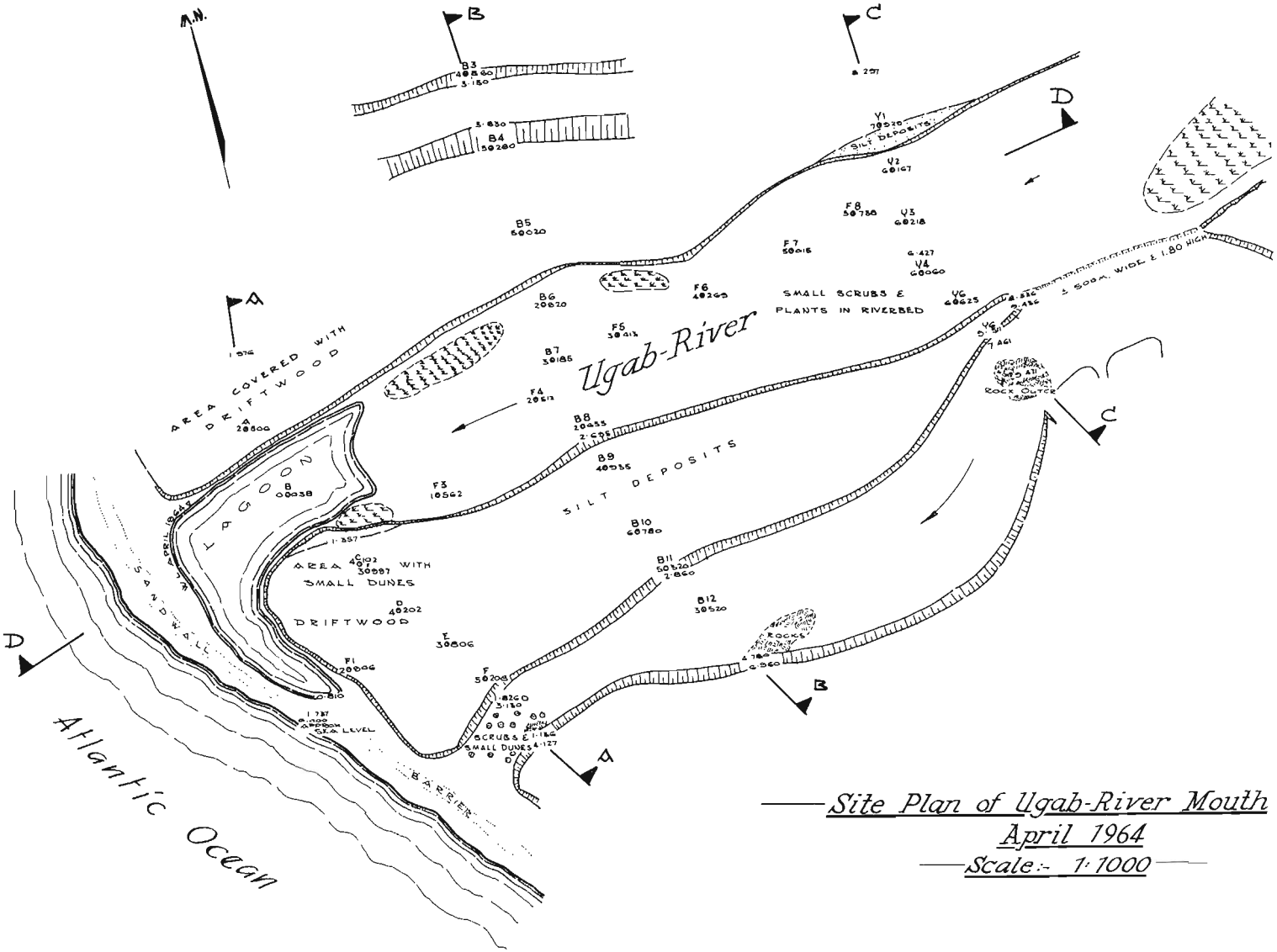

Fig. 13. Site plan of Ugab River mouth.

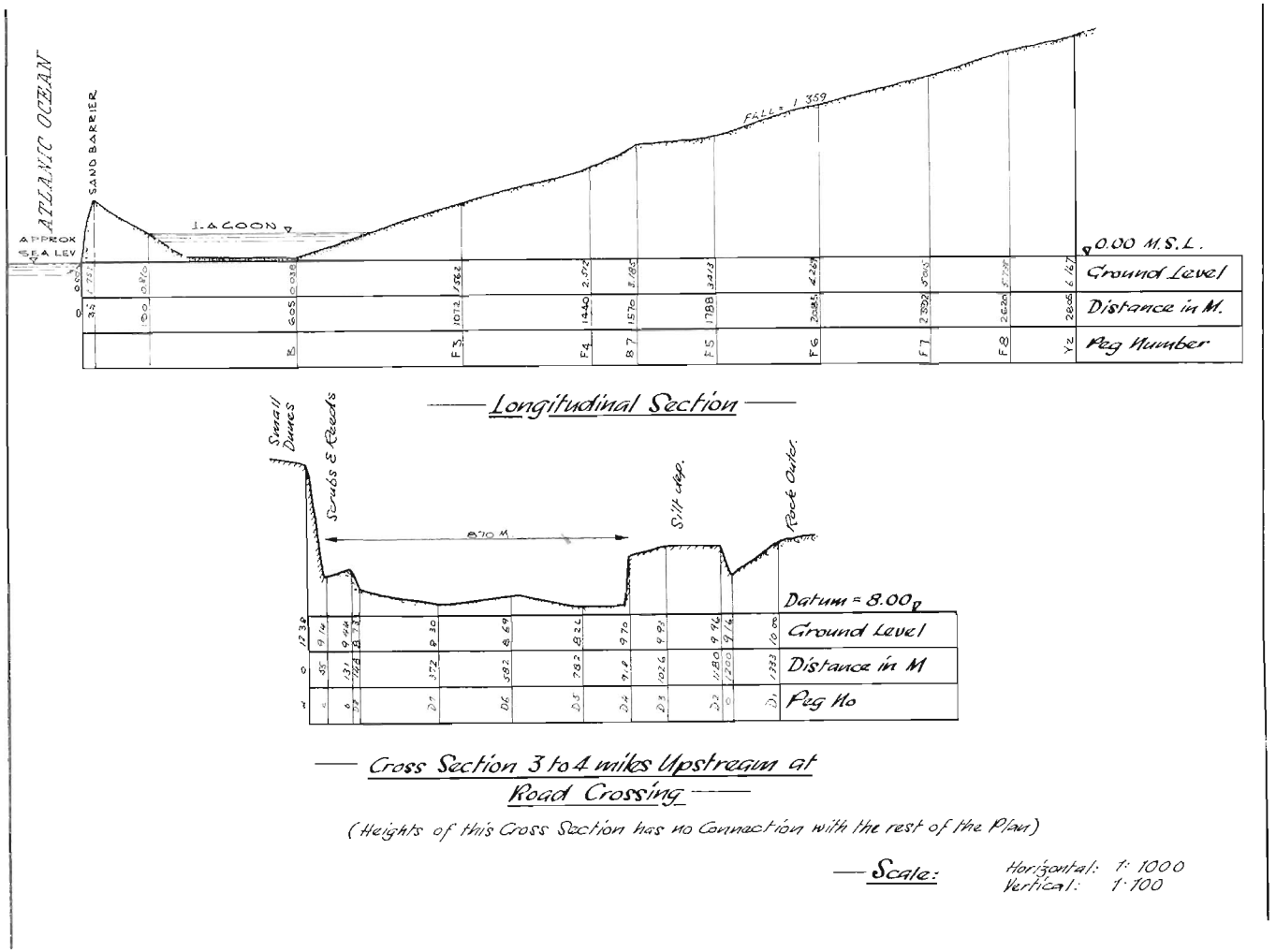

Fig. 14. Ugab. — Longitudinal and cross sections (Ugab River Mouth Survey, April 1964).

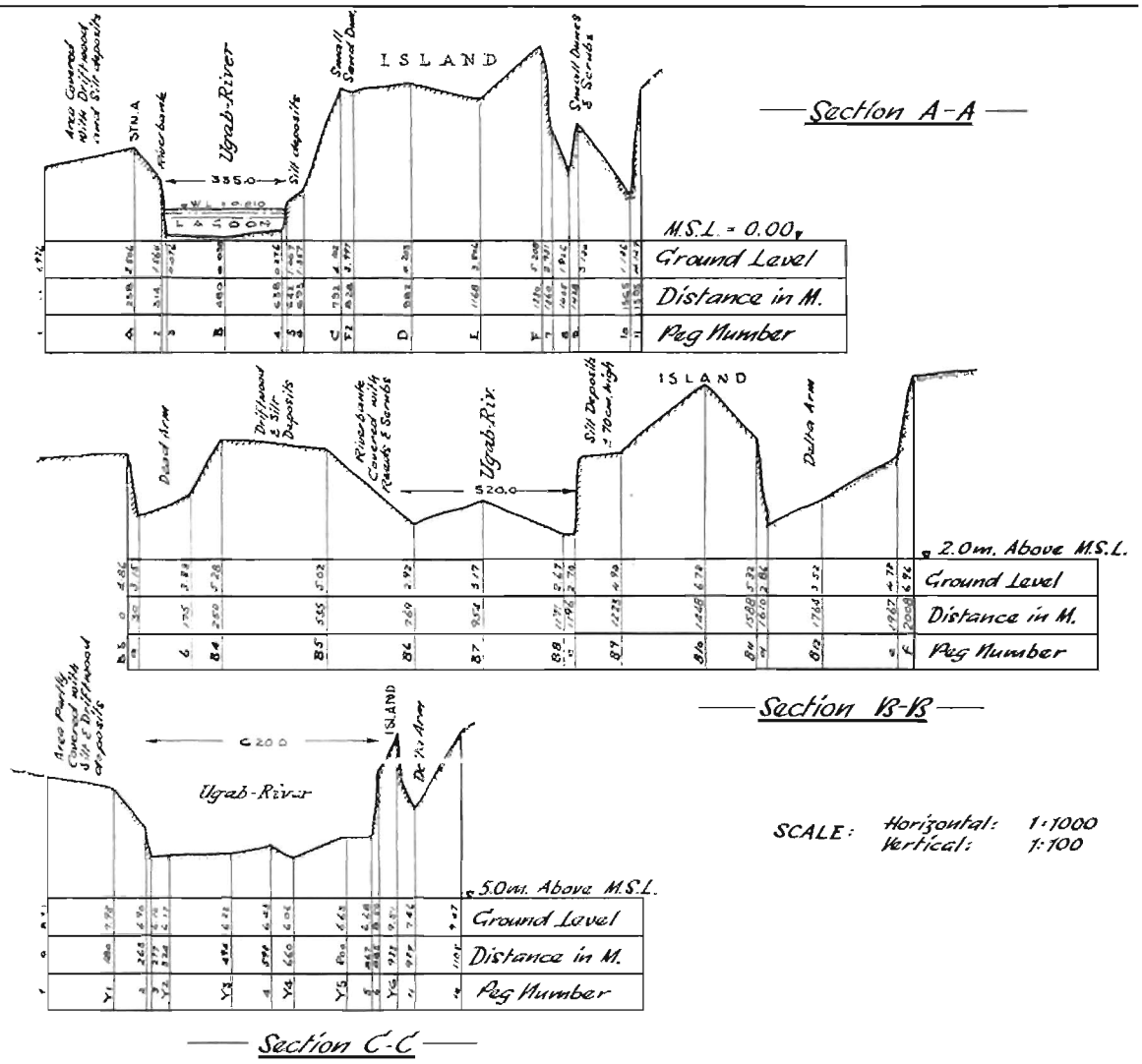

Fig. 15. Ugab. — Cross sections A, B and C (Ugab River Mouth Survey, April 1964).

Sites	km. from the coast	TDS p.p.m.	Remarks
Sorris-Sorris	185	930	flowing water
Pad Omaruru—Franzfontein	200	1,400	"low well"
—	154	2,800	open water
—	130	1,611	open water
—	128	1,592	strong flowing
—	120	1,993	open water
Brandberg West	81	2,326	Well (pumped)
—	615	1,850	low well
—	550	10,770	open water
—	385	13,300	flowing water
Delwersput	5.6	17	Waterlevel 1.2 m. deep
Ugab mouth	0	1,773	shallow well

The TDS-content of the water rises sharply from Sorris-Sorris to Brackputs and then steadily declines up to the coast. Roughly speaking all the samples taken from shallow wells (waterholes) and also from flowing water on the top of the sandbed had an average TDS p.p.m. of 1800 with the exception of the sites near Brackputs which are situated downstream of the Brandberg West well. The water samples for almost the entire Namib section of the river are therefore still within the limit 2000 TDS p.p.m. and thus suitable for human consumption according to the S.A. Standards.

The only water consumer in the whole area of the lower course is the Brandberg West Mine.

The well of Brandberg West Mine is situated in the middle of the sandy river-bed (see Plate III, photo c). The depth of the river sand is 30 m. at the site of the well. The water is about 8 m. deep and the lowest that the water level has dropped in all the years of its existence was about 2.4 m. from the bottom of the river-bed. The pump capacity is 11.5 l/s. The water consumption is 440 m^3 daily; this amounts in a year to 165,000 m^3 — a consumption which is far below the capacity of the river.

The management of the mine had undertaken detailed test boring of more than 70 boreholes over a distance of 4.5 km, in 1953; the boreholes are situated more or less in the middle of the river-bed. The quality of the water in the existing well of the mine is 2,326 TDS p.p.m., thus not satisfactory.

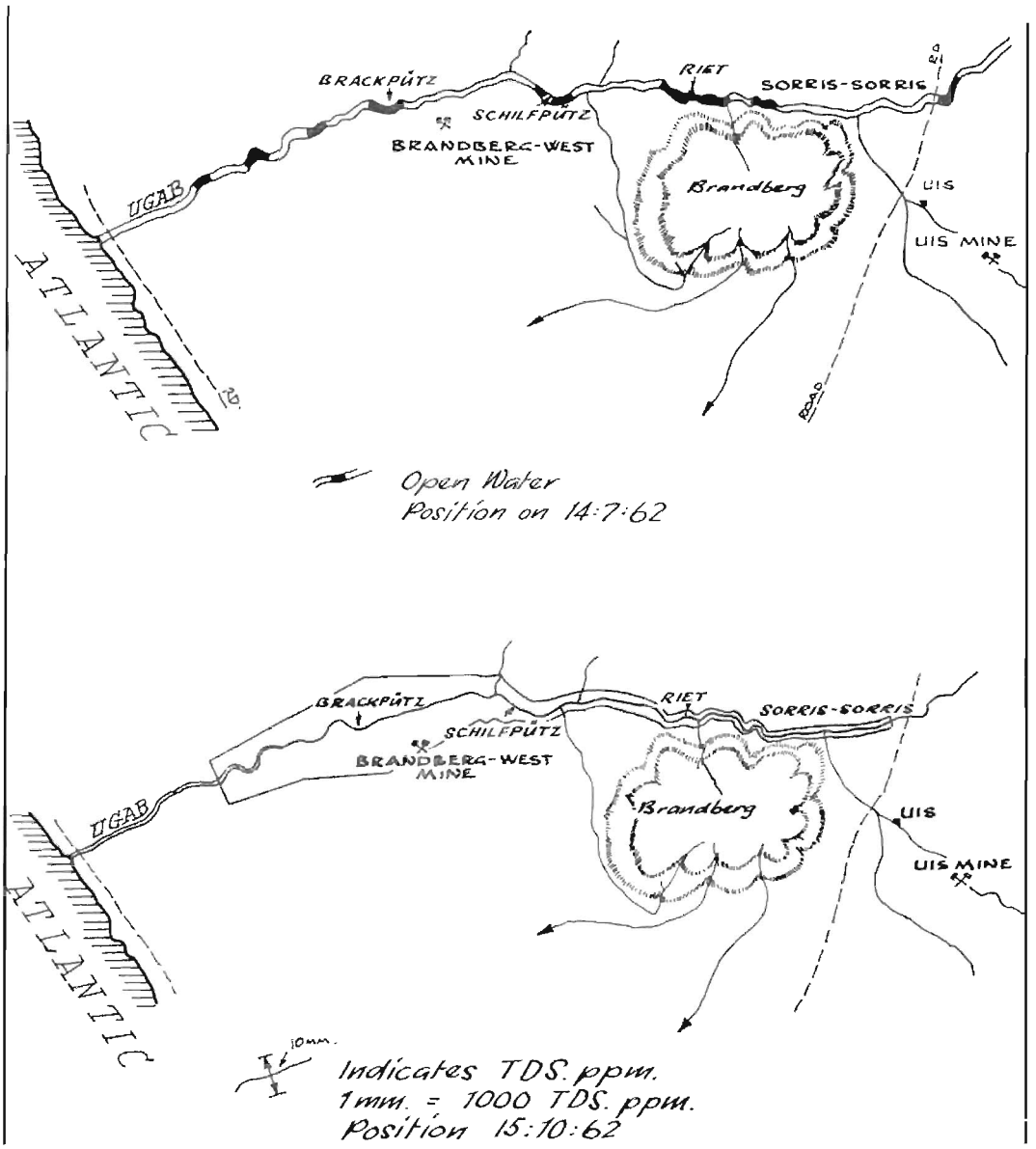

Fig. 16. Map of the Lower Ugab river.

(Distances from the mouth of river to:—

Brackpüts:	71 km.
Schilfpüts:	96 km.
Riet:	116 km.
Sorris-Sorris:	185 km.)

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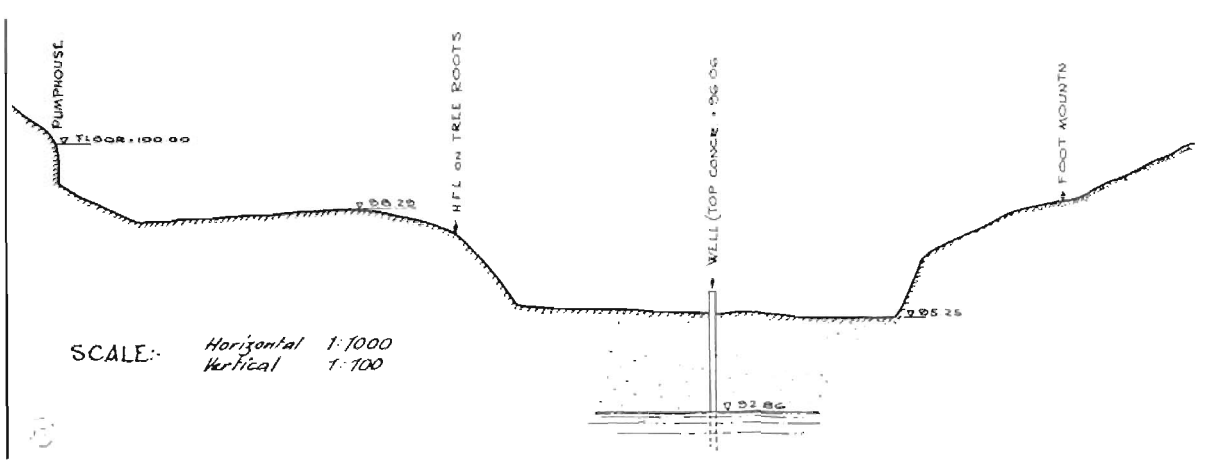

Fig. 17. Brandberg West Mine. — Cross section of the Ugab at the pump station (river gradient = 1:310).

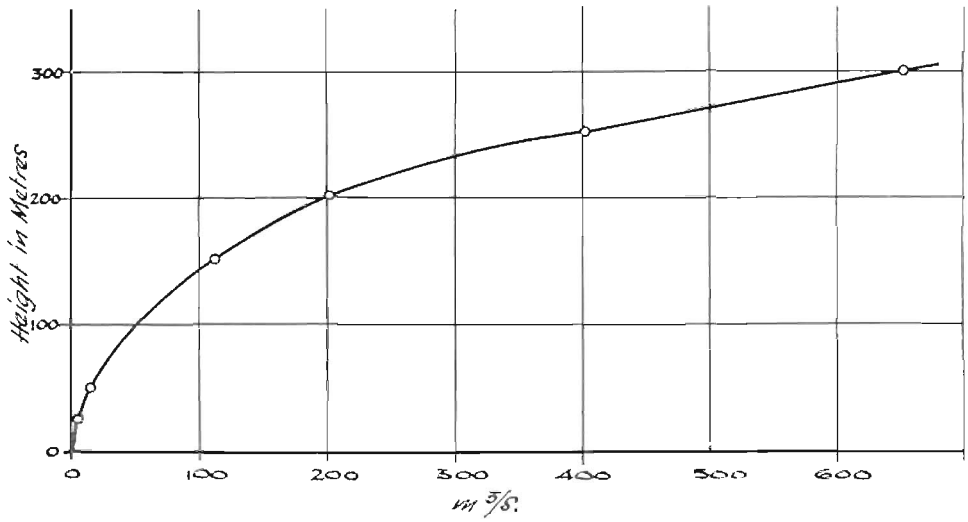

Fig. 18. Brandberg West Mine. — Calibration curve of the Ugab at the well of the Mine.