



# Bergvesenet

Postboks 3021, 7002 Trondheim

## Rapportarkivet

Bergvesenet rapport nr <b>BV 2214</b>	Intern Journal nr	Internt arkiv nr	Rapport lokalisering	Gradering <b>Fortrolig</b>
Kommer fra ..arkiv Sulitjelma Bergverk A/S	Ekstern rapport nr "522140001"	Oversendt fra	Fortrolig pga	Fortrolig fra dato:

Tittel

Rapporter 1915 fra Baldoaivve og Ingeborg. Geologi. Kartlegging.

Forfatter BAY K	Dato <input type="text"/>	Bedrift Sulitjelma Gruber A/S
--------------------	------------------------------	----------------------------------

Kommune	Fylke	Bergdistrikt	1: 50 000 kartblad	1: 250 000 kartblad
---------	-------	--------------	--------------------	---------------------

Fagområde	Dokument type	Forekomster
Råstofftype	Emneord	

Sammendrag

Beskrivelse av kopperforekomstene Ingeborg, Stølberget og Baldoaivve i Saltdal. Geologiske skisser fra inndrevne stoller og synker. Analyser på Cu, Zn, Ni, S, Ag og Au. Planer for videre undersøkelser av forekomstene. Forslag til brytnings- og oppredningsanlegg. To kart mangler. Geologi. Kartlegging.

4  
ENGINEER KARL BAY'S REPORT

o f

SALTDALEN COPPERFIELDS

--303--



# C O N T E N T S.

Introductory remarks .....	page 1
Situation .....	" 1 - 2
Route to mines .....	" 2 - 3
Historic .....	" 3 - 5
Topography .....	" 5 - 6
Geology .....	" 6 - 7
The Baldoivi lode .....	" 7 - 21
Main lode .....	" 8 - 15
Paralel lode .....	" 15 - 17
Tabulated survey .....	" 17 - 18
Plan for continued exploration .....	" 18 - 19
Ore quantity .....	" 19 - 21
The Ingeborg lode .....	" 21 - 24
Ore quantity .....	" 24
The steel hill .....	" 25 - 26
Surrounding occurences & claims .....	" 26
Conclusion .....	" 26 - 27
Plant & working proposal .....	" 27 - 29
Power question .....	" 29 - 30
Harbour .....	" 30
Last remarks .....	" 30
 Geological map .....	 Encl. 1
Topographical map .....	" 2
Special map of Baldoivi lode .....	" 3
Profile map " " " .....	" 4
"- " " Ingeborg & Steel hill .....	" 5
Statistics regarding Sulitjelma Copper works.	" 6



### Introductory remarks.

As enclosures, which there in this report will be referred to is following :

1. Geological map in scale 1 : 100.000 made by the Norwegian State geological Survey, based on the rectangular map L.13 Saltdalen.
2. Topographical Survey scale 1 : 50.000 Leaf L.13 Southwestern part Saltdalen.
3. Special map of Baldoivi Copper lode scale 1 : 2500.
4. A plan showing profiles scale 1 : 500 1 : 2500 from Baldoivi Copper lodes.
5. A plan showing longitudinal profiles of the Ingeborg lode and the steel hill.

The 3 last named maps is made by undersigned during the recent exploration of the here named lodes - in the summer and autumn 1918.

Nearly the whole rectangular area, which is shown on the special map made in scale 1 : 50.000 and marked with red lines. In a similar way is the direction of the profiles of the Ingeborg and the steel hill marked on the general survey.

Last follows as enclosure

6. A few official statistics regarding Sulitjelma Copper works from the start of this work in the beginning of the year 1889 until the end of the year 1912.

### SITUATION .

The Baldoivi lode, which besides that the main lodes on the Baldoivi also comprise Ingeborg, Steel hill and the Størdalshill lodes with adjacent claims, are situated a little over 67° northern latitude and 5° east of Kristiania in the parish of Saltdalen, county of Nordland.

The distance from the good harbour at Saxenvikbay at the bottom (innermost part) of Saltenfjord is for the here described lodes as follows:



To Baldoivi .....	15 km.
" Ingeborg & Stordals lodes ....	9 "
" Steel hill lode .....	16 "

The above named figures refers to the transport distances, which will be when the lodes are taken up for regular mining. (see general survey map scale 1 : 50.000 enclosure 2).

Between 12 and 16 kilometers east of Baldoivi is located the Sulitjelma mines and copperworks, which in all has a 40 kilometer long transport road from their mines and down to their export harbour situated at Fineidet in the Saltenfjord.

The location of Sulitjelma in correspondance to the lodes described in this report will furthermore be seen from the enclosed geological general survey map in scale 1 : 100.000.

#### ROUTE TO MINES.

One travel from Trondhjem to Bodø by the fast mail steamer on a little more then 24 hours, and from Bodø to Rognan with direct local steamer 6 hours. From Rognan one can take a motorboat to the Saxenvik bay (see encl. 2). from there one walk  $\frac{1}{2}$  kilometer over a little peninsular to the Botten lake, and one take so a rowing boat 2,5 kilometers to the southern end of the lake. The road continues now in easterly direction on the south side of the Ingeborg River to the Ingeborg lake, which lake is located immediately below the lode carrying the same name, and in a height of 409 meters above sea level. This road which start with a rather steep incline along the side of the Ingeborg fall, can be made within 2 hours. About the same time does it take to walk further on either to Baldoivi or the Steel hill, which both are located about 900 meters above sea level.

Calculated in time it therefore takes about 4 hours to walk from Rognan to Ingeborg lode, and from Rognan to Baldoivi or the Steel hill about 6 hours.



This is as the conditions are at present. With eventual work, about which I shall refer later on, I have thought that the main plants - concentrating and smelting works etc. - are to be placed at the south end of the Botten Lake. The connection from here down to the quay, which connection are secured on the south side of the Saxenvik is to be established by aid of a narrow ganged railway, which will get a total length of 6 - 7 kilometers. The route from the export harbour, which as a matter of course will get a direct call of all tree weekly coasting steamers as well as the local steamers, will therefore be both short and comfortable to the mines.

When the Nordland state railway later on becomes a fait accompli will the route from the south be still more easy, as Rognan is projected as one of the stations on this railway.

#### HISTORIC.

According to the legal documents regarding the rights to these mines one will notice that the first claims were taken up in 1897, whereby the main deposits within the total mining field were secured. Later on all the remaining mining rights were secured during the years 1898 - 1899 - 1901 and 1904.

In all there is taken out over 100 mining rights, out of which 20 is measured in 1899 as absolutely safeguarding of the main deposits on the Baldoivi - Ingeborg - Steel Hill - and Stordals lodes.

The first examination of the lodes took place in the summer 1898 by the government inspector of mines, Mr. Gottfr. Puntervold, who gave a report dated July 24th of the same year.

From this it will be noticed that it is practical spoken when he saw the lodes not were made any exploration at all- on the other hand Mr. Puntervold speak of the within the whole mining



field very often found strong deposits of ochre, which characterize the outcrop of the lodes on the surface and say at last in his report as follows :

As a result of my examination one will notice according to my examination :

1. That one at the Baldoivi - Steel Hill as at Ingeborg have lodes with a width of at least one meter, carrying copper and iron pyrites and quartz, which
2. on account of the above mentioned ochre coloured outcrops must assume to carry copper over a long distance.

The large extent of the ochre (ironhat) gives probably a measure to this, but this can although not be said as a certainty.

3. "Regarding the quality of the ore, so can there not be said  
"very much about this just at present, but when this on several  
"places, where one has reached firm rock, has shown to be a  
"mixture of copper and iron pyrites and when the lode in the  
"ochre coloured places are demanded away with the adjacent rock  
"standing back or the hanging wall has dropped down, there is  
"all reason to believe that the lode carry pure cupriferous  
"pyrites. But how much percentage this pyrite contain one is at  
"present quite unable to make a fair judgement of."

"Regarding the lodes on the Baldoivi Mr. Puntervold says further more as follows:

"The country rock in the foot wall as well as in the hanging  
"wall were raised as a wall on either side, between which the  
"mineralized outcrop appeared as a strangely coloured matrix  
"with an intensively red colour which is so characteristic for  
"outcrops of such lodes, and which I during my examination of  
"the lodes at Sulitjelma, which I should not fail to remark:

"The lodes of your properties seems to resemble these very much.

The first examinations and working of the occurrences took place during the year 1899-1900, during which time the following works were made:

On the Baldoivi: Adit no. 1, 2 and 3, as well as shaft no. 1, 2 and 3. See special map in scale 1 : 2500 (enclosure 3).



On the Ingeborg lode: Adit no. 1 and 2 as well as the stoope in front of the adit no. 3.

On the Steel Hill : Adit no. 1 and 2 (see profilemap, encl. 5)

The result of the examination will be related later under describing of the different occurrences.

Workings were resumed again in the year 1907 and 1908, when the copper quotations reached its climax.

In these years were shaft no. 4 made on the Baldoivi. On the Ingeborg lode were Continued adit no. 2 and as new work on these lode were started adit no. 3, as well as shaft no. 1, 2 and 3.

By this were trialwork concluded for the Ingeborg lode as quite sufficient to satisfy oneself about the stability and continuation of this.

The exploration work in 1907 and 1908 were planned and made under the supervision of undersigned. The Steel Hill were not examined during these years, as I with the knowledge which I already had gained with the 2 adits driven on this lode furthermore in connection with the outcrop of this lode and furthermore on account of its location mostly regarded this lode as a reserve. It is in my opinion also the least valuable of the deposits described in this assembly of occurrences.

With the favourable result which were attained by shaft no. 4 on the Baldoivi, we had thought the further exploration of this lode should continue immediately.

However other and more important work which had to be made on other places hindered however this, so that the further exploration first took place in 1914.

I proposed and carried then out a plan, by which the lode were examined by diamond drilling. The result of this and further thorough examination of the lode along the surface in connection with a very detailed survey of the lode has given a very favourable result, which has led to that the diamond drilling will be continued this year.

-----

#### Topography.

Under reference to the topographical general map in scale 1 : 50.000 (encl. 2) shall be remarked that the forest limit in this particular district reach an altitude of about 500 meters above sea level. Which again means that at the Ingeborg lode grows the dwarf birch right up to adit no. 2, which on the other hand the lodes at Baldoivi, as well as the Steel hill is situated well above the forest limit.

The topographical circumstances at Baldoivi will be best shown on the special map (encl. 3) whereby the difference in height (altitude) is drawn in with a distance apart of 5 meters.

The altitude of these lodes above sea level is between 800 and up to 1100 meters. Until 1000 meters above sea level is the ground mainly covered by grassturf and partly highland gravel. In higher altitude is barren rock the most predominating.

The Ingeborg lode is situated between 400 to 600 meters above sea level (see encl. 5).

The lode is crossing the Ingeborg river at the outlet of the Ingeborg lake, and cuts through the hill north of the lake in north eastern direction.



The outcrop of the lode is rising somewhat even for a length of 1 kilometer from the river up to an altitude of about 650 meters above sea level, after which it continues rather horizontal along the mountain plain for a length of about 800 meters.

The Steel hill lode is located between 700 meters and 900 meters above sea level. The outcrop of this lode is to be found in an even ridge between the named heights and can be followed on the surface for a length of about 800 meters (see encl. 5).

### Geology.

Referring to the geological map encl. 1 made by the State Geological Survey, it will be seen that the predominant classes of rock in this district is micaschist & limestone, which form the base rock in the most districts of the County of Nordland. The baserock in the district between Saltdalen and to the boundary (between Norway and Sweeden) is mostly micaschist, which is cut through by eruptives of gabbro and granite.

Along the contact between the slates and the eruptives occurs a metamorphised lighter chlorite bearing compact country rock.

In                      and in the neighbourhood of this is it that the ore occurs partly as impregnations in the lode matrix and partly as pure copper pyrites.

The district has numerous lodes and deposits. In the eastern part is situated the large deposits of the Sulitjelma works, partly on the northern side and partly on the south side of Long lake. In the western part is situated the here described lodes namely Baldoivi, Ingeborg Stordalen and the Steel hill lodes as the most important. Of these can especially Baldoivi be mentioned as having a great equality as the most important of the mines belonging to the Sulitjelma groupe of mines, namely "Jacobsbakken" on the south side of the Long Lake.

The Jacobsbakken lode is located about direct east of Baldoivi and the distance between is about 12 kilometers in a straight line.



Both lodes has an important outcrop, which on the surface can be followed several kilometers. Their strike is north - south but while Baldoivi has a dip of  $30^{\circ}$  towards east Jacobsbakken has an equal dip towards west.

Professor A. Helland has in his books re the County of Nordland mentioned, that these two lodes geological seen resembles each other very much.

As already mentioned, has also the Government mining inspector Mr. Puntervold referred to the equality of the lodes in Baldoivi and in Sulitjelma a relation to which also undersigned can confirm through a few visits which I have made to these mines.

This is also conformed by mining inspector Rasmussen who visited Baldoivi after the diamond drilling had taken place in 1914 In his report after the inspection of the lodes had taken place, he says about Baldoivi - Jacobsbakken :

"The relation of the two lodes are in many respects equal"

I am now going to write about the different lodes, and will start with :

#### BALDOIVI

Here can be seen two lodes with a mean strike north  $10^{\circ}$  east and average  $30^{\circ}$  south, dip towards east  $10^{\circ}$ , south equal to the surrounding slate.

The eastern lode, which make the main lode, can be followed on the surface in a length of  $2\frac{1}{2}$  kilometer, as the outcrop of this lode, which on the special map (encl. 3) is marked with a dotted line, distinctly shows itself by its red and yellow brown colour, where the ground is not too much covered.

Besides this is the country rock on the hanging wall side a very important ore leader, which in the uneven terrain bends as a comparatively narrow string of light blue - greyish colour.

The western lode occurs on the footwall side of the main lode and about 40 meters below this measured at right angle on the dip. The outcrop of this lode, which can be followed on the surface for a length of 500 meters is marked on the map-as well as the main lode - with a dotted line.



I have reason to believe that the west lode unite on the depth with the main lode and therefore that this lode is a branch from this. About this shall be referred later on.

The main lode, is examined by the following works: (see special map encl. 3.)

Adit no. 1. This were made at an early date. It is driven rather close to the outcrop on a place where the strike of the rock and dip of same is highly disorienting. In order to keep the underfoot in the adit horizontal the strikes vary very much.

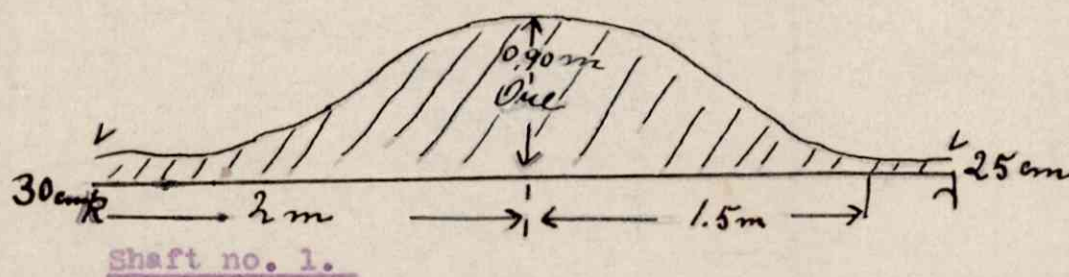
It starts with N. 5° east, and bends eastwards to N. 60° east, after which it bends back to N. 80° west for so at last to end in the direction N. 30° west. The adit is in all 36.5 meters long. at the mouth of the adit is the dip of the layers (country rock) 35°.

The ore were met when they had driven 16 meters horizontal. Where the lode first were met with the width is 0.3 meter, and contain magnetic pyrites with copper pyrites. The width varies very much.

This is although locally not to be regarded as occurring ordinarily here, but typical for the mode of occurrence on the Baldoivi as a whole, which also the examination and trial works seems to confirm.

In this respect the Baldoivi lodes very much resembles the lodes in Sulitjelma which variation in width were characterized by the late director Knudsen in Sulitjelma as pearls on a string.

Adit no. 1 shows a typical pearl, as will be seen of the below drawn sketch, taken 16 meters into the adit.:



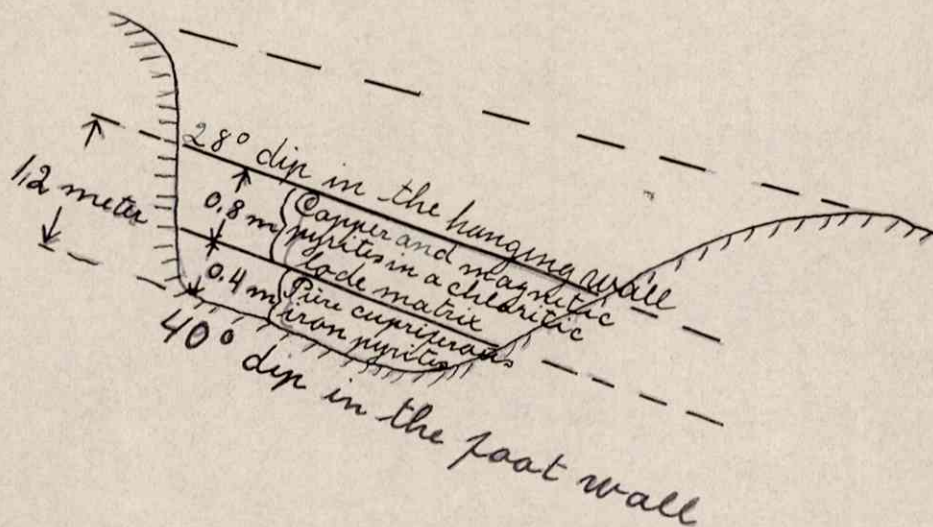
is an old working, which according to the older descrip=



tion is sunk towards 2 meter down on a strongly ochre coloured outcrop without reaching ore in firm rock.

Shaft no. 2.

has cut through the lode, as shown on below sketch :



The lode has therefore a total width of 1.2 meter. Copper and magnetic pyrites is richly impregnated in the lode matrix nearest to the hanging wall over a width of 0.8 meter. An average sample which I took of this lode are, as well as the other samples taken, analysed by Dr. Heidenreich, Kristiania. The essay gave the following result :

Weight	Non dissolving country rock %	S. %	Cu %	Zn. %	Ni %
ca. 4 kg	21.75	28.14	2.86	0.68	0.10

The 0.4 meter section of the lode nearest the foot wall in the shaft shows a middle crystalline nearly pure pyrite with often occurring crystals of iron pyrites of size as ordinary potatoes. This pyrites, which are very typical, occurs especially in Sulitjelma.

An average sample of this section were analysed with the following result :

Weight	Non dissolving country rock	S. %	Cu. %
2 kg.	11.57 %	43.54	1.81



Shaft no. 3.

is sunk only 4 meters southwest of shaft no. 2 and is somewhat smaller than this.

The lode is here only 40 cm. wide and diminish towards the outcrop. On the contrary it contains very fine copper pyrites but not iron pyrites as in shaft no. 2.

The dip of the lode on this place is  $30^{\circ}$ .

The assay result of an average sample gave :

Weight	Non dissolving country rock %	S. %	Cu %	Zn. %	Mn %	Ag %
2 kg	3.42	38.76	10.76	2.75	0.08	0.0012

Au in gram pr. ton

0.12

There were besides this taken samples from the country rock in the hanging and from the foot wall, which as well as the later described rocks have been microscopical examined by Professor Schetelig of the University of Kristiania.

The hanging wall will show to consist of : Muscovite slate.

" foot " " " " " : Muscovite Chlorite slat.

Shaft no. 4. (The incline shaft) is located 12 meters east of shaft no. 2. It is driven through the hanging wall perpendicular on the dip and has reached the ore at a depth of 5.38 meter below the surface.

In the shaft appears very rich copper pyrites with magnetic iron pyrites in considerable larger quantities than the country rock. The iron pyrites, which are on the foot wall side in shaft no. 2, equal to shaft no. 3, can no more be shown here.

The lode shows on the west side a width of 1.35 meter, which, however, diminish towards east, so that the width on the eastern side of the shaft shows 0.6 meter.

This mode of occurrence is characteristic for how the width of the lode varies and is identical with for instance the example I mentioned in the adit no. 1.

In the shaft I measured the dip on the hanging side to  $33^{\circ}$  and the dip on the foot wall to  $15^{\circ}$ .



An average sample taken of the ore from the incline shaft were analysed with following result :

Weight	Non dissolv. countr. rock	S. %	Cu. %	Zn. %	Bi. %
5 kg.	% 26.23	25.50	8.70	1.20	0.07

The microscopical examination of the country rock (foot & hanging wall) showed :

In the hanging wall : Muscawite slate

" " foot " : Biatite chlorite slate with garnets.

Cross cut no. 1.

Has apparently cut two lodes, but in reality it is only one, namely the main lode, which here shows a curve in the outcrop as shown on the profile map from Baldoivi in the profile through bore hole 1 and 2. The crosscut gives outside this no positive information.

Adit no. 2.

gives neither any information, as the hollow place in the ground where it is placed is covered by snow. The adit here which belongs to the oldest workings is according to informations given only driven a few meters along the strike, the width on the place shall be about 0.5 meter.

Cross cut no. 2.

shows fine pyrites, but the lode is not wholly uncovered. The so far described opening works has stated that the main lode has a length of 800 meters along the strike of the lode. For obtaining further information about this lode, as well as the parallel lode in westerly direction diamond drilling were started here.

There were drilled 5 holes, which situation will be seen on the special map (encl. 3).

I commence to describe the most southern.

Bore hole no. 5. (See profile map from Baldoivi, encl. 4).

The hole is put in a right angle on the dip of the country rock and have thus an angle of  $60^{\circ}$  towards west. The length is 62.27 meters.

The main lode is reached in a depth of 19.27 meters after



which the lode is cut through in a width to be judged according to the drill kern 2.70 meters.

The drill kern shows a lodematrix containing chloritic micaschists rich impregnated of mainly copriforous magnetic iron pyrites. The width are quite certain larger then 2.70 meters, as one by experience not get up all the ore with the drill kern, as a good part of the pyrites, and probably more the more rich this is, during the drilling are ground and demanded away with the feeding water used by the drill.

This experience has also been made in Sulitjelma, were very extensive drillings were executed on Jacobsbakken.

2.70 meter is the largest width, which so far is shown on Baldoivi. The outcrop on the surface in the same cross section of the lode does not show that this large width should be attained as high up as this depth. But it shows, how the width can vary as mentioned previously.

At drill hole no. 5 is the main lode reached on a depth of 44 meters, calculated according to the dip of the lode. At the same time shall be mentioned that the height of the lode above sea level where same has penetrated by the drill hole is 945 meters.

Drill holes no. 1 and 2.

is put on in the same section.

The first is with a dip of 55° towards west drilled close to shaft 4 (incline shaft) to a depth of 80 meters.

In this depth, where the drill hole should have cut through the lode, as shown in the incline shaft, is there only found traces of ore in the drill kern. This can only be explained by that the drill has passed a narrow section of the lode.

Of the profile map (encl.4) it will namely be seen that the width in the shaft 4 which is above this particular drill hole alone over the shaft width diminish from 1.35 to 0.6 meter. Should this width continue to decrease only 2 meter further down along the dip, which there were all reason to believe it should for so again to increase, shows it that one has a narrow section of the lode just here where passed by drill hole 1.

That the lode continues on depth below the drill hole



is without doubt. It should namely have penetrated the lode in an altitude above sea level of 965 meters; while the lode on each side of this particular place is shown 945 meters and 932 meters above sea level in the respective drill holes 5 & 4.

That the drill hole no. 1 not has reached the parallel is west of the main lode, had to be calculated with, as the parallel lode not with certainty are proved so far south on the surface as until the profile section through drill hole 1.

Drill hole no. 4.

has a dip of 80 towards west and a length of 61.75 m. The main lode here is reached of the drilling 10.38 meters. The drill kern shows a width of 1.14 meter, which nearest to the hanging wall consist of very fine copper pyrites with magnetic iron pyrites and nearest the foot wall iron pyrites - a relation equal to obtained in shaft no. 2.

The western parallel lode has not been reached. But continue this on depth with the same dip as is shown on the surface, so is the drill hole too short to reach same.

I was not present on the mine when the drilling were under operation, but came first present when same were concluded. Mining captain M. Remmen who were in charge of the drilling has informed me that drill hole no. 4 were stopped as soon as the drill kern showed to contain garnets.

As far as one knew the lode previously and according to what one can observe on the surface, should the occurrence of garnets be a safe sign of , that one had reached down to the foot wall of or below the western parallel lode.

Meanwhile has the microscopical examination of the samples shown, which I have taken of the country rock, that not only the hanging but also the foot wall rock contain garnets, although the first named in a lesser degree than the last named, about which shall be referred to under my description of the parallel lode.

The appearance of garnets in the drill kern is therefore not any proof for that the place of the lode not shall have been passed.



If one combine this, that one not has reached the lode if the dip continue on depth as is shown on the surface, is it proof, that the drill hole is too short. If one judge from the profile through drill hole 4 should this be 7 or 8 meters longer to reach the lode.

Drill hole no. 3.

has cut through both the main and the parallel lode. The first is cut after drilling 4. 20 meters. In the drill kern shows the lode matrix 0.5 meter width impregnated with copper pyrites. After drilling 43.38 meters and has cut or reached the parallel lode with a width of 0.28 meter kern consisting of rich copper pyrites.

In reality it is absolutely sure - as mentioned previously that the width of the lodes are considerably larger than shown by the drill kerns.

By the previously mentioned workings so is the main lode now examined on a length after the strike of 700 meters, and after the dip - in the drill hole 5 - until a depth of 44 m. The lode continue meanwhile northwards, where same can be followed along a very distinct outcrop. So far this particular length has been very little examined and not any attention paid to. But it is worth all possible observation. On several other places I observed besides very important ochre deposits also ironhat formations, which very distinct shows the precence of the lodes.

Not less than about 1300 meters north of drill hole no.3 I put down a little cross cut, called :

Shaft no. 5.

This is marked on the map right east of the Akselskartop= pen. My time and the periode of the year - in the middle of September made it although impossible to make a thorough examination. But I got however stated the following:

As will be seen on the special map (encl. 3) the hanging wall has above the shaft a dip of  $65^{\circ}$  in the shaft itself which is 2 meter deep, it were measured to  $60^{\circ}$  towards east  $5^{\circ}$  south. Only a few meter east of this shaft make the layers of the country rock its usual dip within the lode with  $35^{\circ}$ .



The lode matrix in the shaft has a width of 1.2 meter of which about 1 meter calculated from the hanging wall contain a strongly chloritic lodematrix rich impregnated of a very fine copper pyrite in thin stripes.

Nearest to the foot wall where the decomposition has taken place, seemed the lode according to be judged from the ochre to consist of 30 cm. cupriferous iron pyrites.

In the foot wall country rock one found by the microscopical examination rich iron pyrites, partly in corn partly as fine stripes parallel to the structure of the slate.

Of the lode matrix nearest to the hanging wall were taken a sample, which were analysed with the following result:

Weight	Non dissolv. Country rock %	S. %	Cu. %	Ag. %	Au. gr. per ton
3 kg.	40.66	12.60	5.94	0.0008	0.85

The microscopical examination of the samples from the country rock showed:

In the hanging wall : Muscawite slate.<sup>?</sup> schist.  
" " foot " : " chloritic slate.

I shall after this relate my observations of the lode located west of the main lode and called the

Parallel lode :

The outcrop can be followed on the surface for a length along the strike of 500 meters.

Of the previously made examinations is there only now adit no. 3 and cross cut no. 8 which gives any information, as cross cut no. 3, 4 and 5 not showed the lode in firm rock, but only important ochre deposits.

Adit no. 3,

has been driven in a length of 4 meters after the strike in southern direction. The dip of the lode is 40° towards east - 15° south, and the width is 60 centimeter impregnated lode matrix.

The impregnation contain chiefly of copper pyrites, but also some iron pyrites. The microscopical examination of the country rock gave the following result :



In the hanging wall : Biotite-slate with garnets & zoisite  
 " " foot " : Garnets - Biotite - Slate.

Cross cut no. 6.

is mostly washed out by a little stream or gulch, where the lode is uncovered, showing a width of 60 centimeter. The ore change with copper pyrites in thin stripes and iron pyrites impregnations.

The assay of an average sample gave following result :

Weight	Non diss. countr. rock %	S. %	Cu. %	Zn. %	Ni. %	Ag. %	Au. in gr. pr. ton
1 kg.	42.07	27.95	3.17	1.14	0.09	0.0016	1.2

Drill hole no. 3.

has as earlier described besides the main lode also cut through the parallel lode.

By drilling were shown a width of 28 centimeter of copper and a very rich drill kern indeed, but one can without doubt take it for granted that the lode is still wider, most probably at least 60 centimeter, as shown on the surface. From the profile (section) through drill hole no. 3 (see section map) it will be seen that the parallel lode is cut through at a rather great depth, namely 90 centimeter, calculated after the dip of the lode. The named section indicates furthermore, that the main and parallel lode seem to unite (converge) on depth. This in connection with that the parallel lode is a lode which can be regarded as a branch from the main lode.

Outside the dotted line on the special map the parallel lode can not be traced on the surface. As far north as at the shaft no. 5 does it not exist, as the rock between the shaft and the Akselskartoppen is quite barren.

A sample of the country rock taken 50 meters west and from the foot wall side of the shaft no. 5 showed to consist of biotite - chloritic schist with sparingly occurring corn of iron pyrites. Besides this were taken a sample of the country rock from



the top of Akselskar, which were examined. This showed to consist of quartzite (blue quartz).

-----

The result of the above made examination, which so far has been made on Baldoivi can be abbreviated in the following tabular form.

	The main lode			Parallel lode
	Shaft no. 3	Shaft 4	Shaft 5	Adit no. 3
Hanging wall	Muscawite slate	Muscawite slate	Muscawite slate	Biotite, slate with garnets & zoizit
Foot wall	Muscawite Chloritic slate	Biotite chloritic slate with garnets	Muscawite chloritic slate	Garnet - biotite slate

THE MAIN LODE								
Name	Width of lode	Non discd country rock	S.	Cu.	Zn.	Ni.	Ag.	Au.
	centim.	%	%	%	%	%	%	g/z
Adit no. 1	25/90							
Shaft 2	80	21.75	28.14	2.85	0.68	0.10		
	40	11.57	43.54	1.81				
Shaft 3	20-40	3.42	36.76	10.76	2.75	0.08	0.0012	0.12
Shaft 4	30-135	26.23	25.50	6.70	1.20	0.07		
Shaft 5	90	40.66	12.60	5.94				
	30							
Drill hole no.1	Trace							
" " 2	N11.							
" " 3	50							
" " 4	114							
" " 5	270							



THE PARALLEL LODGE								
Name	Width	Non dissolv. country rock	S.	Cu.	Zn.	Ni.	Ag.	Au.
	Cent.m.	%	%	%	%	%	%	%
Adit no.3	60							
Cross cut no.6	60	42.07	27.95	3.77	1.14.	0.09	0.0016	1.2
Drill hole no. 3	28							

As will be seen is the drill kerns not yet analysed, as they are kept in the barrock on Baldoivi for control and inspection for prospective buyers.

-----

It is quite clear, that the so far made works on the Baldoivi not is enough for an absolute judgement of the mines. But that they promise good for the future possibilities, is without doubt, wherefore examinations and workings must continue.

The plan for a continued examination of the Baldoivi lode,

ought to be as follows :

On the 1200 meter long stretch, from the triangular point with 978 meters height above sea level and northwards, on which distance the hanging rock above the lode not is of so great magnitude, can one with a drill hole of 40-50 meters length be able to cross cut the lode.

After having drilled a series of holes at right angle of the layers of the rock and by this been able to obtain a preliminar knowledge of the lode on this distance, there will be a good opportunity to with shallow adits, 15-20 meters long, to cross cut the lodewhere this is regarded a necessity in order to much definite judge the quality and width, which is of course better than by doing such with diamond drilling. By this manner the main lode will be explored in a most efficient way. But it is beside this also necessary to explore the lode by adits, shafts etc. before a regular work of <sup>the</sup> mines can be established on a large scale.



The most rational manner to explore the lode will be to start with an inclined shaft along the dip say about 100 meters north of drill hole no. 3 and drive this down say 50 meters unto a depth of 900 meters above sea level.

After this depth has been reached continue with a tunnel in both directions along the strike. By this one will obtain quite considerable ore quantities at the same time as one acquire a good knowledge of the lode on a proportionally shallow depth, see encl. 3 and 4.

Such exploration will also be of lasting importance during a regular working, about which I shall come back to later.

#### Ore quantity.

To make exact calculations about this at present stage before the examinations and explorations are concluded is as a matter of course not possible. In order to enable one to form an opinion about what quantities here can be talked of, can one although under certain presuppositions make a calculation.

#### The main lode.

On the distance this has been explored one knows the length and width of the lode rather intimate. On the other hand is the knowledge of the depth of the lode very meagre. One has although experience from other lodes, about the depth to which lodes of this type can reach, and all such points in the direction, that the dimension as a rule are the largest on depth.

About Sulitjelma, which lodes one in this instance is the nearest parallel, the director Mr. Holmsen says in a lecture held at the Polytechnic Institute of Kristiania, December 1st 1914, according to his lecture referred in Teknisk Ugeblad no. 3 for 1915:

"The bulk of the lodes at Sulitjelma is 200 - 300 meter long on the strike. In Tomerhjelm mine (Jacobsbakken) the lode is although explored for a length of about 700 meters along the strike and it is possible that the cupriferous magnetic iron pyrites, which has been discovered during the last years is met with in the northern part of this mine, and which continue for a distance of at least 1 kilometer further",

and further:



"The Sulitjelma mines have still only reached a relatively shallow depth, namely 400 - 450 along the dip. After the analogy from lodes in the Røros district, which geological spoken is of the same type, one are justified in assuming that on the Sulitjelma lodes one will be able to work the lodes at several times greater depth than reached so far.

-----

The main lode on the Baldoivi is as mentioned previously explored for a distance of 700 meters. The average width can one with safety calculate to at least  $1\frac{1}{2}$  meter.

The largest depth, which is reached along the dip (in drill hole no. 5) is 44 meters. If one then only calculate with these factors, which one must regard as safe, one get  $700 \times 44 \times 1 = 30.800 \text{ m}^3$ , or in round figures  $30.000 \text{ m}^3$ . With a probable calculation one can in any case calculate with 10 times this length along the dip of the lode as described above, or  $300.000 \text{ m}^3$ . If one then only assume 2.5 ton crude ore pr.  $\text{m}^3$  one get 750.000 tons.

To make a calculation of how much the lode contain in its direction northwards, where the outcrop can be followed on the surface for 1.5 km. is of no importance, before the lode has been examined on this distance. But it ought to be regarded from the above calculation, that one also here can calculate with large ore quantities.

#### The parallel lode.

For this, which is to be regarded as a reserve lode, one can make the following provisional calculations.

If one say the length of the ore lode according to the outcrop, is 500 meters, the width to 0.6 meter, and depth along the dip according to drill hole no. 3 to 90 meters one get  $500 \times 0.6 \times 90 = 27.000 \text{ m}^3$ . Most probably one can calculate



with a deep of 200 meters before the parallel lode unite on depth with the main lode. One get then  $500 \times 0.6 \times 200 = 60.000 \text{ m}^3$ , and with 2.5 ton per  $\text{m}^3$  150.000 tons.

-----

### The Ingeborg Lode.

The location of this lode north of the Ingeborg Lake (see the topographical map) has been mentioned already. A longitudinal section is 1: 2500 along the outcrop of the lode will be seen from encl. 5.

The strike of the lode is north east-south west with  $70^\circ - 75^\circ$  S dip towards south east. The outcrop can be followed on the surface over a distance of 1700 meters.

The following exploration work is made (see encl. 5) :

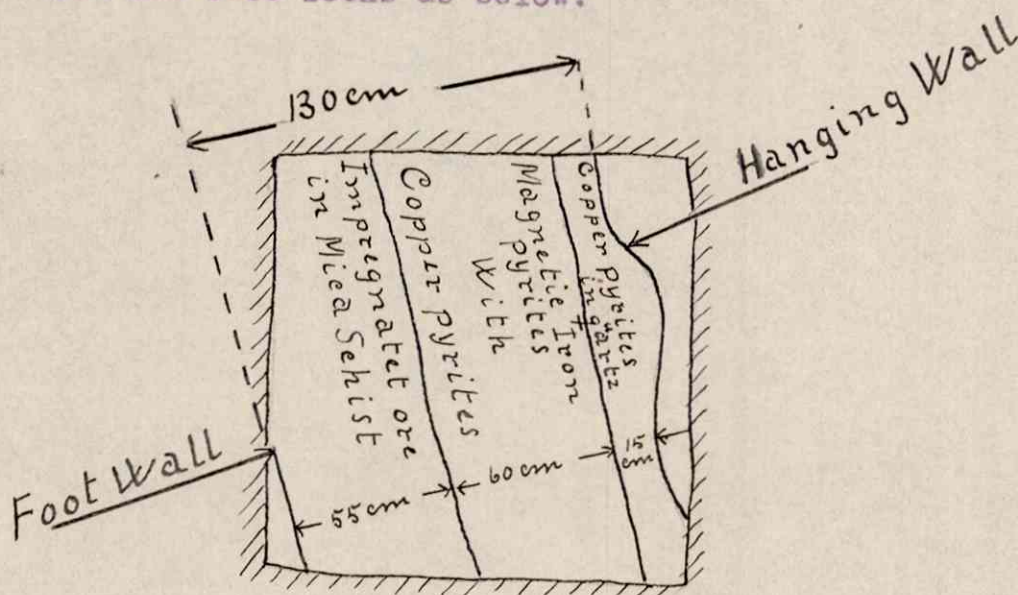
#### Adit no. 1,

has a length of about 35 meters along the strike of the lode which shows a width of 50 centimeter.

The ore consist about solely of magnetic iron pyrites with some copper pyrites.

#### Adit no. 2,

has a length along the strike of the lode of 32 meters. The ore face looks as below:



The average width of the lode in the adit is 1 meter or a little above this. The section nearest the hanging wall with copper pyrites in quartz occur uneven : it comes and disappears again.



An average sample were taken which were assayed with the following result:

Cu. %	S. %	Ni. %	Zn. %	Ag. %	Au in grammes per ton
3.65	13.34	0.11	0.83	0.0001	0.02

The microscopical examination of the country rock showed as follows :

In the foot wall: Garnet Chlorite Slate with biotite.

In the hanging wall: Garnet-Hornblendeschist (gabbro slate similar metamorphised country rock).

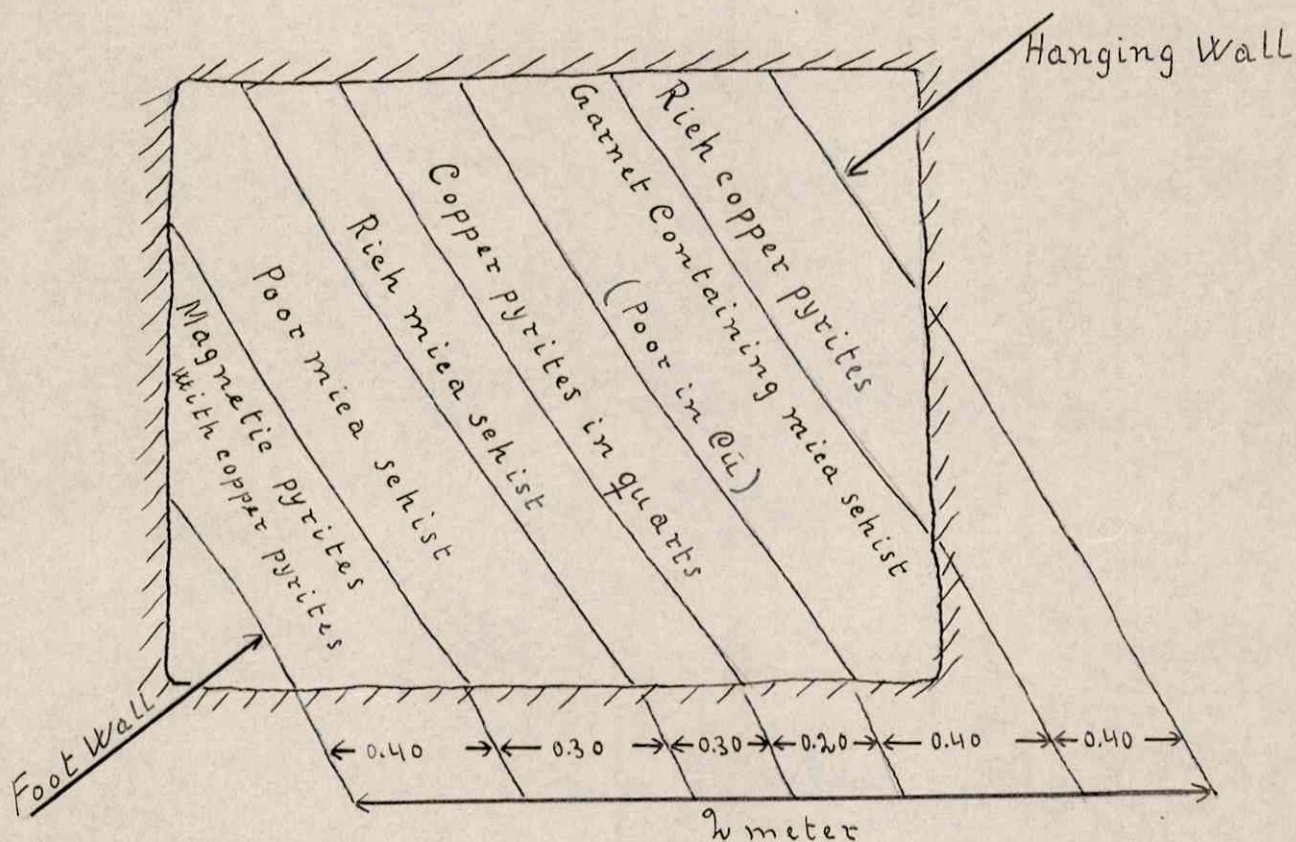
Professor Schetelig says as regards the country rock from the hanging wall :

"This shows distinct sign from the original Emptivestructur".

Adit no. 3,

is as well as the foregoing driven along the strike and has a length of 7 meters.

Below sketch shows the appearance of the ore face



The copper pyrites occurs as follows:

1. Pure in thin stripes (2 - 5 centimeter) and larger clumps.
2. Mixed with the magnetic iron pyrites,
3. Impregnated in the mica schist, which occur in the form of lenses in the lode matrix. The impregnation has varied very much,



from very rich to rather poor.

The width of the different types occurring within the lode matrix can vary, but as a total one can say that the lode on an average for the whole length which no doubt continue several hundred meters in north eastern direction has a width of 2 meters, which one easily can judge from the outcrop of the lode.

An average sample of the ore in adit no. 3 gave as result:

Cu. %	S. %	Ni. %	Zn. %	Ag. %	Au in grammes pr. ton
4.18	18.41	0.15	1.36	0.00045	0.08

The microscopical examination of the country rock showed:

In the foot wall: Garnet - biotite - slate with chlorite.

In the hanging wall: Hornblende schist.

About the country rock in the hanging wall says Professor Schetelig :

"According to the mixture of the mineral one can take it for granted that the country rock is metamorphised gabbro country rock and ought therefore most probably be characterized as gabbro slate".

#### Shaft no. 1.

has been driven to a depth of 5 meters. The lode matrix shows here a total width of 2.8 meter of equal value as in adit no. 3

#### Shaft no. 2.

this were driven 2 meters, after which workings had to be suspended owing to rush of water from above. Firm country rock were not reached, but after 1 meter's working through the ochre earth one met with a firm ironhat, which in a depth of 1 meter showed a width of about 3 meters, or about the same which were uncovered in shaft no. 1.

#### Shaft no. 3.

were driven through an ochre layer of 2 meters and after this 2 meters down through the firm rock.

The width of the lode showed to be about 2 meters mainly consisting of copper pyrites impregnated in mica schist.



Nearest to the hanging wall were found besides rich veins of copper pyrites also some zincblende.

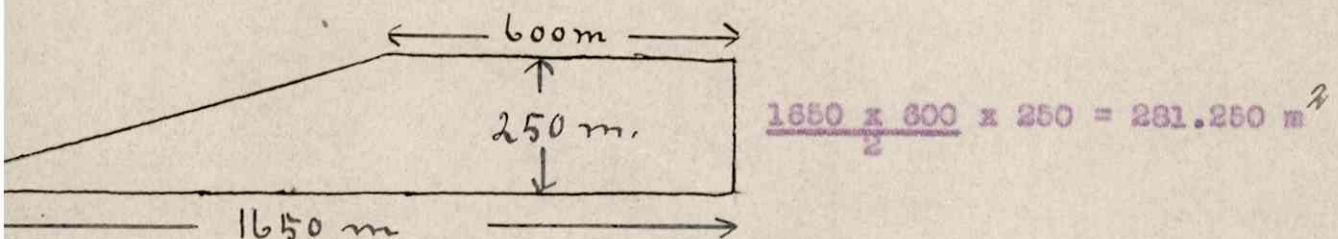
The coppercarrying magnetic pyrites which were found nearest to the foot wall in adit no. 3 and shaft no. 1 can also be shown here.

The Ingeborg lode must most probably be characterized as a contact lode which large extension and wholly spoken very stabil character very distinct can be judged from the very important outcrop of the lode also seen in connection with the explorations and examinations made.

As a special advantage with this lode one must regard its special situation, which here favour one with an easy and very cheap breaking of the ore.

#### The ore quantity

If one presume that the ore body all over at least reach a depth equal to the level of adit no. 1, can the total ore area be calculated on the following base as shown by below sketch



Here is not taken into account the dip of the lode, so in reality should the ore area be somewhat larger. In round figure we calculate, however, only with  $280.000 \text{ m}^3$ .

If one with cautiousness only put the average width to 1 meter and one calculate only to get 2.5 ton pr  $\text{m}^3$  so should the Ingeborg lode alone contain at least 700.000 tons crude ore as standing the level of above adit no. 1 or practical spoken above sea level of the Ingeborg lake.

This is of course a probability calculation, as the depth of the lode along the dip not is known, but I mean, however, that



the calculation is so cautious made that it in any case gives one an idea of what ore quantities one has to calculate with in the Ingeborg lode.

The Steel Hill Lode.

Regarding the location which already is mentioned we have to refer to general map (encl. 2).

The strike of the lode is north-south, and the dip varies between  $30^{\circ}$  and  $40^{\circ}$  towards east.

Of the longitudinal section in scale 1 : 2500 (see encl.5) will be seen that the lode has been explored by aid of 2 adits.

Adit no. 1.

has been driven along the strike in northerly direction for a length of 16 meters. The lode has a width of 0.5 meters and consist mainly of magnetic iron pyrites with copper pyrites and some quartz.

An average sample of the ore from the lump outside the adit were assayed with the following result:

Non dissolv. country rock %	S. %	Cu. %	Zn. %	Ni. %	Au. %	Au in gram per ton
25.42	24.60	3.60	2.70	0.09	0.0038	0.02

The microscopical examination of the country rock showed:

In the foot wall : Biotite - chlorite - slate

In the hanging wall: Chlorite slate with garnet.

Adit no. 2.

has a length of 12 meters along the strike. The width is here 0.65 m. The character of the ore and richness in copper is, however, as in adit no. 1.

The microscopical examination of the samples from the country rock showed:

In the foot wall: Biotite - zoisit - slate.

In the hanging wall: Garnet - chlorite - slate.

-----

The outcrop of the Steel Hill lode can be followed for a length of about 800 meters.

The lode is, however, so little known that one cannot make even an approximate calculation of how much ore the lode contain.



Compared with the lodes of Baldoivi and Ingeborg must this lode be of inferior importance, especial when one take into consideration the comparatively narrow width and the distance apart, which this lode have from the two principal lodes.

I regard this particular lode therefore as a reserve lode which in all probability can contain a lot of ore, which by sorting can give very much rich "Furnace ore".

-----

Surrounding and in the neighbourhood of the described lodes, are to be found, as named before still more lodes of greater and less great importance.

These are thought not examined. For instance the Stærdalen lode, a parallel lode to the Ingeborg lode, and located about 500 meters northwest of this. The Stærdals lode is located in a covered and forrestcovered district except where this cross the Ingeborg river.

Here is namely uncovered some ore, which mainly consist of cupriferous iron pyrites somewhat mixed with quartz.

Of other lodes can be mentioned some which is taken on the north, Baldoivi, which is situated between Baldoivi lode and the Jacobsbakken in Sulitjelma.

Furthermore there is taken some claims in the continuation of the Baldoivi lode south towards the Ballake.

Whether any of these claims has any value at all, it is at the present time quite impossible to say.

-----

#### Conclusion.

One will no doubt from the foregoing see, that the here described lodes together contain important quantities of ore of superior quality. The district (camp) must therefore be regarded as very promissing and as a whole fully justify one to a continued and systematic examination, especially of the main lode on Baldoivi.

The principal ore within the lodes are cupriferous magnetic pyrites. Next occur pure copper pyrites in stripes and lumps; impreg=



nation of copper pyrites in slate and some iron pyrites with a little copper, so called export ore.

The last mentioned is, however, so far only found on Baldoivi on a few places, especially in shaft no. 2.

This is, however, not a local exception. With a continued examination on the Baldoivi one will surely be able to open up much more export ore.

The crude ore will by sorting give:

1. Export ore.
2. Furnace ore.
3. Concentrating ore.

#### Proposal for plant & working.

Under this heading it is only my meaning crudely to point out the favourable conditions for plant and working of the lodes, as I take it for granted that the Baldoivi and the Ingeborg lodes are opened up and worked simultaneously, while the Steel Hill lode until further act as a reserve lode.

The concentrating lode and the smelting works is proposed to be erected at the south end of the Botn lake, where the territory is very favourable for the erection of a large concentrating plant at the outlet of the Knaller valley.

Furthermore one find also here considerable flat ground where one now have a few small farms. This ground will give ample storage for ore, mechanical workshops, staff buildings and barracks. The smelting works can be placed up in the Knaller Valley. Water for the concentrating plant one can obtain from the Knaller valley water fall, while the Ingeborg waterfall right above the south end of the Botn lake will procure the necessary power for the working of the concentrating plant, drill, electric light etc. etc.

The unbarren rock from the sorting house, and tailing from the concentration plant, which ought to be continued with an Elmore plant, can be dumped and washed right into the Botn lake. All the crude ore from the mines on Baldoivi and Ingeborg are to be carried by means of an arial cable down to the concentration plant. On the general plan(encl. 2) is the location of the aerial cable way marked



with a full line in blue colour.

As will be seen starts the cable way from Baldoivi in an easy territory and in a straight line down to the Ingeborg lake, where one erect an angular station.

From there it continue, taking also the ore from the Ingeborg lode to the sorting house at Botn lake. The transport length from Baldoivi to Sorting house 8.5 km. and from Ingeborg to the sorting house 2.5 km. The cable way will for its entire length be such placed that one not need any special power.

The transport of the finished products from the concentrating plant and the smelting works down to the quay at Saxenvik bay will most economical be made by a little railway, which one can work with electric power. The railway is to be built narrowganged, will be between 6 to 7 km. long. The line is marked on the general map (encl. 2) with a dotted blue line. The territory for the railway does not offer any particular difficulties.

Besides what <sup>there</sup> is mentioned of plants etc. there must also be erected small mining camps at Ingeborg and Baldoivi. At Ingeborg where the working of the lode is easy and simple, it is also easy to find the necessary ground for the barracks. Otherwise is this on the Baldoivi, where one of course must do all what one can in order to avoid to get the plant and barracks too high up in the mountain, where it is rather windy.

At the terminal point (see general map (encl.2) and point A. in section A-B on the special map (encl. 3) over Baldoivi) will the mining camp on a particular stretch flat ground and in a height of 800 meters above sea level get a most favourable and good sheltered situation against northern and eastern winds. But the presupposition that the town can be placed here is that the lode on Baldoivi with the continued examination will show what it seems to promise. One will then take into consideration if there should be made a main transport tunnel from point A and eastwards to it reach the main lode. See section cut A-B on the special map (encl. 3) and section after the same direction on the section map (encl. 4). As it will be seen will such main transport tunnel get a length of 800 meters. The most favourable with this is that it will cut the ore body on



a rather great deep, namely 300 meters along the dip.

Before such main transport tunnel can be projected in detail, and its length nearer calculated, one must as nearer stated have the lode explored.

Especially must those on section A-B made diamond drill holes be made and show a satisfactory result.

Under ~~a~~previous heading about further examinations of the lodes at Baldoivi I should also mentioned how this ought to be explored with tunnels along the strike in north and south in an altitude of 900 meters above sea level.

Towards north must such tunnel be driven with the same dimensions as the main transport tunnel and connected with this by a shaft down to the level of adit at an altitude of 825 meters above sea level. During working of the upper level of this lode, will then the transport take place through the tunnels and shafts down to the main transport tunnel, as this shaft then will act as an ore bin.

#### The power question.

The Ingeborg fall is formed by the fall of the Ingeborg river in Botn lake. The river which comes from the Ingeborg lake, has a length of 2 km. On this length does the river fall 400 meters (from Ingeborg lake, which is situated 409 m. above sea level and to Botn lake, which is situated 12 m. above sea level). At the outlet into the Botn lake there is formed a perpendicular fall of 180 meters, which with a little alternation of the direction of the river where the fall start one can increase the height to at least 200 meters.

The superficial area of the river is 20 km.<sup>2</sup>. By regulating of the water one will most probable obtain 0.5 m.<sup>3</sup> per second or a little more as a regulated water flow all the year round. The Ingeborg must in any case be dammed up, where-by there is a good opportunity.

With full regulating of the river and utilizing the whole height between Ingeborg and Botn lake one can calculate with 2000 effective horse power or 1000 horse power if one only utilize 200 meters of the total fall.



The river can be harnessed rather cheap. The horse power will then cost to harness about kr. 200.- and yearly expence to run it will be about kr. 20.- per annum.

---

#### The Harbour.

in Saxenvik bay where the necessary ground for quay is secured on the southern side, is very favourable. The inner part of the bay freeze a little during the winter, but not so far out where the quay is planned.

----

#### Concluding remarks.

It is of no use to make a calculation of the total cost, before one after finished exploration has made it clear for what production the whole shall be planned, and how much of it will be in the form of export ore (cupriferous iron pyrites) and how much will be as copper pyrites (furnace ore). While the cupriferous iron pyrites to be exported so must the furnace ore be smelted on the spot.

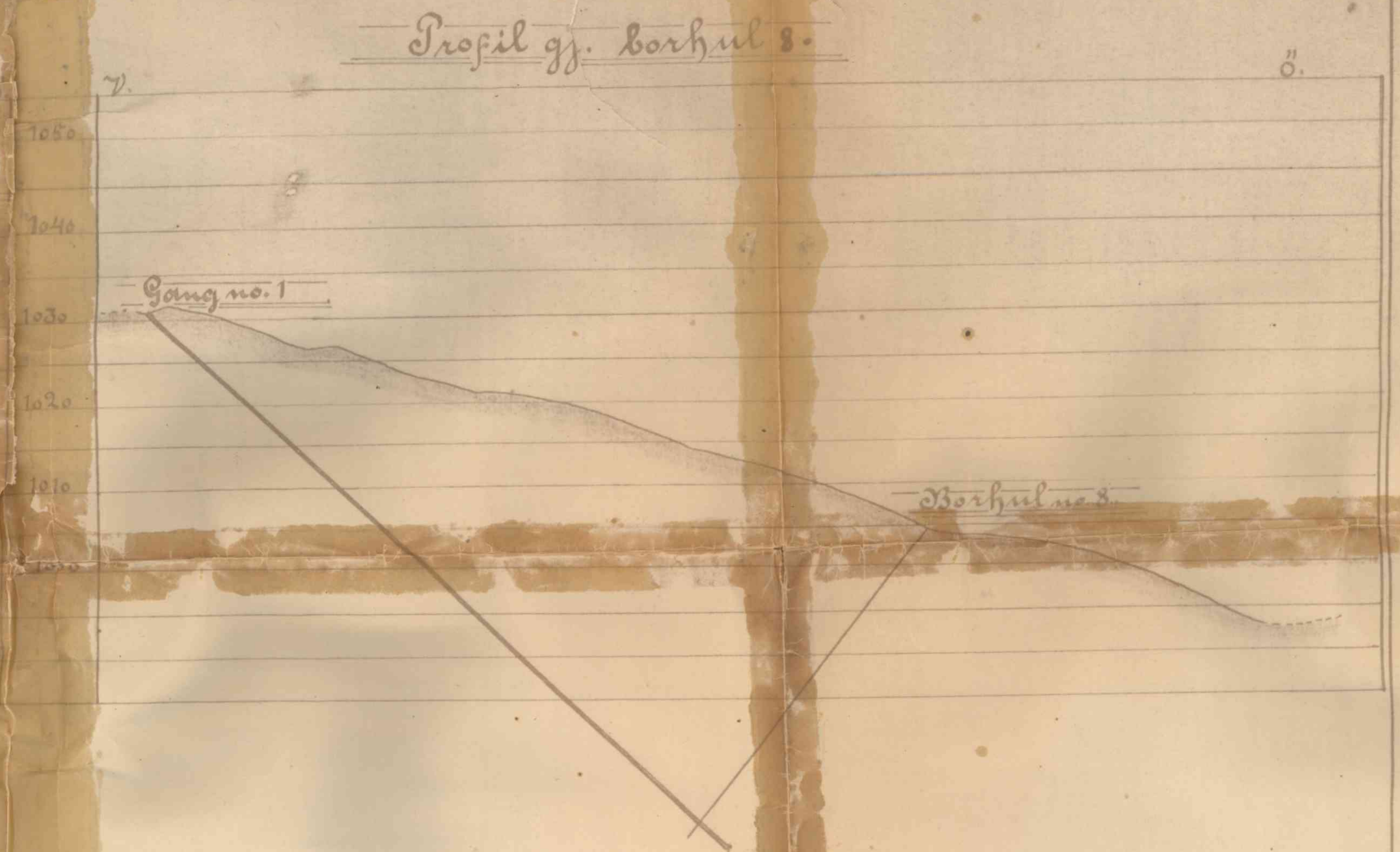
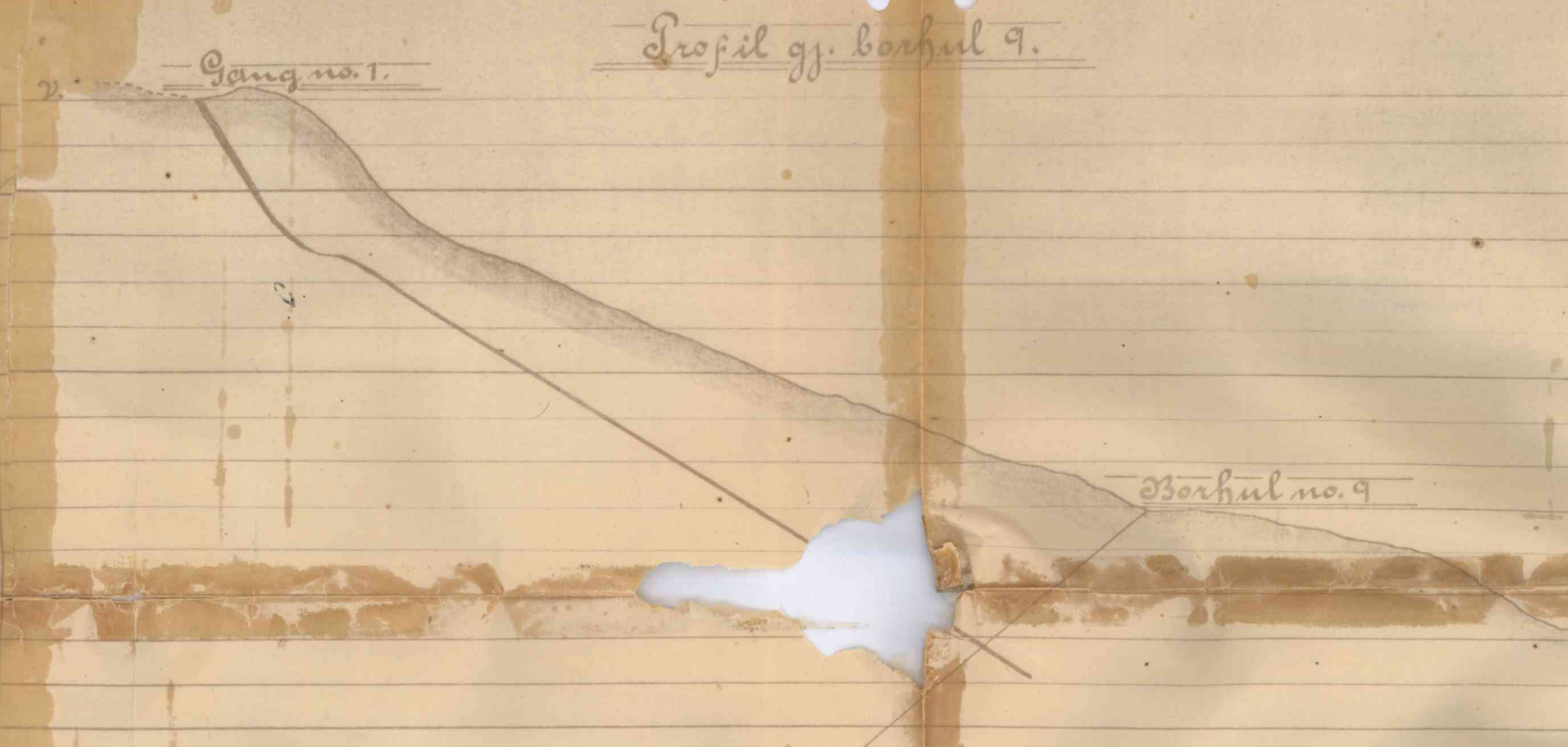
As one know the lodes at present one should judge that the lodes mainly will produce smelting ore and less ore for export.

With regard to plant and working cost it can however be said that these without doubt will be more favourable than at Sulitjelma, to which lodes the here described seems very similar indeed. But the Baldoivi lodes is in several instances still more favourable located than Sulitjelma, especially then as regards transport.

Kristiania May 20th 1915

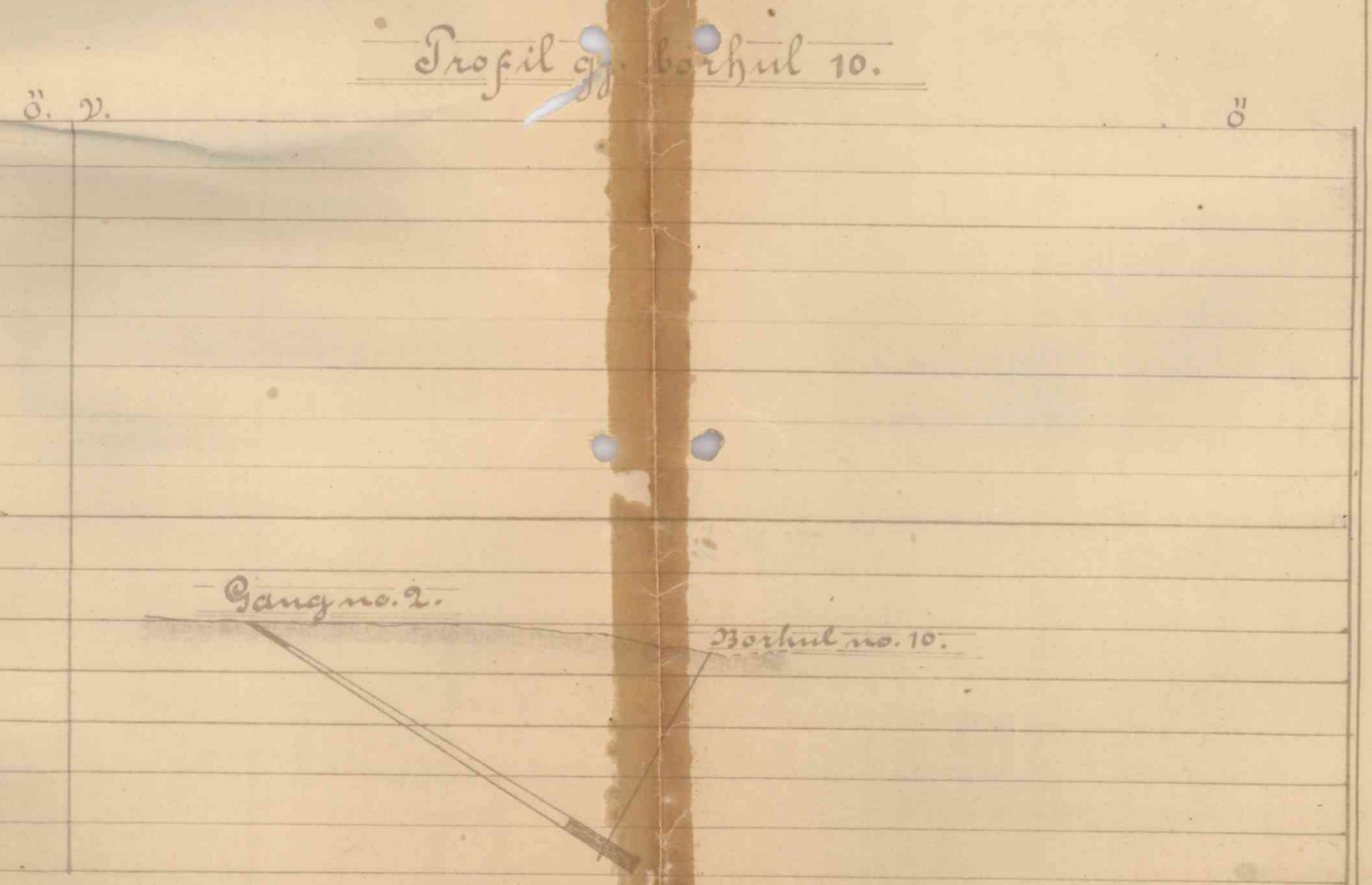
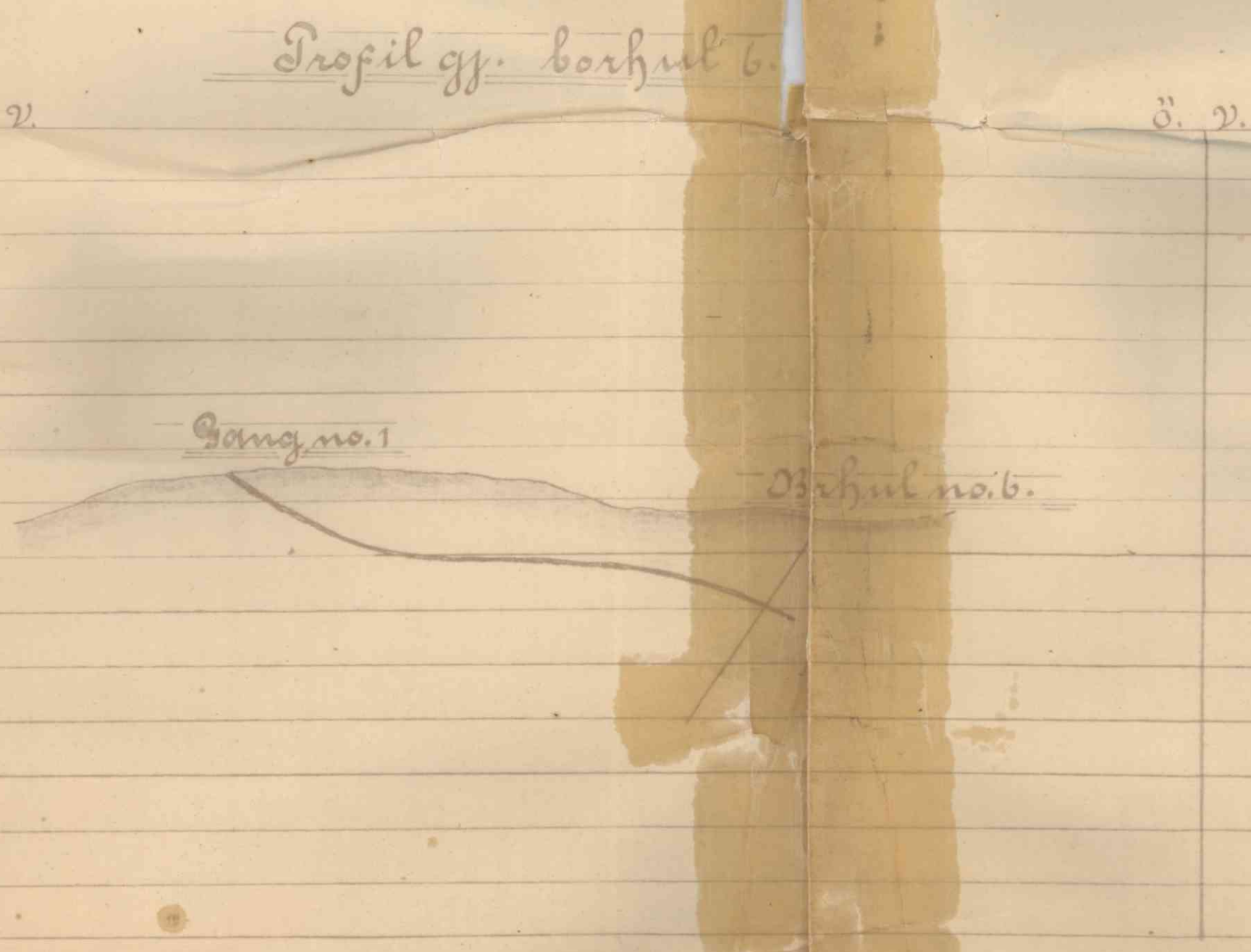
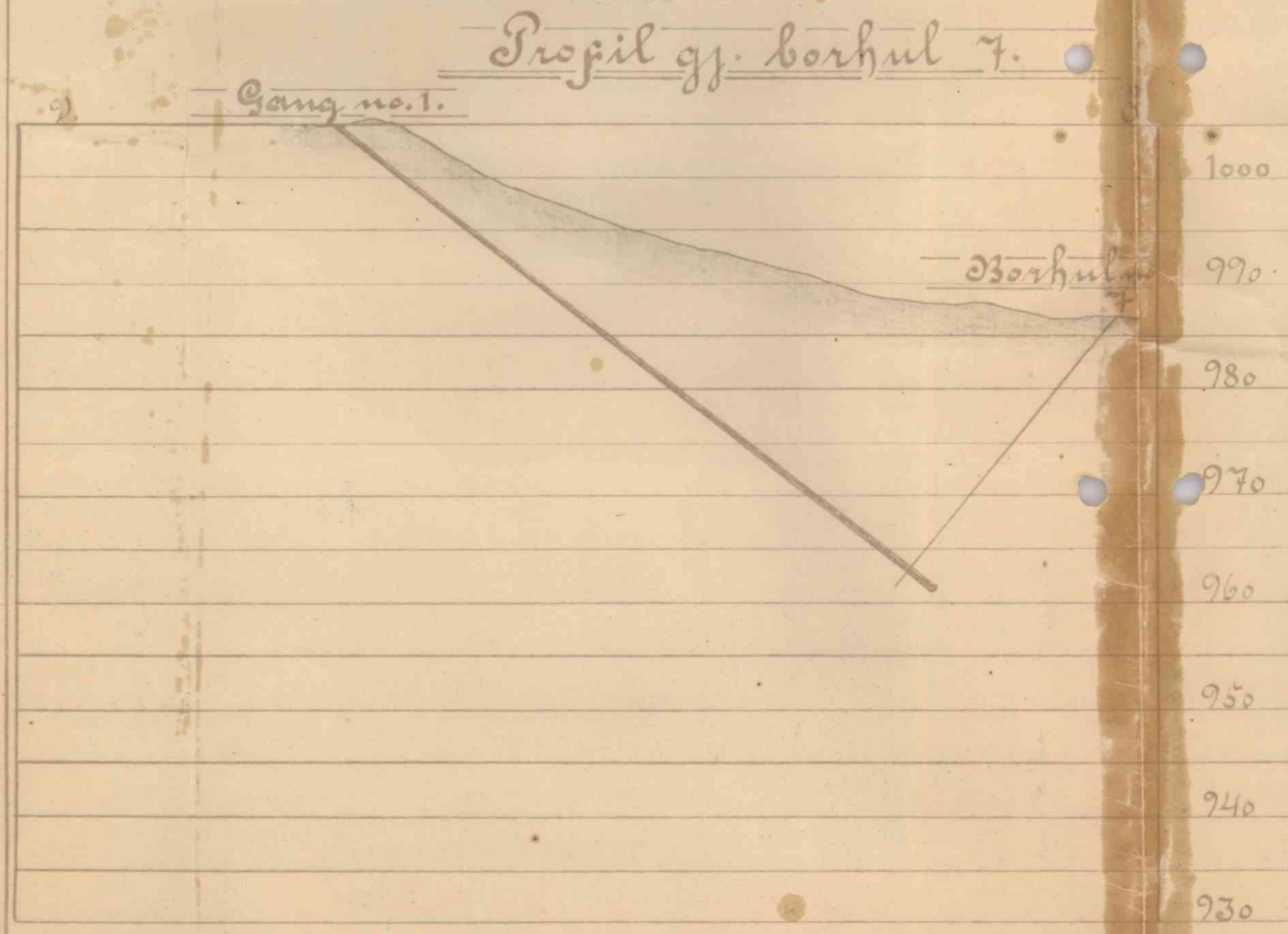
Karl Bay. (sign.)





8. Baldoivi Hobbefelt, Saltdalen.

Målestokk 1:500

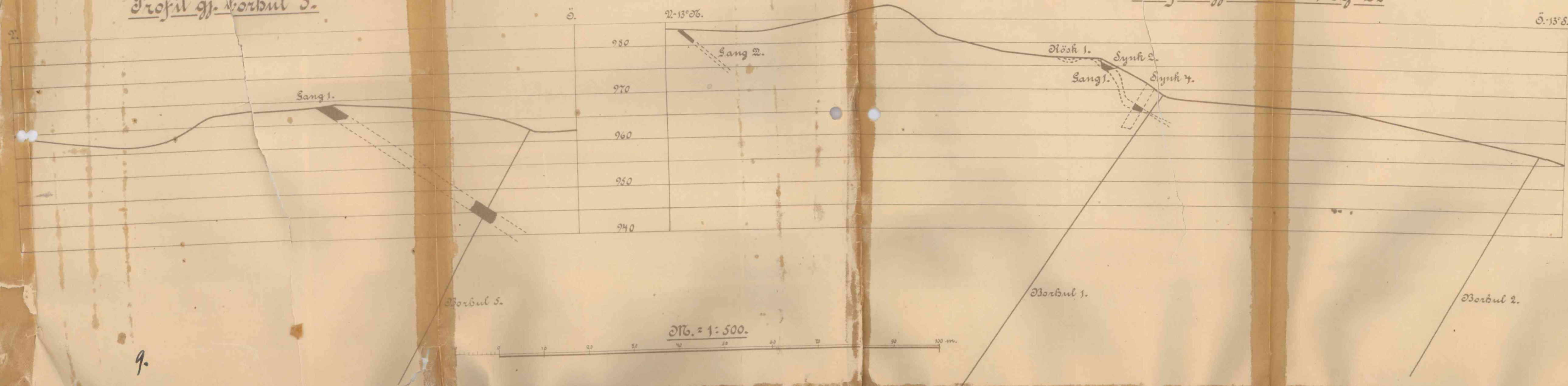


Saltdalen i august 1915  
J. Rønne

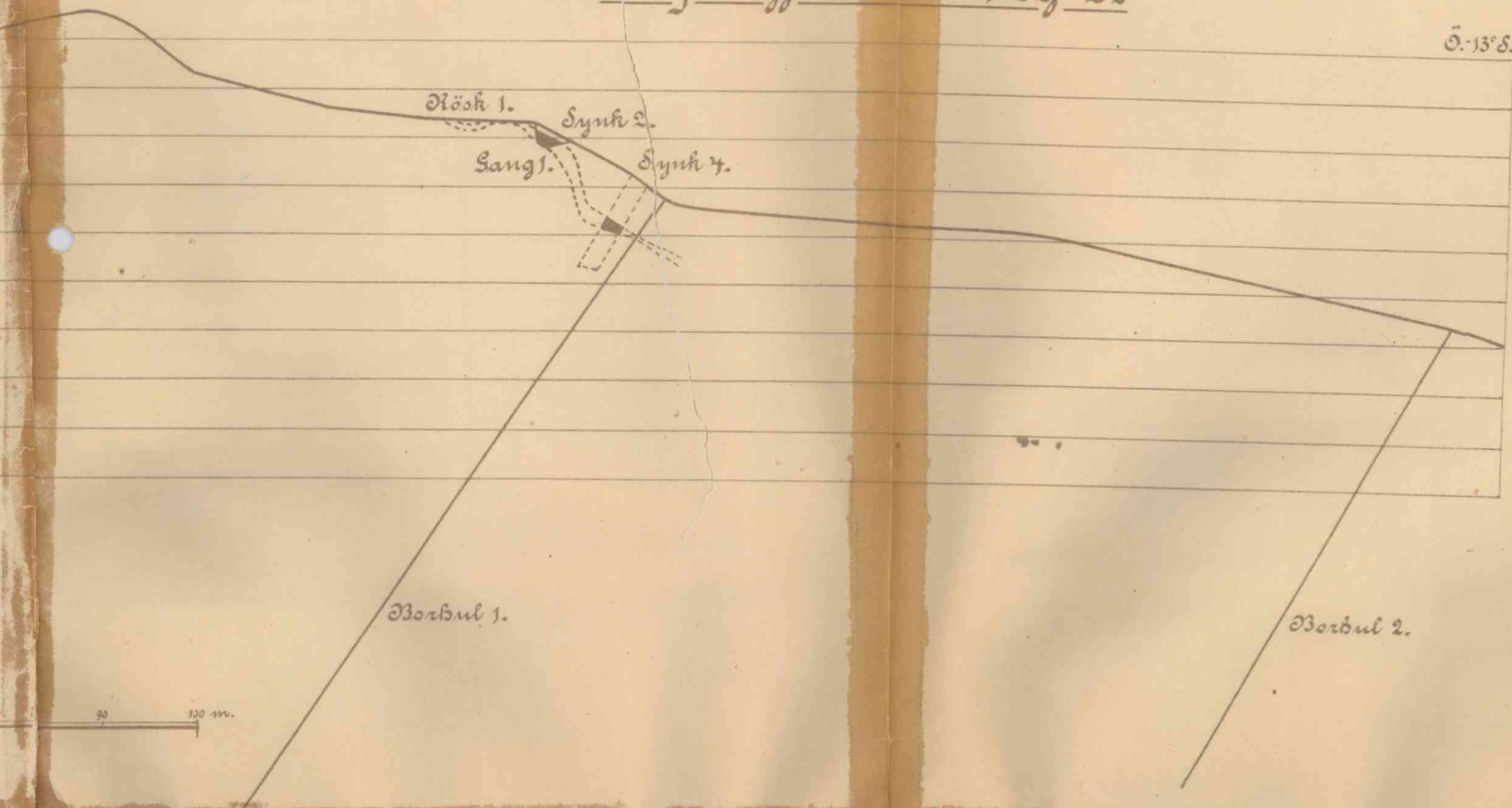


# Baldovi Høkerfelt, Saltdalen.

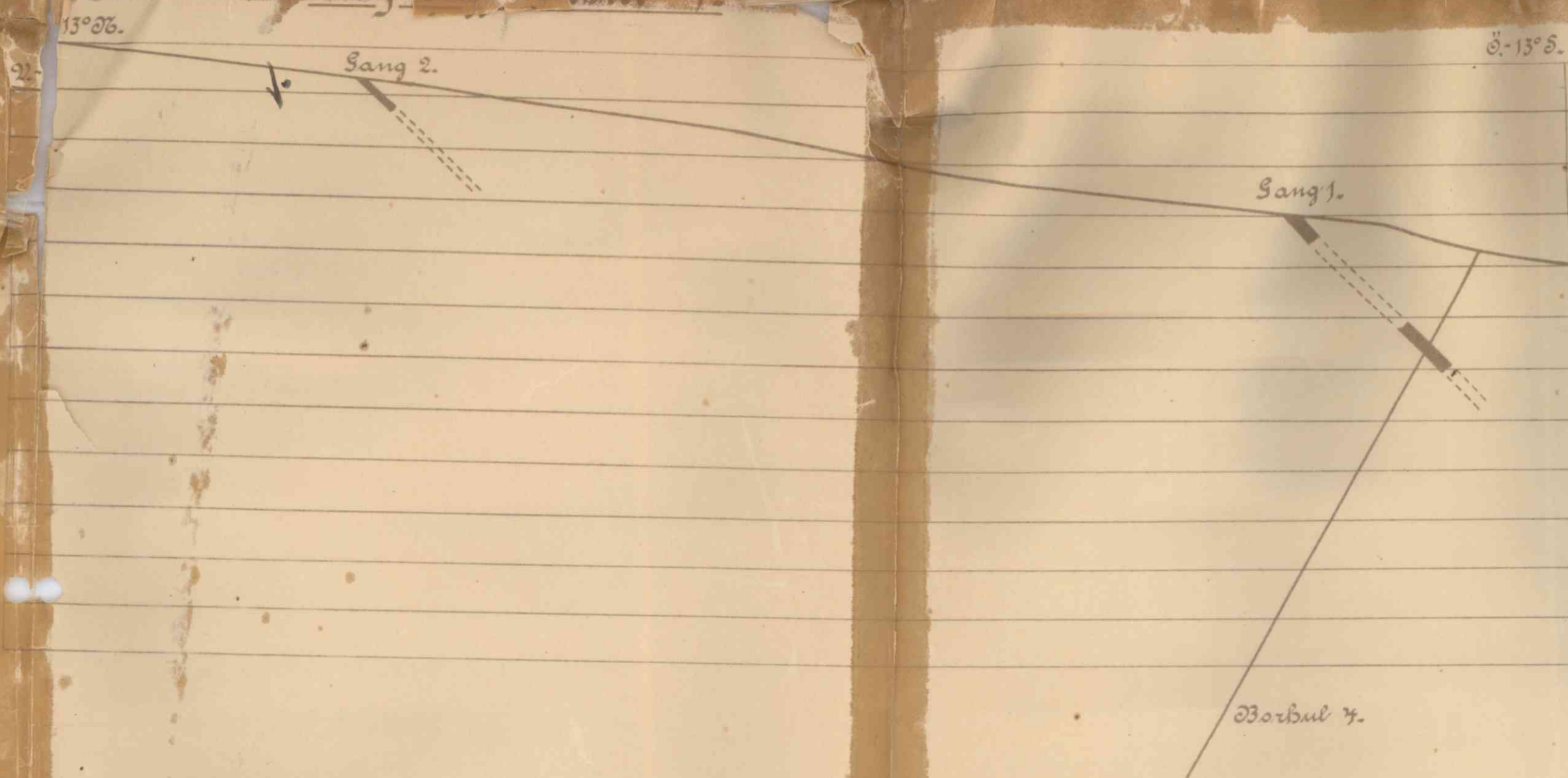
Profil gj. borbul 5.



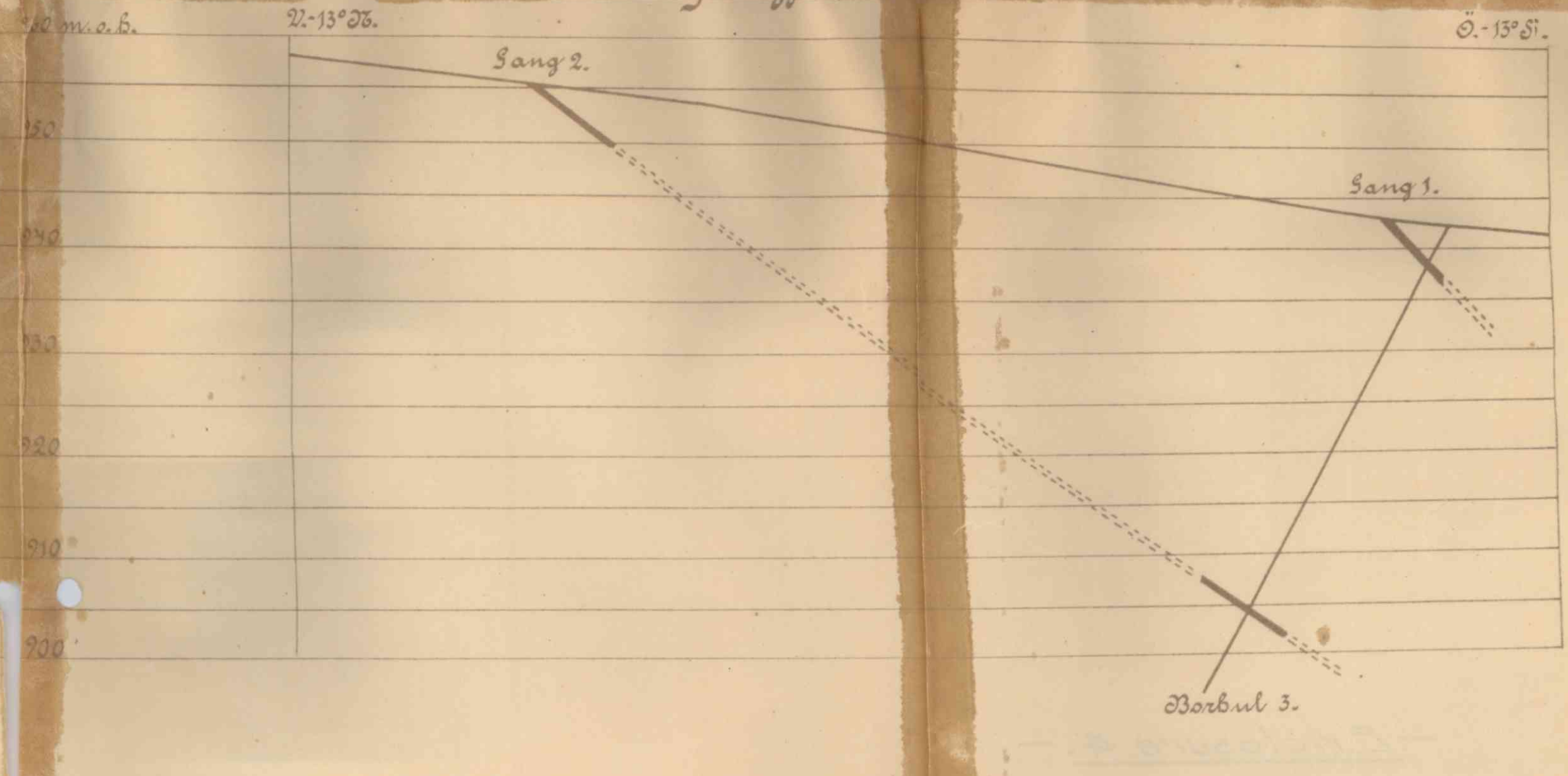
Profil gj. borbul 1 og 2.



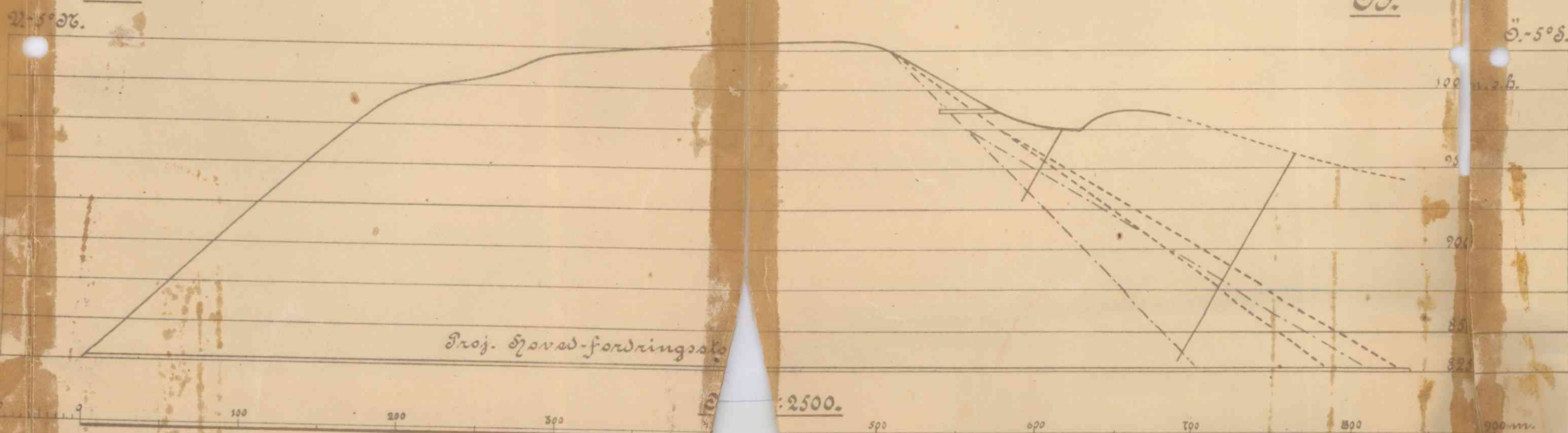
Profil gj. borbul 4.



Profil gj. borbul 3.



A.



B.

Profil: A-B.

- Belegner gangens aprox. fald i 2 alternativer.
- projektørads stoller.
- / ——— Diamantborbul.

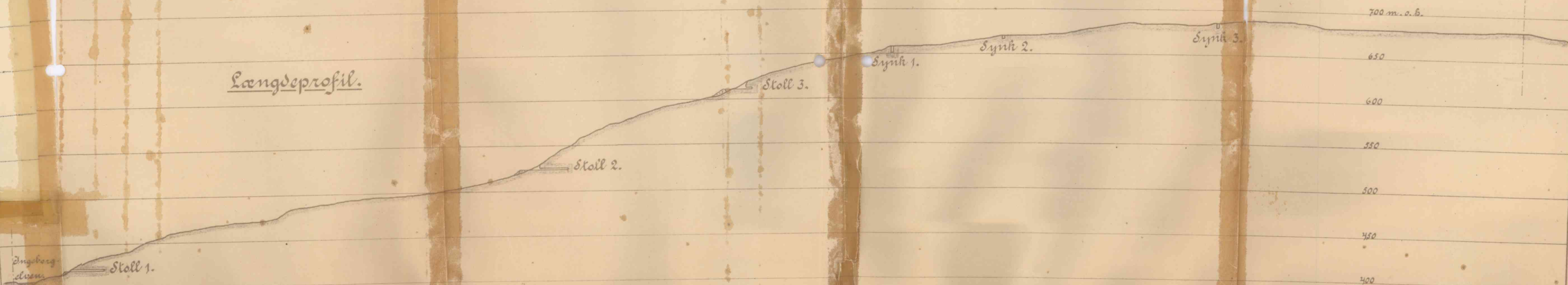
Kristiania febr. 1915.

Karl Bay  
Ingeniør.



# Ingeborggangen, Saltvålen.

Längdprofil.

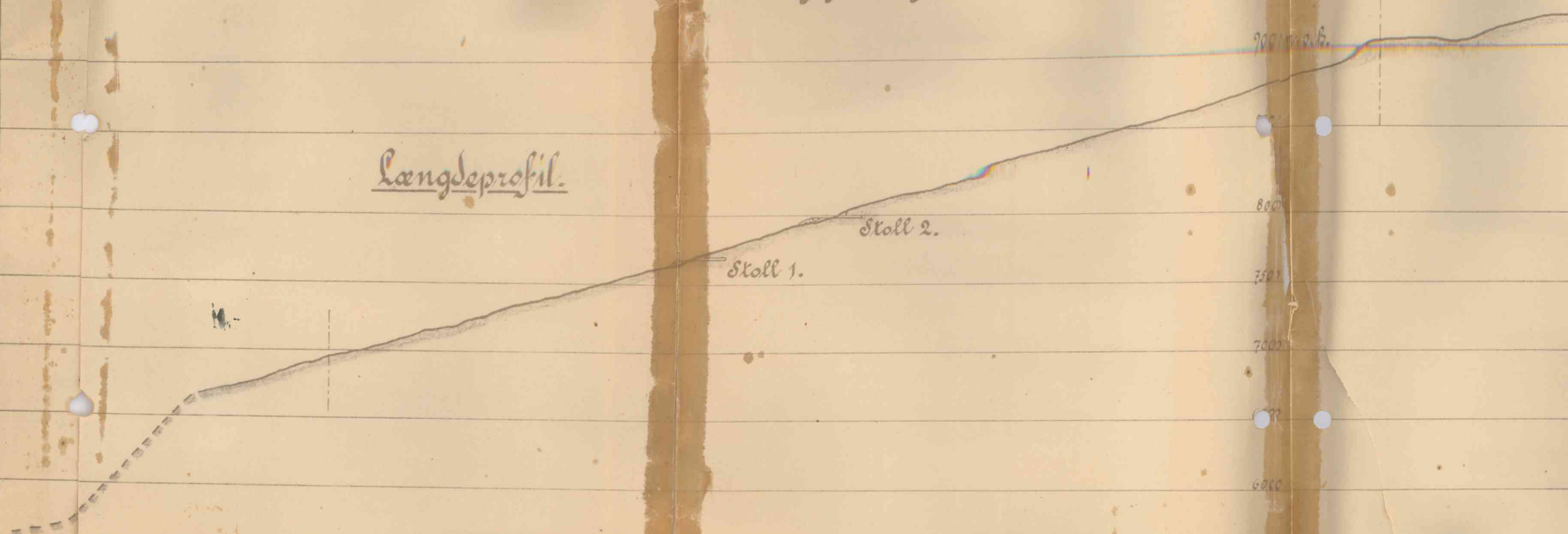


N. 36.

Plan.

## Stadthanggangen.

Längdprofil.



Plan.

N. 36.

Stadthanggens gränser i Sagen.

observations-station.

N. 12500.

50 100 200 300 400 500 m.

Stadthang april 1915.

Karl Bay.  
Ingeniör