



Bergvesenet

Postboks 3021, N-7441 Trondheim

Rapportarkivet

Innlegging av nye rapporter ved: Harald

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Titel
The Esna Mine

Forfatter Holmsen P	Dato Ar mai 1891	Bedrift (oppdragsgiver og/eller oppdragstaker) <input type="text"/>
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Kommune Tydal	Fylke Sør-Trøndelag	Bergdistrikt	1: 50 000 kartblad 17212	1: 250 000 kartblad Trondheim
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Fagområde Geologi Gruveteknisk	Dokument type	Førekomster (førekoms-, gruvefelt, undersøkellesfelt) Tilhører kisførekomstene i Tydal
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Råstoffgruppe Malm/metall	Råstofftype Cu
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Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse
Driftsvurdering av Esna gruve

THE ESNA MINE,

is situated in the high mountains in the district of Tydalen not far from the Swedish border, some hundred meters above the level of the sea and only a hundred meters from the large river Esna near its issue from the Essan lake. The river forms just below its outlet two or three xxx large rapids with a head quite sufficient considering the body of water to provide motive power for a plant for dressing and concentrating the ore.

If required the head of the rapids can be increased by damming up the Essan lake two meters which is easily practicable.

The Esna mine is situated 30 kilometers from Enafors rail station in Sweden which is 109 kilometers by rail to Trondhjem.

The country between Esna and Enafors is throughout flat affording an easy transit between the two places, though rather exposed to snow drifts being partly devoid of trees.

I visited last summer (1890) for the first time the Esna Mine for the purpose of measuring out a considerable concession which had been granted to the owners Messrs A. Huitfeldt & Co. I then made the following official report in my register. Huitfeldt & Co. On the 12th and 13th July inspection was made of the Esna Mine situated in Tydalen

somewhat over 700 meters above the level of the sea close to the Swedish frontier. The Mine lies beyond the limits of the well-known formation of the Roros schists and probably on some older strata. The rock prevailing in its immediate vicinity is amphibolite schist of rather a quartziferous character in which the mineral layers principally consisting of Copper Pyrites with some magnetic Pyrites embedded therein. The Mine is at present opened up to a vertical depth of about 20 meters and in the horizontal levels the considerable dimensions, which may reach 10 meters and more in the various heights.

The safety of the mine was found to be unexceptionable solid pillars being left at suitable intervals.

I am under the impression that the ore and especially the Copper ore occur in several parallel layers having a thickness of 2 meters and upwards with a percentage of Copper amounting to 10 per cent and more. The rock is not distinctly stratified but as far as could be observed in the mine and close by the layers are nearly horizontal or perhaps with a slight dip to the North. The rock is alternating with the ore, but is itself always impregnated with the aforementioned Pyrites and to such an extent that it may be said that down to the present bottom of the mine about 20 meters below the surface - there is a single bed of ore, more or less rich. It is as yet not ascertained how far the ore extends in depth at the bottom a very rich layer 2 or 3 meters thick was seen. Neither is the extent of the deposit known in strike, the work performed bears, however, evidence of its being most probably an uncommonly rich and important deposit.

In the month of March this year, I spent several days at the Esna Mine and examined the property afresh. I can only confirm the opinion I have already expressed and add that the parallel layers mentioned in my first report are probably a single layer which at the time of my first

visit being found interupte in various places conveyed to me the idea of being parallel layers as above stated . By comparing my fresh observations I am necessarily led to the conclusion that it is a vast impregnation principally of Cupreous Pyrites in amphibolic schists .

It certainly extends to the present bottom of the mine . The same kind of rock , though less richly impregnated is seen to occur in two old claims respectively 120 meters S.W. and 210 meters S. distant from the mine . These facts are , however, by no means sufficient to give a founded opinion to the extent and value of the deposit , more extensive exploring work being required in order to make sure of that . So much is however certain that one or more rich layers are embedded in this large impregnated mass of rock , that mining operations have so far been carried out on this layer or these layers and that the deposit appears to be as rich or still richer at the bottom where the workings were temporarily interrupted in the beginning of April last impregnated ore , though not quite so rich as the bottom is seen to occur in the side -walls of the mine , but it is as yet not ascertained how far it extends and whether a richer layer maybe found there . This expectation has since been realized . vide Mr. Bahkes report on the results of diamond borings .

By examining the space of the mine and by drawing samples from the side -walls at accessible places a fair knowledge may be gathered as to the quantity of rich and impregnated ore , which has been mined out and it will be found that large quantities have been extracted from the impregnated rock bounding the rich lode or lodges , probably for the purpose of facilitating the working of the more valuable ore.

It would be very interesting to determine the quantity of Copper contained in the rock raised at Esna from the richer openings as well as from the impregnated rock such a knowledge being very desirable for the purpose of forming an opinion as to the value of the mine . To give a reply to a question so important for the future of the mine it is not aniss to glance at the history of its working from the beginning till now. Its history may be devided into two periods one dating from the opening of the mine in 1854 till its being closed in 1881 owing to the long transport of the ore to the smeltings works, the fall in the Copper price and last but not least to the antiquated methods of

working .The second period includes a few months of last year and the three first months of the present year .

As stated by Mr.Herman Huitfeldt the mine yielded during the first period 3200 cubic meters of rock giving 3793 tons of smelting ore .One cubic meter weighing in average 2,75 tons 3200 cubic meters made consequent-ly 8800 tons yielding 3793 tons as above of smelting ore or 43 per cent of the bulk . There exists no analysis of the Copper ore from the said period ,but considering the expenses of the long transit by horses ,to the smelting works viz.40 kilometers and the heavy costs of turning it into metallic copper it may be supposed to have contained at least 6 a 7 per cent of copper .The waste remaining at the mine having been found to contain 1,36 per cent of Copper and the proportion of steril rock ~~see~~ having been proved not to exceed 12 per cent of the bulk mined out 100 tons of rock from the first period (each ton calculated at 1000 kilogrammes) would thus have produced :45 tons of smelting ore at 6,5 per cent - tons 2,795 of Copper

45 tons of smelting ore at 6,5per cent -	tons 2,795 of Copper
45 - - waste -1,36 - - -	0,612 of -
10 - -steril rock	
-----	-----
100 tons	tons 3,407 of Copper.
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or say 3,407per cent of Cu.

The second period may be subdivided into two parts the first comprising five months when the operations were not properly superintended and the second comprising only one month (March) when the workings were a little better conducted and controlled .

During the early part of the former period the rock raised amounted to 312 cubic meters or 858 tons yielding 123 tons of ore for for export or say 14 per cent of the bulk mined with a percentage of Copper averaging 5 per cent .

The ore put apart for chrushing and dressing contained according to the analysis affixed 5,65 per cent of Copper ,100 tons of rock

raised this giving:

14 tons of export ore at 8 per cent Cu-	tons 1,120
74 - - crushing - 5,55 - - -	- 4,230
12 - - steril rock - -	
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100 tons -	tons 5,350

or say 5,35 per cent of Copper.

The returns for the second parts of the same period are as follows: rock raised 52 cubic meters or 229 tons produce 84 tons of export ore

say for 100 tons of rock mined:

25 tons of export ore at 8 per cent	- tons 2,240
60 - - crushing ore at 4,0% according to	
12 - - steril rock - -	analy cis -- 2,410
-----	-----
100 tons -	tons 4,650

of Copper or 4,650 per cent on an average.

It appears to me to be proved by these figures that the average percentage of copper contained in the rock raised to the surface at the Esna Mine for the whole time of working may put down as 8 per cent at least or rather as 4 per cent if anything. Now the question is whether a profitable mining based on the aforesaid percentage of Copper can be established or not?

In reply to this question I have guided by my long mining experience, worked out two different estimates, viz.

- No1. only supposing mechanical concentration or dressing, and
- No2. also supposing a further concentration of the ore by submitting it to a single smelting process.

As could be expected a priori the second alternative is without comparison the most advantageous one as the concentration of the ore by a higher degree diminishes the effects to the situation of the mine being not otherwise. In both alternatives the ore is supposed to be concentrated only to a certain degree.

The resolut would certainly be still better by producing metallic copper instead of doing the things by halves and the method nearest at hand would then be the making of Bessemer Copper and its subsequent refining by electrolysis with a view to extracting the silver contained in the ore, which assays 0,012 and 0,015 per cent according to percentage of Copper.

On account of these reasons I would rather advise a test to be made in accordance with my second alternative, being confident that similar enterprise if carried out economically and rationally, will be a paying one and help at the same time to acquire a better knowledge of the nature of the deposit.

I have as will be seen by the above been trying to explain my of the value of the Esna Mine, however, it may of course be questioned whether my opinion is the right one. I should like to have my views submitted to a close criticism. I know that Mr. Hurthfeldt intends to offer the property to English buyers, and would be glad to have competent English mining expert come over and report on the Esna Mine and the written as preliminary that may assist and possibly guide the English expedition.

Trondhjem, May 1891

(sd) P. Holmsen

Chief Inspector of Mines in the
district of Trondhjem.

Estimate of costs of developing the Esna Mine and the neighbouring claims supposing the ore mechanically concentrated to 15 per cent of copper without smelting it to regulus . Owing to the ore containing magnetic Pyrites and a certain quantity of heavy siderous amphibole the concentration by mechanical treatment alone cannot be carried successfully further than to 15 per cent .

The mine is supposed to be worked on the same scale as more fully explained in alternative No 2 say with a daily output of 30 tons of rock or 9000 tons a year of 300 working days at an average cost of kronor 5,08 per ton making a total of 45720 kronor a year .

Stone crusher and dressing table are supposed to be employed as in No 2, but the sorting on the dressing table not carried on quite so far as only the steril rock is intended to be picked out .

Above appliances are supposed to be able to treat daily, 30 tons of rock holding 3 percent of Copper or 9000 tons a year of 250 working days .

From the dressing table 1/8th or 6 tons a day are supposed to be picked out as steril rock leaving for the concentration wills 300000- kilograms containing 1080 kilograms or 3,6 per cent of Co per

As the dressing table will not require so much attendance as supposed in alternative No 2 the cost will not exceed half a krone per ton or 4500 kronor a year for 9000 tons .

As stated before 30000 kilograms per rock containing 1080 kilograms of are supposed to be conveyed to the rolls concentrating plant . It being necessary to submit the ore to a higher degree of concentration than supposed in alternative No 2 the loss in concentration may be estimated at 30 per cent which calculated on 1080 kilograms give 324 kilograms .

The ore after having been concentrated will thus contain 1080-324 or 756 kilograms of Co per and is estimated to be reduced in weight to 1/8th , say 5000 kilograms holding 15 per cent of Copper

appliances owing to its being carried on to a further degree the costs necessarily be higher than is estimated in No 2, say about kroner 2,25 per ton makin together :

2,25 x 30 x 250 or 16875 kroner or in round figures 17000kroner

The yearly production of 15 per cent ore will thus amount to 5 x 250 or 1250 tons with freight and selling expences will be as follow

transport to Enafors to-Trondhjem-, at 10 kroner per ton		Kr,12500
freights by rail from Enafors to Trondhjem, hire of yard		
etc.at	6kr.per ton	-7500
freight to England	10 Kr - -	- 12500
Packing	8 Kr - -	8250
Selling expences	7 Kr - -	-8750

		Kroner :47500

Summary of expences:

Mining	Kroner 45720	
Hand dressing	- 4500	
Concentration	- 17000	
Freight and selling expences	----- 47500	Kr. 114720

Proceeds.

1250tons 15 per cent ore paid for at 13 per cent at the price of 8 kroner per unit- 104 kroner		Kr. 130000

deduct for		Kr. 16280
Management	3000	
Maintenance of plant,taxes etc.4280		- 7280

net profit kroner		8000

say £ 444.0.0

The yearly working expences are as above Kr. 114720

and the costs of plants as given in Alternati e No 2 the savingof the water-jacketsfurnace being counter-

balanced b, more concentrating appliances being required Kr. 72000

are together Kr. 186720

equal to £ 10400.0.0

Trondhjem, May 1891

(sgd) P. Holmsen

Chief Inspector of Mines.

Alternative No II.

Estimate of profits based on an average yield of 3 per cent of Copper in the rock.-

The workings are chiefly intended to develop the mine with a view of ascertaining the nature of the deposit by opening the Main-Mine by means of levels and examining the appertaining the claims such workings being calculated at the same time to give reasonable returns as shown hereunder.

To attain the double object above mentioned the following arrangements are assumed to be necessary:

1. A powerfull steam engine at the mine for winding and pumping.
2. a dam at the outlet of the Essau Lake for the purpose of damming it up a couple of meters,
3. a strong stone-breaker with seperating drum and dressing-table,
4. a rail road from the mine to the stone-breaker,
5. a rolling mill for dressing and concentrating,
6. a stamping mill with appliances for treating the ore after it has passed the rolling mill,
7. A water-jacket furnace for reducing for a single smelting process the concentrated ore from the mills.

The ore delivered by the dressing table is supposed to contain 8 per cent of Copper and the produce from the concentrating mill about 10 per cent.

It is not considered advisable to carry further the mechanical concentration of the ore which by being smelted will give a regulus with a percentage of 30 to 40 per cent of Copper.

According to the present scheme the Main-Mine and the claims are supposed to deliver daily:

1,5 cubic meter of rock in sinking	at 11 kroner	-Kro 16,50
3 do do - do - levels	- 9 -	- - 27,00
<u>6,5 do do - do - stoopings</u>	- 6 -	- - <u>39,00</u>
11,0 cubic meter together at a cost of		<u>Kr. 82,50</u>
making in average per cubic meter		Kr. 7,50
ts which must be added for smith and coals		<u>- - 0,73</u>
say total cost per cubic meter		<u>Kr. 8,23</u>

The weight of a cubic meter being about 2450 kilograms the daily output will thus amount to about 30 tons of rock costing per ton as follows :

Mining as above	Kr. 3,02
Winding and pumping	- 1,03
Sundr. expenses (under mining expenses Capt. in, timbering &c)	Kr 0,33
Unforeseen expenses	- 0,41
Contingencies	- 0,13
Breaking the rock by sledges and freeing the stone-breaker	<u>- - 0,26</u>
total mining expenses per ton	<u>Kr. 5,08</u>

say for a day, 30 tons x 5,08 = 152,40 or for a year of 300 workings days Kr. 45720 as being the costs of extracting 9000 tons of rock.

If, treating daily, 36 tons the stone-breaker and the dressing table will give for 250 days 9000 tons a year at a cost calculated at a 1 krone per ton, say 9000 kroner a year.

36 tons or 36000 kilograms of rock containing 3 per cent or 1080 kilograms of Copper will yield by being sorted on the dressing table as follows:

about 300 kilograms superior ore at 20 per cent	-60 kilos of copper
1/6th or 6000 - hand dressed ore at 8 per cent	-480 - - -
1/6th - 6000 - steril rock	- - - - -
<u>12300 kilograms</u>	<u>540 kilos of copper</u>

There will thus go to the concentrating mill 58000-128000
 about 2500 kilograms of rock containing 1080-540, say 540 kilograms
 2.25 per cent of Copper.

By calculating the cost of concentration at Kr. 1,54 per ton they
 will amount to 9240 kroner a year of 250 working days. The mixture after
 having been concentrated will be reduced to about 1/8th or about 4000 kilograms
 the loss in concentration being estimated at 25 per cent say 540-155-405
 kilograms of Copper is 4000 kilograms or 10,1 per cent Cu.

The following quantity of ore will thus be available for smelting, say
 about

500	kilograms superior ore	containing	60	kilos of copper	
6000	-	hand dressed ore	-	480	- - -
<u>4000</u>	-	concentrated	-	<u>405</u>	- - -

say 10300 kilograms of smelting ore cont. 945 kilos of Copper.

averaging 9,2 per cent.

The water jacket furnace may be supposed to treat 22 tons
 a day of 24 hours, thus receiving the produce of two days concentration
 with the addition of the necessary flux of limestone.

Consequently 10300 kilos x 2 = 20600 + 5 per cent flux or 1050 say together
 about 22 tons.

I put the smelting expenses as follows:

Cokes 7 tons, each 24 hectoliters at Kr. 1,80	Kr. 300
Flux (limestone)	- 20%
Wages	- 50
Sundry expenses	- 30

making together:	<u>Kr. 400</u>

say for 125 working days Kr. 50000.-

Above 22 tons of smelting materials will yield about 6 tons
 of regulus containing 945 x 2 = 1890 - 20 for loss in smelting, say
 1870 kilograms or about 57 per cent of Copper giving for 125 working

days 625 tons of regulus year .

The summary of the total expenses will thus be as follows:

Mining		Kr. 45720
Hand dressing		- . 9000
Concentrating		- 9240
Smelting		- 50000
Transport to Enafors of 625 tons at 10 kroner		- 6250
Freight by rail and hire of yard - 6 -		- 3750
Freight to England - 10 -		- 6250
Selling expenses 7 per cent of the value		- <u>13750</u>
	say, together	<u>Kr. 143960</u>
	or in round figures	Kr. 144000

Proceeds.

625 tons of regulus holding 37 per cent of copper and

~~paid for at Kr. 6 per unit 315~~

paid for at 35 per cent made at Kr. 2 per unit 315

kroner per ton, say

196875

deduct for

leaving

Kr. 52875

management taxes, maintenance &c.

8875

or a net profit of

Kr. 44000

Summary:

Cost of establishment &c

Kr. 72000

Working expenses a year

154000

together

Kr. 226000

or £ 12500

Trondhjem May 1891

(sgd) P. Holmsen

Chief Inspector of Mines.