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Vertraulich   Bilbilag

Lehman

B E R I C H T

I N B E R I C H T I G U N G D E S

Repparfjord K U P F E R V O R K O M M E N S U N D S E I N E S M E T A L L W I R T S C H A F T L I C H E N B E D E U T U N G

von

Bergingenieur F. H O L M S E N

Zusammen mit Baumeister J... ON aus Ludvika in Schweden habe ich vom ..-2-1940 eine Reise nach Repperfjord bei Hammerfest in Finmarken ..., Norwegen, gemacht, um verschiedene Fragen über eine baldige Inbetriebnahme des seit 1904 untersuchten Kupfererzvorkommens, das der schwedischen Gesellschaft Nordiska Gruf A.B. gehört, an Ort und Stelle zu untersuchen.

In Oslo war mir mitgeteilt worden, daß man dreimal wöchentlich Autobusverbindung zwischen Hammerfest und Repperfjord hat. Es war deshalb eine Enttäuschung, bei der Ankunft in Hammerfest zu erfahren, daß der Autoweg des ganzen Winter von Schnee blockiert ist, sodaß überhaupt während des Winters keine Autoverbindung zwischen Hammerfest und Repperfjord besteht.

Nach einer stürmischen Reise mit Motorboot kamen wir ... auch an in Repperfjord an und haben im Hause der Gesellschaft b... hat, gesproch... Hafen gewohnt. ... zu empfeh... Materialien

T R A N S P O R T W E G.

Maschinen und Materialien für die Anlage und Materialien ... einen Betrieb müssen vom See nach dem Grubengebiet, sowie Roherz oder ... es tionskonzentrat von der Grube nach dem Hafen transportiert wer... ...nn, zu ist deshalb nicht zu vermeiden, daß ein brauchbarer Autoweg zu ...00 bis Jahreszeiten offen gehalten wird. Aus einer vom Stabsfahnenjunk... B..G 1904 gezeichneten Karte (1:4000) kann man sehen, daß ein We... Ufer entlang nach Vestre Ariselv führt und von hier nach einer Bi... von etwa 90° dem Aris-Fluß nach dem Grubengebiet folgt.

Die Strecke vom Hafen (auf der Karte als "Kontor" bezeichnet) nach dem Ariselv ist ein Teil des Hauptwegs von Hammerfest nach Karasjok, etwa 3,6 m breit und im Sommer gut gehalten. Sie kann ohne jede Vor-

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arbeiten für schweren Autotransport benutzt werden.

Der privaten Grubenweg der Gesellschaft vom Ufer des Arisely entlang nach den Gruben ist teilweise recht steil und überall schmal, durchschnittlich etwa 2 m, und für Pferdetransport gebaut. Ich habe den Eindruck, daß der Weg recht gut gebaut ist, wesentlich auf Steinboden. Auf einer Stelle, wo der Weg am steilen Abhang entlang gebaut ist, war die Bahn immer niedergebrochen, und es wird auf eine Strecke von etwa 50 bis 60 m nötig, den Weg umzubauen und zu verstärken.

Weiter nach den Gruben, an der genannten Stelle vorbei, geht der Weg wieder über flacheres Land und ist überall auf Gestein gelegt. Ich glaube, daß die Verstärkung und Verbesserung des Wegs keine Schwierigkeiten machen wird, aber es ist neben dem Bau eines neuen Kais unbedingt die erste Arbeit, die ausgeführt werden muß.

K A I und H A F E N V E R H Ä L T N I S S E

Bei dem auf der Karte als "Kontor" bezeichneten Gebäude war ein Holzkai als Verlängerung des der Gesellschaft gehörenden alten angefangenen Steinkais gebaut. Dieser Holzkai wurde aber im Januar dieses Jahres vom Fjordeis zerstört.

Tiefenmessungen im Meer sind früher außerhalb des Kais gemacht und zeigen, daß die Verhältnisse für den Bau günstig sind. Ich habe in Hammerfest mit einem Herrn HAUAN, der sowohl Kaianlagen wie auch andere Holz- und Betonarbeiten über ganz Finmarken gebaut hat, gesprochen. Er meinte, daß es wegen der Eisverhältnisse in Repparfjord zu empfehlen ist, den Kai aus Beton zu bauen. Um die Maschinen und Materialien für eine Anlage empfangen zu können, kann man aber vorläufig einen Holzkai im Laufe von wenigen Wochen bauen. Für den Betrieb wird es jedoch nötig sein, einen starken Kai, der Eisdruck aushalten kann, zu bauen. Weiter muß ein Lagergebäude für Flotationskonsentrat (1500 bis 2000 t) mit Transportband und Schrapperanlage gebaut werden.

S Ü S S W A S S E R - Z U F U H R

Wie man auf der Karte sieht, laufen zwei Flüsse: der Østre Arisely und der Vestre Arisely in der Richtung SW-NO nach dem Repparfjord, also parallel der Streichrichtung des Repparfjord-Erzvorkommens. Von diesen zwei Flüssen ist der Vestre Arisely dem Grubengebiet am nächsten. - Die zwei nahliegenden Flüsse sind durch einen Gebirgsrücken von etwa 30 bis 40 m Höhe von einander getrennt.

Der Østre Arisely kommt vom See Arisvand, der eine nicht unbedeutende Wasserfläche und Tiefe hat und nach Angaben recht fischreich

ist, im Winter also nicht bis zum Boden gefroren ist.

Der Vestre Arisely dagegen kommt von unbedeutenden Gebirgsseen, die wie man befürchten muß in der kalten Jahreszeit bodenfrieren werden.

Während unserer Besichtigung oben am Aricelvtal bis zum Grubengebiet war der Fluß vollkommen unter einer hartgepreßten mehrere m dicken Schneedecke verschwunden. Nach Angaben von Kepperfjord-Einwohnern über die Wassermengen in verschiedenen Jahreszeiten fürchteten wir, daß die Wassermenge, die wir im Vestre Arisely in der jetzigen trockenen und kalten Jahreszeit finden würden, ungenügend für Flotation, Kompressor-Kühlwasser usw sein würde.

Es war deshalb eine erfreuliche Überraschung, durch Weggraben von Schnee und Eis einen frischen Strom von etwa 1 m Breite und 20 cm Tiefe zu finden, von dem ich eine 10 Liter Probe für Wasseruntersuchungen nahm.

Die für die Anlage nötige Wassermenge wird etwa bei vollem Ausbau bis 120.000 t Roherz per Jahr:

für Flotation	1350 l/min.
" Kompressor	150 " "
" Haushalt 100 Personen .	15 " "
" Spülwasser Bohrmaschinen	50 " "
" Dieselmotor	50 " "
zusammen	1615 l/min.,

also etwa 27 l

Wesentlich mehr als diese Wassermenge haben wir jetzt in Vestre Arisely beim Grubengebiet beobachtet. Nach Angaben sind eben die Monate Februar und März die trockensten und wasserärmsten. Wir sehen die Frage der Wasserzufuhr für eine Grubenanlage durch Versorgung von Vestre Arisely mit einer Pumpenanlage, die natürlich frostfrei montiert werden muß, als gelöst an.

D I E K L I M A V E R H Ä L T N I S S E

haben wir durch Erkundigungen bei Leuten von Hammerfest und Kepperfjord so genau wie möglich untersucht, da ich es für wichtig halte, daß man sich so genaue Kenntnisse wie möglich über die Schwierigkeiten für Anlage und Betrieb durch die in West-Finmarken im Vergleich zu den südnorwegischen Verhältnissen harten Wetterverhältnisse durch Schnee, lange Kälteperioden und Stürme verschaffe.

Allgemein kann man damit rechnen, daß die Kälteperiode mit Temperaturen unter 0° Mitte November bis Mitte Mai oder Anfang Juni dauert.

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In den letzten Jahren ist der Boden bis Weihnachten schneefrei geblieben, dagegen schneebedeckt von Januar bis Juni.

Im übrigen kann man sagen, das die Gegend von Repparfjord stürmisch ist. Die schlimmsten Winde sind die südlichen und südwestlichen, die mit kaltem Wetter kommen. Die nördlichen und rein westlichen Winde kommen mit feuchtem und etwas milderem Wetter und sind deshalb nicht so gefürchtet. Die Anlagen bei der Grube werden in einer Meereshöhe von etwa 350 bis 360 m liegen; die Temperatur ist hier einige Grad niedriger als am Fjord. Es ist da oben auch beinah immer Wind und oder Sturm. Die Anlagen müssen deshalb möglichst im Berg eingeschossen werden (Erzbunker, Zerkleinerungsanlage usw). Von Baumeister JANSON wurde vorgeschlagen, Bohrschmiede, Reparatur von Bohrmaschinen, Lager für Materialien, Grube usw in einem Querschlag des Olle-Stollens, nachdem genügend Raum durch Strossarbeit geschaffen worden ist, einzubauen. Dieser Vorschlag ist nach meiner Meinung gut.

WOHNGEBÄUDE

Wir rechnen mit einer Belegschaft von insgesamt 100 Arbeitern, 5 bis 6 Beamten sowie 2 Ingenieuren, für die Wohnungen geschaffen werden müssen, d.h. für die Arbeiter Schlafzimmer mit 4 Betten, Kantine und Aufenthaltsraum samt Raue möglichst mit finnischem Dampfbad.

Die Beamten können in Einzelzimmern im ersten Stock des Bürogebäudes wohnen. Für die 2 Ingenieure muß ein kleines Haus mit 3 Schlafzimmern samt Esszimmer und Bad gebaut werden. Man muß also an Wohnungen bauen:

1 Ingenieurwohnung im 1. Stockwerk
1 Büro mit Zimmern für Beamte im ersten Stock
4 Arbeiterwohnungen für je 25 Mann
1 Kantine und Raue.

Wie sonst in Norwegen werden sämtliche Gbäude am besten aus Holz gebaut. Es ist zu empfehlen, daß sämtliche Häuser von einer Spezialfirma gebaut werden, natürlich nach eingeholten Angeboten von verschiedenen Firmen. Wir haben vorläufig eine Besprechung gehabt mit der Zimmerfestfirma H. Nilsen Materialhandel, dessen Inhaber große Erfahrung von Bauarbeiten in Finnmarken hat und der uns Angebote vorläufig geben wird.

KRAFT

Für die ganze Anlage wird man anfangs etwa 500 PS benötigen, nämlich für:

Flotation	300 PS
Kompressor	120 PS
Licht	20 PS
Bohrschmiede und Werkstatt .	20 PS
Ventilatoren u.Kleinmaschinen	
Grube	10 PS
Sonstiges	10 PS

Man kann für eine Kraftlieferung mit 3 Möglichkeiten rechnen:

1- Eigener Kraftausbau

2- Kraftmiete von Porsa Kraftzentrale, die der Gemeinde Hammerfest gehört

3- Dieselmotoranlage bei der Grube.

Die Verhältnisse liegen für eigenen Kraftausbau nicht günstig, und ich nehme an, daß ein solches Projekt auch wegen Zeitverlust nicht in Frage kommen kann. Die Porsa Kraftzentrale, seiner Zeit von Porsa Kobbergruber gebaut, gehört jetzt der Gemeinde Hammerfest, die eine Hochspannungslinie mit 22.000 Volt, teils in Kabel, gebaut hat.

Es ist weiter eine Hochspannungslinie von Porsa nach Fuegfjord zur Versorgung der Kvalsund Gemeinde geplant. Von Fuegfjord nach Repperfjord ist es nur etwa 5 km. Eine Kraftüberführung von Porsa nach den Repperfjordgruben scheint somit günstig zu werden. Jetzt sind aber nur 500 PS von den im Wasserfall vorhandenen 1200 PS ausgebaut, es wäre also nötig, sowohl Wasserrohrleitung wie Turbine mit Generator zu beschaffen.

Die Gemeinde Hammerfest ist in einer schlechten ökonomischen Lage und es wurde mir mitgeteilt, daß es ausgeschlossen ist, daß die Gemeinde das nötige Kapital für diesen Ausbau selbst beschaffen kann.

Ich glaube aber, daß es möglich ist, eine günstige Kraftmiete durch Vorauszahlung eines Betrags, der den weiteren Ausbau der Kraftzentrale ermöglicht, zu erhalten.

Man kann weiter damit rechnen, daß der Kraftverbrauch in Finmarken in der hellen Jahreszeit von Mai bis August gering ist, weil es dann Tag und Nacht hell ist. Dies muß man für eine Grubenanlage günstig ausnützen können. xxx

Ich habe vorläufig kurz mit dem Stadtingenieur in Hammerfest über die Kraftfrage gesprochen, habe aber vor meiner Abreise nach Repperfjord ein Zusammenkommen verabredet. Die verschiedenen Möglichkeiten werden weiter unten diskutiert.

Die letzte und wahrscheinlich im Anfang sicherste Kraftquelle ist eine Dieselmotoranlage mit direkt gekuppeltem Generator. Sowohl Brenn-

...Schmieröl sind im Preis gestiegen, und auch wegen dem relativ teuren Transport der Olle und der andern Materialien wird die Dieselkraft im Vergleich mit Wasserkraft jetzt noch teurer als vorher. Ich fürchte, daß man trotzdem mindestens anfangs unter allen Umständen mit einem Dieselmotor anfangen muß, empfehle aber, doch eine Hochspannungslinie zu bauen, selbst wenn die Gemeinde Hammerfest vorerst nur ungenügende Kraftmengen abgeben kann.

U N T E R S U C H U N G E N

Ich hatte gehofft, daß ich sämtliche Untertagearbeiten hätte besichtigen können. Nachdem wir aber einen ganzen Tag durch hartgepreßte Schneedecke etwa 4 m tief gearbeitet hatten, um die Stollenöffnung des Olle-Stollens zu finden, mußte ich es in dieser Jahreszeit aufgeben, auch die Johns- und Erichs Gruben zu besichtigen.

Vom Johns Stollen ist übrigens anfang Februar (bevor die später gekommenen großen Schneemengen die Arbeit erschwerten) eine Erzprobe von etwa 1,2 t an Professor BJÖRLING, Stockholm, geschickt worden.

Ich bin aber die ganze Olle-Grube durchgegangen. Diese besteht aus einem etwa 180 m langen Stollen, dessen Mundloch 356 m über dem Meer liegt, senkrecht zur Streichrichtung des Vorkommens. Man kann durch auf dem Stollenstoß abgesetzten grünen Kupferkarbonatstreifen und Flächen leicht feststellen, wo man erzführende und wo man erzfreie Partien hat.

So scheint die erste Strecke des Stollens erzfrei zu sein. Etwa 30 m vom Mundloch ist ein kurzer Querschlag nach Norden getrieben, ohne Erzmengen von Bedeutung getroffen zu haben. Ein Feldort senkrecht auf dem Stollen also in der Streichrichtung des Vorkommens ist sowohl gegen SW wie NO etwa 80 m getrieben und hat augenscheinlich recht gut Erz getroffen. Dieses Feldort ist nicht im Bericht des Ingenieurs GOLDKUHL genannt und ist deshalb wahrscheinlich später getrieben. Ich habe Proben für Flotationsversuche, die von mir ausgeführt werden, genommen. Weiter habe ich Proben für Flotationsversuche von dem großen Schurf, der etwa gerade über dem Olle-Stollen getrieben ist, genommen. Weiter habe ich noch Proben von Erz aus den Bergehalden außerhalb Johns Stollen genommen.

Sowohl nach dem Bericht von GOLDKUHL, wie noch mehr nach dem Berichte von OTTO STRÖMAN (1913) liegen wahrscheinlich die ganz überwiegenden Erzmengen in "Olles Malmer". Es muß deshalb interessant sein, Flotationsversuche von diesen Erzen auszuführen.

Nach Besprechungen mit Betriebsleiter JANSON und nach Besichtigungen vor Ort und Stelle werden wir aus diesem Grunde auch vorschlagen, daß zur Transportverbindung zwischen Grube und Aufbereitungsanlage der alte Olle-Stollen als vorläufiger Förderstollen gewählt wird, weil man dadurch wahrscheinlich die durch die Arbeiten in "Kvadraten", "Segmitet", "Trianglen" und Olle Stollen gefundenen relativ großen Erzpartien, wesentlich über der Olle-Stollen-Sohle liegend, hierdurch einfach und schnell abgebaut werden können. Ein anderer Grund, weshalb wir bei diesem Plan geblieben sind, ist, daß wir zwischen Olle Stollen und John Stollen einen günstigen Baugrund für die Aufbereitungsanlage gefunden haben, wo die Oberfläche des Erzbunkers in demselben Niveau wie der Olle Stollen liegt. Falls man wünscht, wird es auch keine Schwierigkeiten machen, die wahrscheinlich etwas reicheren John-Erze direkt vom Johns Stollen nach dem Erzbunker der Aufbereitungsanlage unseres Plans zu fördern.

ZUGANG VON GELERNTEN ARBEITERN

Wegen der isolierten Lage der Grube und wegen der harten Wetterverhältnisse wäre es vorzuziehen, sämtliche Arbeiter aus der Gegend oder mindestens von West-Finnmarken zu nehmen.

Ich muß leider sagen, daß mein Eindruck von den Einwohnern, die ich gesehen habe, und auch die Erfahrung anderer Betriebsingenieure mit den Leuten hier nicht sehr günstig sind. Die Bevölkerung ist oft eine Mischung von Norwegern oder Finnen mit Lappen, oder auch von reinfinnischer Abstammung. Ich glaube, daß man alle oder die meisten Facharbeiter, wie Holzarbeiter, Motorarbeiter, Mechaniker, Elektriker, Grubenarbeiter (besonders Bohrarbeiter) und Flotationsarbeiter von einem anderen Grubengebiet wie z.B. dann, wo von den stillgelegten Gruben: Bossmo, Sofjell und Dunderland viele Facharbeiter arbeitslos geworden sind, nehmen muß.

Es wird wahrscheinlich vorteilhaft sein, die meisten Bauarbeiter für die Anlage nach Angebot an eine Baufirma in Hammerfest oder Tromsø zu übergeben. Den schwierigen Maschinentransport dagegen wird man wahrscheinlich am vorteilhaftesten selbst übernehmen, dasselbe gilt natürlich für Montage und Inbetriebsetzung der Anlage.

[illegible] AUFBEREITUNG

Die Aufbereitung für das Kepper.jordkupfererz wird heutzutage als eine einfache Flotationsaufbereitung gebaut werden. (Da nur Cu-Mineralien, nur ein Flotationskonzentrat). Man kann wahrscheinlich, weil es sich hier um kupferreiche Mineralien (Kupferglanz und Bornit) handelt, mit mindestens 35 % Cu im Konzentrat rechnen (siehe Bericht über frühere Aufbereitungsversuche von GOLDSCHMIDT).

Mit einem Ausbringen von 90 % und Roherz mit durchschnittlich 1,6 % Cu braucht man: 24,3 t Roherz per t Konzentrat. Die produzierte Konzentratmenge von 60.000 t Roherz wird also jährlich: 2.470 t, von 120.000 t Roherz 4.940 t jährlich mit 35 % Cu, ergeben.

Die oben genannte Berechnung ist natürlich keine endgültige und eine nur angenommene, reicht aber für die Abwägung der günstigsten Lage der Aufbereitung aus zum Vergleich der zu transportierenden Mengen Kupfermaterials.

Es gibt zwei Alternativen für die Lage der Aufbereitung:

I: Die ganze Aufbereitung wird im Grubengebiet und in diesem Fall so nah wie möglich am Förderstollen aufgestellt, ebenso wie Kompressor, Zerkleinerung und Dieselmotor (falls man nicht genügend elektrische Kraft bekommt).

II: Im Grubengebiet werden nur Kompressor und Backengrobbrecher aufgestellt (damit nicht zu grosse Erzstücke von der Grube mit der Seilbahn gefördert werden müssen). Feinzerkleinerung, Flotation und Kraftanlage werden beim Kepperfjord Kai gebaut.

Wenn I kann man mit hohen Hochspannungsstrom mit kurzen Leitungen von der Kraftstation arbeiten. Der Transport von der Grube zum Kai wird von etwa 2.500 t (5.000 t) Kupferkonzentrat jährlich, für welche Mengen eine Seilbahn nicht rentabel sein würde, mit Lastauto, das die andere für Grube und Flotation nötigen Materialien zurücknimmt, vorgenommen.

Nach II werden 60.000 t (resp. 120.000 t) Roherz mit 1,6 % Cu nach der Aufbereitung beim Kai transportiert und für diese Mengen kann nur eine Seilbahn in Frage kommen. Da die 2 Kraftverbraucher Grube und Aufbereitung getrennt liegen, muss ein Hochspannung zwischen Kepperfjord Kai und Grube gebaut werden. Was die Seilbahn betrifft, so kann diese entweder in gerade Linie über die Gebirge wie auf der Karte von SCHMIDT gezeigt wird oder durch das Kristal zur Mündung des Kepperfjordelvs an der Fjord gebaut werden. Nach vorgenommenen Untersuchungen und nach Erfahrungen von anderen norwegischen Gruben muss von dem Bau

The Copper Ore Deposits

on

1283

U l v e r y g g e n M o u n t a i n,

near

Ripperfjord, Finmarken.

Detailed Description of Development Work.

THE JOHN'S MINE.

Underground work

The tunnel T /see sketch 1/ which gives access to the Johns Mine is about 8.800 feet S.W. from the shore of the fjord, on the line of the strike of the lode. It is between the Erik's tunnel N.E. and the Clie's tunnel S. W. at a distance of 980 feet from the former and 1.100 feet from the latter. The elevation of the surface above the John's tunnel is 1.270 feet above the sea, while the tunnel itself is 80 feet below the outcrop of the lode. A Shaft /S/ has been sunk from the tunnel level about 60 feet deep. The lowest present ore exposure in this mine is , therefore, 140 feet below the surface. The tunnel has been driven into the mountain side almost perpendicularly to the strike of the lode.

At a distance of 44 feet from the mouth of the tunnel drifts have been run N. E. and S. W. on the strike of the lode, due north and due west respectively, the former 100 feet long, the latter 90 feet, The N. E. drift /D.N. passes through good ore its entire length, with the exeption of 18 feet, samples of which returned only 0,33 % copper. The first 60 feet of the N.E. drift from the tunnel contain 3,52 % copper. then follow 18 feet containing 0,33 % copper, and finally 24 feet containing 1,25 % copper. The whole block, 100 feet long, contains therefore, an average of 2,42 % copper.

At the N.E. end of the drift, cross-cuts have been driven N.W. and S.E., the former about 13 feet long, the latter

35 feet. At the S.E. end of the latter an upraise /U/ has been made to the surface. A poorer zone commences, evidently at the line of these cross-cuts. Samples from them returned from 0,1 to 0,7 % copper only.

Near the junction of the tunnel and drifts, the above-mentioned shaft /S/ has been sunk in pay ore.

The drift /D.W./ extends S.W. from the tunnel for a distance of 90 feet, but is not sufficiently mineralised to justify ore extraction. The samples taken here average about 0,2o % copper. At the S.W. end of this drift a cross-cut /C2/ runs N. W. for a length of about 90 feet. The first 20 feet of this crosscut from the south W. drift /B.W./ are poorly mineralised, containing about 0,2o % copper. Put at this point the mineralisation commences to increase in value until it rises to 0,5, 0,6, 0,8 % copper, reaching 3,15 % at a point 37 feet from the starting point of the cross-cut /C2/, at its junction from the S.W. drift /B.W./. At this point a drift /D1/ has been run S.W. through good ore for a length of 90 feet. The first 30 feet of this drift going S.W. from the cross-cut /C2/ contain 2,14 % copper, the next 30 feet, 2,31 copper, while the remaining 30 feet to the face of the drift returning 1,61 % copper, resulting in an average of 1,95 % for the whole drift, the face still being in good ore, containing 1,7 % copper. The cross-cut /C2/ continues from this drift /D1/ about 50 feet N.W. mineralised to the face, the samples returning an average of 1,62 % copper.

The adit level /T/ leading into the mine has also been extended N. W., but its direction bearing heavily S.W., it passes soon into the area of poorer mineralisation. While the assay returns for the first 25 feet of the tunnel extension showed 2,o1 % copper, the average of the remaining 55 feet is only 0,7 % copper, resulting in an average of 1,13 % copper for the whole length of the cross-cut.

Ore being exposed N.E. and S.W. of the tunnel, a bore hole was started near the junction of the tunnel, and drifts in a direction S. 87° W., dip -- 44° from the horizontal. This bore-hole is driven therefore, through and immediately below the zone of poorer mineralisation between the two ore bodies exposed in the tunnel level. The first 14 feet of this bore-hole passed through ore containing

2,50 % copper. The value then decreased gradually, passing through a zone of poorer mineralisation for a distance of 46 feet, when it reached ore again, containing, however, only 0,87 % copper. After penetrating this for a distance of 60 feet it reached a zone of poor mineralisation and was abandoned after reaching a total length of 273 feet.

To ascertain wherher this decrease in value was local or permanent, another bore-hole was driven. For a distance of 35 feet from the orifice the cores averaged 1,84 % copper, decreasing thence gradually in value to 0,6 and 0,4 % and, after a total depth of 65 feet had been reached, the hole was abaudoned.

SURFACE WORK.

Nine cross-cuts, from 50 to 280 feet long, constitute the development on the surface of the John' s Mine. The lode is plainly exposed, and is easily followed. The farthest ore exposed N.W. is 514 feet from the mouth of the John's tunnel in cross-cut II. /about 135 feet long/, in a direction perpendicularly to the strike of the lode. The N.W. limit of the lode, the hanging wall , has, however, not been reached here so far.

The mineralisation in this cross-cut II. is poor, averaging about 0,5 % copper, although for a small distance this cross-cut returns 1,1% copper, indicating, possibly, the starting pint of a block of richer mineralisation.

Immediately S.E. from cross-cut II. and at a distance of about 40 feet N.E. on the strike of the lode, a cross-cut /I/ 78 feet long exposes the ore again. For about 30 feet at its N.W. end, practically on a continuation of cross-cut II., the mineralisation is poor, starting with 0,5 % copper, but rising in value gradually in its S.E. direktion until it reaches 1 % at a distance of 30 feet, increasing in value until it reaches 3,6 % copper for the last 15 feet.

About 40 feet of the S.E. end of this cross-cut /I/ return an average of 1,5 % copper.

Immediately S.E. from this cross-cut the lode crops out boldly.

About 180 feet N.E. from the N.W. end of cross-cut /I/ and parallel with cross-cut /III./ has been driven, running about

100 feet N.W. The average mineralisation of this cross-cut III, is 0,62 % copper while it averages 1,5 % copper for a distance of about 30 feet in the N.W. end of the cross-cut.

About 173 feet N.E. on the strike of the lode from cross-cut III., or about 400 feet N.E. from cross-cut II., a long cross-cut /IV/ has been driven for a length of 280 feet through a zone of poor mineralisation, averaging about 0,5 % copper. For a length of about 35 feet at its N.W. and the samples returned 1,32 % copper.

About 300 feet S.W. from the Johns tunnel, a cross-cut /V./ 165 feet long, has been driven through a zone of poor mineralisation, returning a little over 0,1 % copper.

Parallel with this cross-cut and at a distance S.W. of about 130 feet from the John's tunnel, cross-cut VI., about 65 feet long, exposes ore containing 1,76 % copper for a length of about 30 feet in its N.W. half, or 1,23 % for the whole length of the cross-cut.

Almost immediately above the John's tunnel a cross-cut / VII. / about 55 feet long, exposes good ore in its entire length, containing 2,53 % copper.

Crosscut IX., about 50 feet long, driven above the N.E. part of drift D.N., marks evidently the transition of this richer block into a poor block of ore again. It contains only 0,61 % copper while in its continuation N.W. , cross-cut /VIII./, about 100 feet long, traverses the same poor block of ore, containing not much more than traces of copper.

The result of the sampling of the John's Mine show unmistakeably that, while the whole lode is mineralised, blocks of richer mineralisation in this ore zone alternate with those of poorer mineralisation. The assay returns demonstrate that in all blocks the richest ore is about in the centre of the block for some distance, decreasing in value gradually in each direction until the limits of the richer blocks merge into the poorer blocks.

The distance between the furthermost S.W. ore exposure on the John's Mine and the furthermost N.E. ore exposure on the adjoining Olle's Mine is about 400 feet. No exploratory work of any description has been done in this space, although the lode crops out boldly and promising.

The destance between the furthermost N.E. ore exposure on the John's Mine and the furthermost S.W. ore exposure on the adjoining Erik's Mine is about 550 feet. No exploratory work of any description has been done in this space.

Ore probably in Sight.

Block P.--- This block is exposed underground by the drift /D.N./ for a length of over 100 feet, averaging 2,45 % copper. It is again exposed on the surface in cross-cut VII. The limit of the present ore exposures in the John's Mine at depth is 60 feet below the tunnel level, or 140 feet below the apex of the lode.

To prove the continuation of this ore body, as exposed at the surface and at the tunnel level, a bore hole was driven by a diamond drill near the junction of the tunnel, and drifts pointing N. 48° W. at an angle of 26° from the horizontal. This bore hole is 126 feet long, and it penetrates pay ore for a distance of 33 feet averaging 1,3 % copper. After passing for a further distance of 30 feet, through a zone of poor mineralisation containing 0,2 % copper, it reaches pay ore again containing 1,46 % copper, which is penetrates for a further distance of 26 feet. At this point it reached a zone of poorer mineralisation again, and was abandoned after reaching a total length of 126 feet. Assuming then, that the further development work proves the reasonable assumption correct, that the ore blocks between the present limits of their exposure maintain their characteristics throughout, we should have a block of ore here for extraction 100 feet long, 56 feet wide and 140 feet deep, or 56.000 tons of ore at an average of 2,18 % copper per ton.

Block P I.--- This block is exposed underground by the S.W. drift /D.I./ for a length of about 100 feet, by a cross-cut C 2 for a length of about 50 feet, and on the surface for a length of about 35 feet. This would represent, under the assumption stated above,

a block of ore 100 feet long, 140 feet deep and 85 feet thick, or 85.000 tons of ore at an average of 1,86 % copper per ton.

Block 3.----- The only ore exposure representing this block we find is cross-cut I., on the surface for a length of about 50 feet, and in cross-cut II. for about 20 feet. It should be noted that the average mineral contents for this 50 feet in cross-cut I. is 1,7 % copper, the value of the mineralisation increasing from 1 % at the N.W. end of the ore exposing part of the cross-cut to 3,6 % at the S.E. end of the same part.

It appears, therefore, reasonable to assume, having due regard to the characteristics of the ore blocks which are at present known to a greater extent, that the cross-cut has only exposed one-half of the thickness of the ore block. It would, however, be beyond the limit of conservatism to state that we have a block of ore here 100 feet square and 140 feet deep, representing 100.000 tons of ore, but it is a possibility so strongly indicated by the characteristics of the more developed ore bodies in this property, that a disappointment may be lokked for only remotely. With due regard to the limited development, we are justified, however, to assume here the existence of an ore body at least 50 feet by 100 feet in area, representing about 360 tons of ore to each foot in depth, or 50.000 for a depth of 140 feet, the present lowest ore exposure in the John's Mine. This block of ore would average 1,53 % copper.

Block 4.--- The ore exposures in cross- cut III, and IV., about 50 feet long each, and a distance of 175 feet apart on the strike of the lode , showing their greatest values in their present N. W. face, warrant /under the same reservations as those stated in regard to Block 3 / the assumption that we have here an ore body of an area of at least 50 feet by 175 feet, representing 625 tons of ore for each foot in depth, or 87.000 tons for a depth of 140 feet.

An examination of sketch 1, showing the present development work at the Johns Mine, shows that between the ore blocks indicated by the surface cross-cuts and the underground work, a large virgin territory remains, where further prospecting work will undoubtedly uncover additional ore bodies.

The contour of the ground permits of a tunnel being driven

into the mountain side at least 200 feet deeper than the present tunnel, hwich would tap the lode at about 300 feet below its apex. This tunnel would be nearly 1.000 feet long.

THE ERIK'S MINE.

At a distance of about 1.000 feet N.E. on the strike of the lode from the John's tunnel, is the adit T, which leads into the Erik's Mine. The surface above the tunnel is at an elevation of 1.160 feet above the sea, or 110 feet lower than the surface of the John's tunnel. The Erik's tunnel is about 80 feet below the surface. It is driven into the mountain side at practically right angles to the strike of the lode. A shaft /S./ has been sunk from the tunnel level to a depth of 70 feet. From the bottom of the shaft a cross-cut /C/ runs N.W. about 35 feet long.

The ore has been exposed in this mine, therefore, for a total depth of 150 feet from its apex, or 120 feet lower than the lowest ore exposure in the John's Mine.

The tunnel /T/ cuts the footwall of the lode at a distance of about 30 feet from its mouth. Strike and dip are here practically identical with those measured at the John's Mine, i.e. N.42° E., for the strike and 78° N.W. from horizontal for the dip.

At a distance of 43 feet from the mouth of the tunnel drifts have been driven N.E. and S.W. /D.N. and D.W. respectively/ about 70 feet long each. The N.E. drift /D.N./ passes for a distance of 50 feet through good ore, avereging 4,1o % copper. Ten feet in about the centre of this 50 feet stretch of ore return an average of 4,53 % copper, where the ore assys almost 5 % copper.

The remaining 20 feet of the N.E. drift /N.D./ to the face contain 1,69 % copper, the value decreasing gradually towards the face of the drift from 3 % to 0,9 copper, the latter at the face of the drift. The whole length of the drift /70 feet/ averagee, therefore, 2,7 % copper.

The S.W. drift /D.W./ contains for a length of 30 feet from the tunnel 3, % copper, decreasing in the last 12 feet from 3 % to 1,4 % copper.

The following 25 feet S.W. average 0,69 % copper, decreasing gradually in value in this distance from 1,4 % to 0,5 % copper. The average copper contents of the ore block exposed in the S.W. drift /D.W./ for an length of 55 feet, is therefore 1,95 % copper.

At the N. E. end of the drift D. W. it meets another tunnel /TI/ about 40 feet long, parallel to the first-mentioned tunnel /T/ From the drift /D.N./ this tunnel/T.I./ runs S.E. in ore xkxxkx containing 0,63 % copper, to the footwall of the lode, a distance of about 10 feet. About 20 feet S.W. from the face of the N.E. drift /D.N./ a cross-cut/C 1/ has been drivne N.W. 40 feet long , entirely in ore averaging 1,67 % copper. An upraise /U/ has been raised from this cross-cut to the surface at a point about 15 feet from its junction with the N.E. drift /N.D./ This upraise is entirely in ore averaging 2,36 % copper.

This tunnel /T/ has been extended N.W. for a length of about 70 feet.

The samples taken here average 1,24 % copper.

In the S.W. drift /D.W./ at a point about 50 feet S.W. from the tunnel /T/ a cross-cut /C 2/ has been driven N.W. 30 feet long. The samples taken in this cross-cut average only 0,35 % copper.

At the end of the S.W. drift /D.W./, at a distance of 80 feet S.W. from the tunnel, a cross-cut /C 3/, 35 feet long, has been driven N.W., and another cross-cut /C 4/, 33 feet long, runs S.E. At the same point the drift sometimes , turning gently northerly, running almost due west for a further 66 feet. Both cross-cuts and the continuation northerly of the S.W. drift /D.W./ are in a block of poor mineralisation /P.1/ containing about 0,25 % copper.

SURFACE WORK AND ORE PROBABLY IN SIGHT.

By the underground development work at the Erika Mine, a block of ore has been opened up, exposed by two shafts from the surface to a depth of 150 feet, and by several drifts and cross-cuts. The block within the limits of the present ore exposure is 125 feet long, 85 feet thick and 150 feet deep — representing over 110.000 tons of ore containing 1,90 % copper.

At the surface, near this block of ore, S.W., a cross-cut /II./ has been driven about 125 feet long. For a distance of 80 feet this cross-cut contains 1,15 % copper, while 38 feet of this distance can be extracted assaying 1,9 % copper. The remainder of the cross-cut being poorly mineralised, contains from 0,1 % to 0,2 % copper only.

At a distance of about 350 feet S.W. from the Erik's tunnel /T/ and about 170 feet N.W. from its mouth, a cross-cut /1/, 60 feet long exposes good ore in about 35 feet of its length. The ore averages 1,77 % copper, the values commencing in about the centre of the cross-cut with 0,3 %, increasing going N.W. the last 20 feet, averaging 1,87 % copper, the richest ore being found in the N.W. face of the cross-cut, containing , 2,41 % . We find here again the characteristic indications of an ore body, the values increasing to a maximum towards centre and decreasing towards the limits of the ore body.

Under the same assumptions which were explained in the descriptions of similar ore exposures in the John' s Mine, we may reasonably expect a considerably body of good ore here, but the limited development does not justify a definite expression as to ore in sight.

Compared with other parts of the property S.W. the surface work at the Erik's Mine is very limited , although the lode crops out blodly along the surface and looks very promising. Only the two cross-cut mentioned have been made here, leaving an unexplored space of over 300 feet between them.

N.E. of the Erik' s Mine an attempt at exploration has been made at the Johannes Claim only, leaving a virgin strip of over 7.000 feet between this claim and the Erik' s Mine. The lode crops out and can be easily followed over the whole distance.

THE OLLE' S MINE.

Tunnel.--- At a distance of 1.100 feet S. W. on the strike of the lode from the tunnel leading into the John's Mine, the Olle's tunnel has been driven into the mountain side. Five hundred feet of territory in this distance has not been prospected at all. The tunnel is about 600 feet long.

The elevation of the Olle's tunnel is 1.328 feet. It is about 150 feet below the outcrop of the lode, and about 50 feet higher than the John's tunnel and 170 feet higher than the Erik' s tunnel.

The Olle's tunnel has been driven across the lode through poorly mineralised ground, cutting, however, at a distance of about 350 feet from its face, an ore body about 30 feet long, in the tunnel, containing 1,28 % copper. It is not worty that immediately above the tunnel but some distance further S.W., an ore body of considerable expent is exposed /in surface cross-cuts IV and V/. of which the ore exposure in the tunnel represents undoubtedly the N.E. limit.

The object of the owners of the mine of driving the tunnel has evidently been to tap the large ore bodies exposed in cross- cuts IV and V. Running parallel to them, however, it will be necessary to run short drifts S.W. to obtain the same results. It is understood that this has been the original intention.

To prove the existence of the ore body at the depth of the tunnel, a drift was run S.W. below the ore body exposed on the surface by cross-cut V. At the conclution of the writer's last visit to the property in November last, this drift had reached a length of about 6 feet. Samples taken at the face of the drift at that time contained a little over 1 % copper, justifying the assumption that the ore body exposed at the surface in cross-cut V. had been tapped. This drift is now being extended.

Surface work and Cross-cut IV and V.— Immediately above the ore exposure in the tunnel, but some distance S.W. from it, surface cross-cut IV., about 135 feet long, passes through ore containing 1,39 % copper, for a distance of 80 feet. In the immediate continuation of this cross-cut N.W., but at a distance of about 30 feet S.W., crosscut V., about 300 feet long, has been driven, exposing good ore for about 70 feet in its S.E. end. The ore exposure in these two cross-cuts belong evidently to the same body, and contain 1,38 % copper. N.W. beyond this ore exposure in cross-cut V., ~~anotherxzone~~ after passing a zone of poor mineralisation for about 100 feet, another ore body is opened up, showing a with of 120 feet. The samples taken here average 2,06 % copper. This is the ore body referring to above as having probably been tapped by the drift now being

driven below it, S.W. from the tunnel level.

Cross-cut III and Cross-cut II.--- Parallel to the tunnel and to cross-cut V., and fully 200 feet N.W. from them, cross-cut III., 250 feet long, passes at its S.E. end a good ore body for a length of 60 feet. The samples taken here average 2,56 % copper. Beyond this ore body N.W., a poorly mineralised zone is passed, but in the immediate continuation S.E. of the ore body exposed in cross-cut III, the same ore body is opened up in cross-cut II. /100 feet long/ for a length of about 70 feet, averaging 1,6 % copper, although at its N.W. end it contains over 2 % copper, decreasing in value gradually southwesterly.

Cross-cut I.---- About 200 feet east from cross-cut III, an ore body is exposed in cross-cut I. /80 feet long/, for a length of about 20 feet, containing 1,52 % copper. This ore-body represents either the east limit of the ore-body exposed in cross-cut III. and II., or of another ore body further east, which has not been prospected so far. The territory between cross-cut I at Olle's Mine and the nearestopening east at the John's Mine, a distande on the strike of the lode of over 500 feet, has not been explored.

Ore in sight.---- The work at the Olle's Mine has undoubtedly exposed large and valuable ore bodies, the exploitation of which will result most profitably. It is to be regretted that the long tunnel should have been driven without disclosing at depth the character of the ore bodies exposed in cross-cut V.

The drift which is now being driven S.W. from the tunnel level appears, however, to have reached the N.E. bounary of the body exposed in cross-cut V, as intimedted above. Further development is required to prove the correctness of this conclution, although the probability may be assumed with justification. Assuming this ore body to extend to the tunnel level, over 150 feet below the surface, we would find here a block of ore, at least 100 feet thick, 200 feet long and 150 feet deep, representing 210.000 tons , containing /at the surface/ 2,06 % copper.

The tunnel has evidently been cut through the east limit or the ore occasionally, but penetrating a zone of poor mineralisation.

Cross-cut I.---- About 200 feet N.E. from Cross-cut II,

body exposed in cross-cut IV.

Block B. ---------- The ore exposure in the S.E. end of the cross-cut V., the N.W. end of the cross-cut IV. and in the tunnel, belong evidently to the same ore body.

The Extreme limits of its exposure are, therefore, on the line of the strike between cross-cut V and the tunnel level, 70 feet perpendiculary to the strike from its N.W. exposure in cross-cut V., to its S.E. exposure on cross-cut IV., 150 feet, representing a block containing 112.000 tons, averaging 1,36 % copper.

Block B. 1.------- The ore opened up in cross-cut II and III belongs apparently to the same ore body. The extreme exposure are from its N.W. limit in cross-cut III. to its S.E. limit in cross-cut II., 130 feet, and along the strike direction of the lode from cross-cut III to cross-cut II., about 100 feet, representing an area of 13.000 square feet, or over continues at depth of the tunnel level, the present lowest ore exposure in this mine, this block would contain 140.000 tons of ore.

The ore exposure in cross-cut I is not sufficient of since to form the base of speculative calculation, beyond the reference made to it above in the description of the work performed.

Large areas within the present development work at the Olle's Mine have not been prospected. Further ore bodies will undoubtedly be found here, if the lode is thorcughly explored.

TRIANGELN AND SEGMENTED MINES.

Tunnel and cross-cut II.--- About 600 feet N.W. from the Olles tunnel the Triangeln tunnel has been driven into the mountain side. The tunnel is only about 20 feet long, at an elevation of 1.350 feet above the sea, and about 100 feet below the outcrop of the lode. It is immediately below a surface cross-cut II., 300 feet long. This cross-cut passes through ore the whole distance, averaging 1,7 % copper.

Segmented Shaft.---Near its N.W. end an inclined shaft the Segmented, has been sunk to a depth of about 50 feet, passing ore occasionally, but penetrating a zone of poor mineralisation.

Cross-cut I.---- About 170 feet N.E. from Cross-cut II,— a similar cross-cut I has been made, paralleling the former, about 500 feet long. Excepting a stretch of about 20 feet near the middle

of the cut, where the samples returned 1,4% copper, the cross-cut passes through poorer mineralised ground, increasing gradually in value to apoint about 100 feet from the N.W. face of the cross-cut where the mineralisation has reached 1 % copper, and continues to the N.W. end of the cross-cut, averaging 1,1 % copper.

Cross-cut III and IV.----- Immediately S.W. of the N.W. end of the cross-cut II, at a distance of 100 feet, two cross-cuts III and IV have been driven adjoining each other so closely that they may be regarded as one continous cross-cut. The combined length of these cross-cuts is 100 feet. They have been driven entirely in ore, assaying 1,87 % copper.

Cross-Cut V.---- About 150 feet S.E. from cross-cuts III and IV., and about 130 feet S.W. from cross-cut II., ore is exposed again in cross-cut V., about 35 feet long, averaging 1,35 % copper.

Cross-cut VI.---At a distance of about 260 feet S.W. from cross-cut II., parallel in the latter, cross-cut VI, about 200 feet long, passes through orein the S.E. half of the cut, averaging 2,06 % copper for a length of 100 feet, while about 50 feet in the N.W. half, direct continuation, return 1,4 % copper. The whole cross-cut contain over 1 % copper, while 150 feet of it average 1,8 % copper.

To prove the continuation of the ore body as exposed on the surface, a bore hole was driven into the mountain side by a diamond drill, pointing N 40° W. at an angle of 10°. At a distance of 10 feet the ore was encountered, containing 0,5 % copper. As the hole proceeded. the grade of the ore increased until at a depth of 130 feet the core assayed 3,12 % copper, decreasing thence in value in the next 65 feet, where the core assayed 1,4 % copper. Beyond this point a zone of poorer mineralisation was reached, and after reaching a depth of 400 feet, having passed an additional ore body 65 feet thick, containing 1,6 % copper, it was discontinued, although the limit of the mineralbearing zone exposing ore bodies at the surface had not been reached.

This bore-hole has exposed two ore-bodies, 120 and 65 feet

thick respectively, averaging over 1 % copper or /leaving out the lower ores near the orifice of the hole / 80 feet and 65 feet thick respectively, containing 1,64 % copper.

Ore in sight.------- The openings made suggest that we are here in the presence of an immense ore body, bounded by cross-cut II at the Triangeln and cross-cuts I. and III. at the Kvadraten on the line of the strike of the lode, 400 feet, and by cross-cuts III. and IV., and the Triangeln tunnel, 300 feet, perpendicularly to the strike, representing an area of 120.000 square feet, which would furnish for each foot in depth about 8.500 tons of ore.

Assuming, then, that the ore continues at depth to at least the tunnel level, 100 feet, without change, the block would furnish 850.000 tons of ore containing 1,6 % copper.

Cross-cut I ------ In the absence of further development throwing light on the extent of the ore body exposed in cross-cut I., a statement as to the probable amount of ore represented by it would not be justified. Having in view the characteristics of the more fully developed ore bodies on the property, the comparatively low mineralisation of the ore exposure in cross-cut I would suggest that it forms either the N.E. limit of the big ore body /B/ described above, or that it represents the S.W. limit of a new ore bpdy.

KVADRATEN MINE.

Tunnel.----- About 450 feet S.W. from the Triangeln tunnel the Kvadraten tunnel exposes, at a depth of about 100 feet below the outcrop of the lode. The tunnel is 230 feet long, at an elevation of 1.335 feet. It is, therefore, 350 feet higher than the lower ore exposure in the Erik's Mine. The mineralisation commences at the mouth of the tunnel, and increases until it reaches about 1 % copper, at a distance of about 30 feet continuing for about 120 feet, where it passes into poorly mineralised ground again. The samples taken of the ore body return 1,33 % copper.

SURFACE WORK.

Cross-cut I and II.------ immediately N.E. from the tunnel and on a line with the ore body exposed therein, surface cross cuts I and II have been driven , 75 and 120 feet long respectively

Cross-cut I passes ore /over 1% copper/ in its entire length, while the last 50 feet N.W. contain 1,30 % copper, some samples near the N.W. face returning 2,52 % copper. Cross-cut II. practically a direct continuation of cross-cut I., runs entirely in ore averaging 1,6 % copper.

Cross-cut III. ------- At a distance of 140 feet S.W. from the tunnel, cross-cut III. has been driven, about 40 feet long. Although the samples taken here returned about 1 % for the whole length of the cross-cut, only about 20 feet in the centre averaging 1,25 % copper.

Cross-cut IV. ---------About 80 feet S.W. from cross-cut II. cross-cut IV., about 40 feet long, traverses ore at its S.E. half for length of about 20 feet. This ore contains 1,1o % copper, although the average of the whole cross-cut yields about 0,9 %.

Cross-cuts V and VI.------These cuts, lying in a depression of the ground, could not be sampled at the time of the writer's visit being filled with water, which, on account of snow covering the depression could not be conveniently cleared. Samples taken here on a former occasion by two well-known engineers, returned 1,40 % copper for about 30 feet at the S.E. end of the cut V., and 1,52 % copper for about 40 feet at the S.E. end of the cut VI.

Crosscuts VII and VIII.----about 100 feet S.W. from cross-cut VI., cut VII and VIII., about 100 feet long, have been driven practically a direct continuation. The samples taken here returned 1,23 % copper for cut VIII, and 1,66 % for cut VII, averaging 1,1% copper for the whole distance of 100 feet.

Ore in Sight.------ The Kvadraten tunnel and cross- cuts I and II have opened an ore body, which between their present limits measures about 60 feet, along the strike of the lode, and 200 feet at right angles to it, an area of 12.000 square feet, representing about 850 tons of ore to each foot in depth. Assuming that this ore body continues at depth without change to the tunnel level, where it is also exposed, this block would yield

85.000 tons of ore, averaging 1,44 % copper.

Cross-cuts III to VIII.----- The ore exposures in cross-cuts III to VIII are not of sufficient size to justify a speculation as to an amount of ore they might represent to the depth of the tunnel level. Bearing in mind the characteristics of the more fully developed ore occurrences in this lode, in conjunction with fact that the ore exposures in cuts III to VIII are at the S.E. end of the cuts, and that the mineralisation is comparatively poor where exposed in cuts IV. and VII, situated furthest N.W. and richer in cuts V. and VI, situated further S.E. , it may justly be conjectured that further developments S.E. and S.W. will demonstrate the existence of one or more large and well-mineralised ore bodies.

VESTRA FALTET EAST.

Tunnel. -------- Between the last south-westerly surface cross-cut of the Kvadraten Mine and the first North-easterly cross-cut on the Vestra Faltet East, is a virgin territory of over 1.000 square feet. The lode crops out boldly and promising in this space, but no prospecting work of any description has been done here.

An attempt has been made to tap the ore bodies at depth at the Vestra Faltet East Mine by the Heyermann's tunnel. This tunnel has been driven into the mountain slope, at a distance S.E. of about 500 feet from the surface ore exposures. The tunnel is said to have reached a length of 60 feet, and to have passed through good ore. It could not be inspected, its mouth being so inconveniently situated that it was covered with snow and debris at the time of the writer's visit, in such a manner that the task to uncover it would have been most laborious and difficult.

The tunnel mouth is at an elevation of 1.400 feet, and would tap, if extended, the ore bodies exposed in the surface cross-cuts at a depth of about 150 feet.

SURFACE.

Cross-cut I.----- The furthermost N.E. ore exposure of this time is in cross-cut I, 170 feet long, where for a length of about 50 feet at its N.E. end it averages 1,33 % copper, while the last 30 feet the N.W. face return 1,64 % copper.

Near the N.W. end of this cross-cut, in the section which ret 1,64 % copper, a shaft has been sunk about 30 feet deep entirely in ore.

Cross-cut II.----- At a distance of about 180 feet S.W. from cross-cut I, a surface cut II, 120 feet long, has evidently been driven in a zone of poor mineralisation. The samples taken here average about 0,15 % copper.

Cross-cut III.-----About 130 feet further S.W., cross-cut III, about 100 feet long, exposes ore throughout. The samples taken here average 1,55 % copper, although for some distance from 2,5 to 3,2 % copper were recorded.

In the section near the N.W. end of this cut, which returned 2,5 % copper, a shaft has also been sunk to a depth of about 30 feet.

Cross-cut IV.----- With the exeption of cut A in this group which contained 1,5 % copper, the small cuts in this group are poorly mineralised, averaging only 0,80 % copper.

Ore in Sight.------- The only ore exposures which justify a speculation on a certain amount of ore they might represent to the depth of the tunnel level, are those in cuts III and IV A, which probably belong to the same ore body. In this case there would be an ore body here between the limits of the present ore exposures in the two cuts, 160 feet long, on the strike of the lode, and of a thickness equal to one half of the total length of the exposure in the cuts perpendiculary to the strike, 60 feet representing an area of 9.600 square feet, which will yield 680 tons of ore to each foot in depth. Assuming that this ore continues without change in its characteristics to the tunnel level, this block will contain about 100.000 tons of ore, containing1,55 % copper.

A block of poor mineralisation adjoins this block, again N.E. and S.W., exposed by cuts II and the four south-easterly cuts of the group IV respectively.

N.E. from cut II a good block of ore is evidently exposed again in the N.W. half of the cut I. But this being the only exposure, a suggestion as to any amount of ore it might represent would

be hazardous.

In the light of the above mentioned and repeatedly referred to characteristics of the ore occurrences in this lode, as indicated by the more fulle developed ore bodies, it can not be doubted that cut IV A and cut III are in the S.E. part of an ore-body, which will continue N.W. and that the ore exposure in cut I is also leading into a well mineralised ore body N.W. In cut III, as well as in cut I, the value of the ore increases gradually towards the N.W. reaching the highest value at their N.W. face.

VESTRA FALTET MINE WEST /Sketch VII/.

Cross-cut I.----- About 120 feet S.W. from the group of the cuts IV at the Vestra Faltet East Mine, we find the first ore exposure on the Vestra Faltet West Mine in the surface cross-cut I, about 200 feet long. The ore in this cut is poorly mineralised, containing about 0,5 % copper, with the exeption of about 20 feet in about the centre, which returned 1,85 % copper.

Cross-cut II and III.--- Cuts II and III, almost due N.W. from cut I, with a combined length of about 80 feet, are in a poorly mineralised zone, containing 0,3 % copper.

Cross-cut IV.------ Cut IV, about 20 feet long, contains only 0,6 % copper.

Cross-cut V.------ Cut V, about 100 feet long , is also in a zone of poor mineralisation at its S.E. half, but contain 1,4 % copper in the last 40 feet at its N. W. end.

Cross-cut VI.---- Of the group of cuts, VI only, the most north-westerly cut, shows abpve 1 % copper, returning 1,15 %. The remaining three contain from 0 25 % to 0,6 % copper.

Ore in Sight.------ The development work at this mine is not sufficiently advanced to warrant any suggestion as to a possible amount of ore indicated by the ore exposures. It is probable that the ore exposures in cut V and the most north-westerly cut of group VI belong to the same ore body. Only further development can demonstrate this.

/Signed/ Otto Stalmann.

London, January 12 th, 1913.

rges Geologiske Undersøkelse
Josefinegt. 34 - Oslo
E EHo

Oslo, den 17. oktober 1955.

Geolog Peter Padget

Norges geologiske undersökelse

O s l o.

Bestemmelse av Cu i 5 pröver fra Ulveryggen, Repparfjord.

Pröve merket:			Cu
554,	Trench	VI	0,76 %
555,	"	XI (1).....	1,12 "
556,	"	XI (2).....	0,49 "
557,	"	XI (3).....	0,91 "
558,	"	XI (4).....	0,45 "

Bestemmelsen er utfört av Erna Christensen.

Brynjulf Brun

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Oslo, 3/11.55

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Norges geologiske undersökelse.

O s l o.

Bestemmelse av Cu i pröve merket Ulveryggen, Repparfjord.

Trench XI.

2,87 % Cu

Bestemmelsen er utfört av Irma Christensen.

Bjørn Jeff Brunn

Norges Geologiske Undersøkelse
Josefines gate 34
Sentralbord 69 57 90

Oslo, den 14. novbr. 1955

EC/EHo

Geolog Peter Padget,
Norges geologiske undersökelse.
O s l o.

Bestemmelse av Cu i pröve fra Repparfjord, Trench XI,
1, 2 , 3, 4. Nr. 582.

0,73 % Cu.

Bestemmelsen er utfört av Erna Christensen.

Erna Christensen.

Norges Geologiske Undersøkelse

Josefines gate 34
Sentralbord 69 57 80
EC/EHo.

Oslo, den 20. oktober 1955

Geolog Peter Padget,
Norges geologiske undersökel[illegible].
O S L O.

Bestemmelse av Cu i 3 pröver fra Kepparfjord.

Pröve merket			Cu
560	Trench I (1)	.....	<0,03%
561	" (2)	.....	<0,03%
562	" XI kopperrik sone	..	1,41%

Bestemmelsene er utfört av Erna Christensen.

Bergvesenet

Utdrag av rapport av C. W. Carstens

REPPARFJORD KOBBERMALMFOREKOMSTER (i Finnmark).

.... Forekomstene optrær i en eiendommelig sparagmitisk bergart vest for Repparfjordbotn på nordsiden av Ariselven i høider 3-400 m.o.h. .....

Den optrædende sparagmitskifer, som tilhører de såkalte Finnmarksformasjoner, fører overveiende kvarts, plagioklas, klorit og muscovit. Biotit, pyroxen og enkelte andre mineraler inngår leilighetsvis i mindre mengder. I veksellagring med denne bergart optrær hist og her mindre mektige fyllitbenker. En rekke mikroskopiske preparater synes å antyde at den gjennemsnitlige SiO_2 -gehalt i almindelighet ikke ligger stort over 75%. (Kvartsgehalten er i almindelighet 60-65%). Samtidig inngår forholdsvis betydelige kvanta alkalier.

På Ulveryggen, hvor hovedforekomsten finnes, er den forhåndenværende sparagmitskifer, som her optrær med vesentlig NE-lig strøkretning og steilt fall, over en lengde av 1.5-2 km og over en bredde av op til over 100 m (tildels litt forskjøvet i forhold til strøkets retning) mere eller mindre sterkt impregneret med kobberglans og brogetkobber. Et meget stort antall røskegrøfter (i alt ca 50) er her opskutt lodrett strøkretningen. Samtidig er der fra søndre dalside ansatt flere stoller i forbinnelse med forskjellige undersøkelsesdrifter, orter og synker. Samtlige stollmunner lå ved mitt besøk 13.juli helt tildekket av sne og gjorde stollene helt utilgjengelige.

En gjennemsnitsprøve fra Ulveryggens malmsone, representerende stuffprøver og uttatt i 1929 viser følgende kjemiske sammensetning:

2.16 %	Cu
81.83 %	SiO_2
8.39 %	Fe_2O_3
6.97 %	Al_2O_3
0.60 %	MgO
0.28 %	CaO

Da stufprøver ved forekomster av ovennevnte type kun gir et lite pålidelig holdepunkt for verdsettelsen av den forhåndenværende gang, bør ovenstående tall korrigeres ganske betraktlig. Man kommer da sandsynligvis til en kobbergehalt av gjennemsnitlig 1 å 2 %, kanskje tildels derunder, samtidig som SiO_2-gehalten likeledes vil synke ganske vesentlig.

Innenfor malmsonen viser bergarten på en rekke steder på sletter og sprekker malakitbelegg (i almindelighet regnet som indikator på impregnasjon av kobberglans og brogetkobber). I en rekke av de av de opsprengte røsker er imidlertid malakitgehalten sterkt vekslende, hvilket samtidig antyder en meget varierende kobber-gehalt. I større partier av malmsonen kan således kobbermineraler ikke påvises med det blotte øie eller luppe.

Forekomstenes utstrekning og utholdenhet mot dypet er forholdsvis ukjent, da samtlige drifter under dagen ligger temmelig nær dagoverflaten. De optredende kobbersulfiders stabilitet mot større dyp er imidlertid i de fleste tilfeller temmelig tvilsom.

Utenfor Ulverygen optrær sulfidimpregnerte sparagmitskifere av samme type på flere steder uten at disse dog synes å spille nogen betydelig rolle.

. . . . . .

HD. 797-1933 I.

F. B. 66 / 1933

HD.1359-1933 I.

Ripper jord Copper Mines

Report

by

Professor Johan H. L. Vogt.

24/8/07.

Translation.

The Ripperfjord Copper Ore Field.

at Ripperfjord in Kvalsund, south of Hammerfest, Finmarken Amt, Norway

Regarding location, transportation and communications the pamphlet issued by "Nordiska Grufaktiebolaget"/Ripperfjord Mines/ Östersund, Sweden, gives ample information. ~~Maps will only be compared.~~

The copper ore field is located about 40 km.S.E. of Hammerfest. The "sparagmite" ore deposits lie generally at a height of about 250/300 or 350 m. above the sea. Close by Ripperfjord, near the foreman's dwelling house, is good space for the erection of Works. A projected ropeway from the Eric's mine to this place will be 1½ km. long and from the Johns mine and the Ollies mine the distance is in a straight line about 1650 and 1800 m. respectively.

There is in the neighbourhood of the place for the proposed works available waterpower /by damming &c./.

The mining at the main deposits /the "sparagmite ore"/ can for a long time be carried on by adit driving.

Details as regards altitude, distance, water fall district &c. can be had from a map which the Company at present is preparing in scale 1-4000, but this map, however, was not completed at the time of my visit.

Geological Review.- Near the shore of the inner part of Ripperfjord and from here to Ulveryggen with surroundings and quite a distance to S.E. appears immense beds of quartz sandstone with conglomerate and "sparagmite".

At the Brathammeren mine and "Skiffergangen" /slate vein/ appears a green, at times very slaty, mineral which most likely is a transformed argillaceous schist, about which I will, however, not express my positive opinion. These beds belong to the formation which T. Dahl at the time called "Raipas" and are now supposed by many to be of devonian age. At other places in the contiguos district for instance at Kvalsund, in the neighbourhood of Näverfjord and near Altenfjord at Porsa /N.B. not at the mines/ appears very large deposits of dolomite.

At a distance of, to judge by the eye, a little more than 1 km.S.E. from Ulveryggen occurs a field of Serpentine.

According to what I know from earlier examinations there is

on the peninsula between Ripperfjord and the Ripperfjord valley in the East and Altenfjord in the West also large fields of gabbro and granite.

The quartz sandstone with appertaining layers of conglomerate and "sparagmite" is a hard, compact, somewhat transformed rock, which as a whole is of rather a monotonous character. It is as a rule comparatively small grained /i.e. with small grains of sand/. At several places are, however, layers of conglomerate or conglomerbreccia, seen, with only small edge worn stones, at Ulverygren often of a size of hazelnut /seldom larger/, and of sparagmite /i.e. layers with both grains of quartz and felspar/. The ore at Ulverygren is in everyday-vocabulary called "sparagmite" ore. This name has most likely its source from the fact that I, during my visit in 1903. saw a small working of ore in sparagmite, and for this reason I did at that time call the ore "sparagmite" ore, but "sparagmite" is not the dominating rock here. The ore could just as well be called sandstone ore. At Ulverygren and the nearest surroundings the strike is very regular, about N.E. to S.W. nearest 35 or 40° - S35 or 40° and the dip is at Ulverygren steep towards N.W. I measured the dip at Erika mine and John mine to about 75°, at Olles Mine to 80 -85°. The small variations in the observations here I do not find worthy of any consideration. The result is that in the group of Erika mine - John mine - Olles Mine and the cuts S.W. of Olles Mine, strike and dip are very regular. At other places, consequently in profile, near the Ripperfjord, are on the other hand seen quite strong foldings with dip in various directions.

The width of the quartz sandstone section with appurtenant layers of conglomerate and sparagmite is quite large, at least 350 m. probably considerably more. The time did not allow me /topographical basis also being wanting/ to make up a geographical profile, which, however, at the present time would not be of any technical interest.

The boundary between the sand stone and the green, often schisty rock at "Skifferegnen" and the Brathammeren mine, runs about 50 meters North West of the Brath n Mine.

Geological comments re. the copper ore deposits.-

On the peninsular between the Ripperfjord, Ripperfjord valley in the East, Altenfjord in the West and Kvalsund in the North there are a whole series of copper ore deposits of various geological /or morphological/ characters. The occurrence of the ore is to an essential degree dependent upon the mechanical character of the surrounding rock.

There are accordingly,-

a) Typical ore veins, namely calcareous spar - quartz - veins with copper pyrites and sulphur pyrites. For instance, the Bruthammeren mine near Ripper jord, amongst others the Porsa veins.

b) So called schist veins, namely impregnations /infiltrations/ in slaty rock or slaty zones within certain rocks.

c) So called sparagmite ore in sandstone - conglomerate-sparagmite rock species.

It is easy to decide that the copper ore everywhere here is in a geological /genetic/ respect of a younger character and that it neither in the schist ore /skifferm lm/ nor in the "sparagmite ore was formed simultaneously with the rock in question. Especially as regards the "sparagmite"ore one finds fine streaks of ore veins intersecting each other all over in the rock indicating that the ore is infiltrated through the rock after its formation.

Geologically analogous ore deposits infiltrated or insifted in sand stone are found at various places abroad. Larger deposits of this character are on the contrary, as far as I can remember, not to be found in Norway or Sweden. In the sand stone, which originally must have been a more or less porous rock, the infiltrations quite often distributed themselves in the great number of pores through the whole rock. I want to distinctly point out that in dealing with the sparagmite ore there is not dealt with primary sedimentation of copper ore but with a secondary infiltration. This is richest in certain lenticular limited parts, as far as known by the direction in field of about the same strike and dip as the country rock, but it is not to be understood so that there are certain levels or sections of the country rock with the same copper percentage.

The impregnattion in the sand stone and so forth at Ulverygen can be followed for a length /mainly but not accurately reckoned along the strike of the country rock/ of 1 km. or more and there is occasionally -when the poor ore is taken in- impregnation of a width /vertically on the strike/ of about 100 m. At the small lakes and about S.W. of the cuttings in the continuation of Ulverygen near Olles Mine there is also to be found impregnation of sparagmite ore at quite a great distance from the dominating strike at the Erik's, Johns and Olles Mines /Ulverygen/. We are consequently here dealing with an impregnation of sparagmite ore of large dimensions as to length and width. This impregnation took place, geologically speaking, at a very early period, when the present surface was several kilometers lower than the surface at that time. At that time overlying masses of rock of several kilometers thickness are now eroded away. When the impregnation of sparagmite ore has such considerable dimensions in length and width and as the impregnation took place at a depth, independently of the now existing surface, then the impregnation cannot cease near under the present surface but will continue to greater depths.

The particularly rich impregnation lenses which are found close to the surface, for instance in the adits, will probably disappear locally or wedge themselves out at a depth, but the impregnation, as such, will continue with changing sections of rich and poor impregnations. A horizontal sections, for instance 100 meters or 200 meters below the present surface at Ulverygen will thus have the same general character as the present surface /or level for instance at the Erik adit/. At the Olles adit ore has been proved at a depth of 60 meter below the surface and one must therefore come to the conclusion that the ore continues at a depth. It would of course be well to have actual proof of this, but personally I attach great importance to the general conclusion arrived at through examination of the occurrences and general geology of same.

The Sparagmite Ore.- It is evident both through examination of the Mines and study of the assays that the immense sand stone deposits at Ulverygen /principal deposit, are of a width

measured at a 100 m. or more, all over, or nearly all over, impregnated with ore, to wit, Borrite which occasionally is accompanied with some chalcostic and copper pyrite.

The impregnation is often poor, but there are richer local impregnations and it is of course, only those richer impregnations that have a technicleconomical interest. In order to give an idea about the poorer impregnations there are copied here some assays of drill-core from th diamond drill holes at Erie's mine, the drill-hole was 80 m. in depth and the drill-core from every fourth m. to wit for 3- to 4 m. 7 - 8m. and so forth to 70-80m. / was assayed The assays given in succession, /for 3 - 4m. 7 - 8m. 11 - 12 m. etc/ showed, 0.09, 0.35. 0.11. 0.02. 0.85. 0.81. 0.94. 0.32 0.13 0.13 0.20 0.10. 0.10. 0.13. 0.18. 0.31. 0.08. 0.16 0.10 0.28 of copper. Further is a serie of assays copied from Klems drift, also in Erik's mine which drift essentially runs through poor impregnations

0.10 0.12 0.10 0.08 0.27 0.09 0.43 0.19 0.13 0.10.
0.23 0.19 0.14 0.18 0.18 0.52 0.33 0.48 0.12 0.28.
0.95 0.99 0.32 1.37 1.68 0.13 0.58 0.23 0.14 % copper.

All these assays arranged according to copper percentage.

0.02 0.08 0.08 0.09 0.09 % copper
0.10 0.10 0.10 0.10 0.10 0.10 0.11 0.12 0.12 0.12
0.13 0.13 0.13 0.13 0.14 0.14 0.16 0.18 0.18 0.18
0.19 0.19 % copper
0.20. 0.23 0.25 0.27 0.28 %
0.31 0.32 0.32 0.33 0.33 0.38%
0.43 0.48
0.52 0.58
0.81 0.85 0.94 0.95 0.99 %
1.37 1.68 %

These figures seem to show that the copper-percentage in the poor impregnation- which as a matter of course, will practically not be mined- only exceptionally sinks below 0.10% copper, the poor impregnation seems oftener to hold a copper percentage between 0.10 & 0.50% with an average of about 0.2 % in copper. That is to say, that if in working it should happen that some of the poor impregnation

should be mixed with the goods going into the Concentrator, this poor impregnations will then, however, pay its own concentration expenses. The economical interests will, as previously stated, be concentrated on the richer impregnation sections. These appear lentiform within the poore impregnations. There are sections of so large dimensions that they can be worked seperately by themselves and which hold over 3% in copper /average samples for several meters length/ and have at Eriks and Johns mine shown 3.10 3.20, 3.24, 3.25, 3.45, 3.60, 3.73, 4.10, 4.13, 4.17% in copper. Outside of these rich sections come zones with lower copper percentage. 2-3% and thereafter 1-2% and lower.

The working should be arranged according to the following plan,-

Through preparatory work prove the richest sections where the richest, central parts, with an average of 3% copper or more, can be worked by themselves. Also the fairly rich impregnations can be worked by themselves. There is thus every opportunity to mine ore of different percentage of copper. How low the copper percentage should be allowed to run is of course dependent upon concentration expenses &c. I believe it would pay to handle one as low as 1% in copper, or possibly a little below. The limit, however, cannot be decided as yet.

The sparagmite ore has been exploited at 3 mines, partly through adits and partly through cross-cuts /in John's mine also by a shaft/ in Ulverygsen, namely Erik's, John's and Olle's mines. /See map/. The distances between these mines are -

Between Eriks and John's mine	336 m.
" John's and Olle's mine	330 m.

The adit level in Johns mine is about 30 m. and in Olles mine about 20 m. above the level of the adit in Erik's mine.

The 3 mines are situated after each other, nearly, but not exactly on the strike. In each of these mines, besides the poor impregnation, are certain streaks of richer impregnation, between 1 & 3% copper. Hereof can any one easily convinced by going into

into the mine and take samples at various places.

As the work with the drifts proceeded there were taken a series of average samples, those are already assayed. A few months ago there were in addition to these very comprehensive series of average samples taken, representing nearly every meter in the drifts. These average samples are not as yet assayed, though, when these samples are completed and laid in on the map, it will give a very good knowledge of the extension of the rich parts in the three mines "Eriks' John's & Olle's " When the assays are completed and delivered to me I will give a more specified report. I want in the meantime only to say that in Ulveryggen there are several deposits worth working, holding over 3% in copper and also other large deposits carrying between 1 & 2% in copper which would pay to work. A calculation has been laid before me showing that in the "sperageite-field" ores areas have already been ascertained,

With at least 3% copper		295 m²
" " " 2%	"	3130 "
" " " 1%	"	1585 "

By studying the mine maps, the up to this time made assays, and by walking round in the mines, I got the decided opinion that the above figures were not too high. But as in the near future detailed assays will be had, I wish to express myself upon the ore areas and its productiveness.

Besides the mines there are a whole suit of excavations made across the strike of the deposits further S.W. in Ulveryggen. Hereby it is ascertained that the deposits are at least 1. Km in length. Erik's mine is situated furthest towards N.E. in Ulveryggen s eems not to belong to the richest parts of the deposits. In the more central parts, at John's & Olle's mines and at the cuts S.W. of Olle's mine appears the copper-percentage, as an average, to be higher than at Erik's mine.

It is here dealt with a large ore-field of which I have the best hope.

The ore can be delivered cheap.

The mining-work will certainly be burdened with a considerable length of drifts but the mining of the ore will become cheap. To what

price a ton of ore should be figured at will principally depend on how low a copper-grade one can go. if one can go, as I believe clear down to 1% copper or possibly still lower will the mining expenses come very low. I wish, however, to postpone expressing an opinion about the estimates until the assays are ready, as they will give better information about the ore areas and mining conditions.

Preliminary remarks about the treatment of the ore. The mining work can be so arranged, that the richest goods with an average of 3% copper /or probably a little higher/ and the poorer goods, with an average of from 3% copper and down to 1% in copper / & probably a little below/ are kept separately. I count the rich goods to an average of 1½% copper. There will be undoubtedly more of the poor goods than of the rich. I will first refer to the different hither to obtained estimates and tests performed.

CHLOREOUS ROASTING & EXTRACTION. A test performed at Falun, Sweden, under the management of K.A. Åkerblom /for many years superintendent of Falu Extraction works/ showed.

The ingoing ore held . 3.17% copper.
" waste held 0.17% "
" loss in the waste was consequently 8.00%

With a supposed yearly production of 100,000 tons of ingoing goods K. A. Åkerblom has calculated the construction-expenses for extraction plant at 1. Million Norwegian Kroner. and the running expenses / including amortisation, engineer wagens etc. etc./ at 10 Kr. p.ton

With a yearly production of 10,000 tons ingoing goods Åkerblom figured the construction expenses at 17 Kr. per ton. /including amortization etc./ The supposition for this estimate is that the copper is delivered ready as refined copper. An eventual small silver percentage without any economical consequence worth mentioning, is not taken into consideration in the income-calculations.

THE ELLMORE PROCESS. A test /proportionated in a small scale/ with sparagmite-ore showed.

The ingoing ore held 2.47% copper
" wasteheld. 0.40 % "
" Concentrate 23.56% "

This concentrate will later have to be treated for the production of metallic copper. Another test, not with the sparagmite ore, but with slate ore showed,-

The ingoing ore held,	0.89% copper
The waste held maximum,	0.19% "
The concentrate held,	17.29% "

The loss by the Ellmore process can in accordance with these tests be put at 15-20% of the copper percentage in the crude ore. To this comes the loss in the treatment of the concentrate for producing metallic copper. The total loss of metal can probably be put at 25% - ½ of the copper contents in the ingoing goods and possibly one may have to calculate the loss a little higher still. An estimate on a yearly production of 100,000 tons of raw ore gives /without considering mining/ a construction cost of Kr. 325,000, and running expenses per ton at most Kr. 4.50. To this will of course have to be added expenses for treatment of the concentrate into metallic copper. If a smelting plant be built at the place then I estimate this expense at about Kr. 150 per ton of copper /the expense is otherwise to a great extent dependent upon the percentage of copper in the concentrate. If in order to reduce the loss of copper by the Ellmore process one is satisfied with a concentrate with a lower copper percentage the expenses in later treatment will be considerably higher. For ore with 6-7% copper the smelting expenses, under conditions as at Rippersjord, may be estimated at Kr. 200.- per ton copper. Experiments with Siemens-Halske electrolytic copper process are now going on, but any results are as yet not known.

The chloreous roasting with subsequent extraction /which we will call the Falun process/ works, according to experience with a low loss of copper /about 8-10% of the ingoing goods/, but the expense per ton is high. The estimate is,- a yearly production of 100,000 tons crude ore Kr. 10.-, and a yearly production of 10,000 tons crude ore Kr. 17.- per ton. The cost by the Siemens-Halskes process will probably also come up to these figures. As the sparagmite ore principally contains quartz /silica/ and as the

copper percentage is comparatively low then the smelting of the ore to copper matte is out of the question. It is useless to make any trials in this respect.

I consider it impossible to utilise a metallurgical process, which always will be comparatively expensive calculated per ton ingoing goods, on such a low grade ore /although cheap in mining/ as the sparagmite ore. The bulk of the ore will hold a comparatively low percentage, below 2% probably nearer 1½%, and such an ore requires for preparatory treatment a cheap mechanical process for preliminary production of concentrate. The cost as regards the old concentration methods is a couple of kroner per ingoing goods, but gives with such finely impregnated ore as the one in question a very considerable loss in the waste. The oil processes are somewhat dearer /I have seen an estimate at Kr. 4½ per ton crude ore/, but they have the advantage that the work with a less loss of metal. I have confidence in the oil process and this would be the most rational at Fipperfjord. There are at present several oil processes, but which of these should be selected it is difficult for me to say as I have not had any experience in the different methods. This question should be carefully investigated. It may be that it also would be the most rational to use an oil process for the rich ore, with 3% copper and higher. However, I consider it more probable that it will pay best, so as to avoid the not so inconsiderable loss connected with the oil process, to utilise a metallurgical process upon the rich ore, although this is more expensive per ton crude ore. There may be a question of the Falun process, the working of which is well known, or Siemns-Halskes electrolytic process, which up to the present time has been little used. There can be no question of direct smelting of the sparagmite ore. So as to thoroughly go into this questions trials should be made with,-

Oil process with crude ore containing about 1½% copper

Falun process /or Siemens-Halskes process/ with crude ore containing 3% copper.

Further tests with the Falun process is hardly necessary.

The Brathammaren mine and "Skiftergangen".- The Brathammaren mine is situated about 5-6 kilometers from the fjord by the road

or about 6-7 km. from the proposed smelting works. The vein cuts through the stratification of the country rock. This is nearly vertical, about 85 deg. towards S.E., whilst the vein has a dip of about 30 deg. towards S.E. The vein has been exploited for a length of about 50-60 meters and about 40 meters along the dip. The thickness of the vein is in the middle parts 0.6 - 0.8 m. but gets narrower towards the ends /the horizontal line/ and is here 0.1 - 0.2 m. The vein is a felspar - quartz vein carrying some copper pyrites. Ore has been picked containing 7% in copper but the vein is comparatively short in length /strike/, not very wide and does not carry much copper ore. The adjoining lode, the so called "Skiffergangen", containe variegated copper, occurring partly in quartz kidneys and partly impregnated in schist. The vein has been uncovered in several places for a length of about 450 m. but the different impregnations are not found on the same level. There are at the different places impregnations in different slate zones that will complicate the working considerably. In addition, the impregnation is irregular, and in my opinion, taken as a whole, this vein has little or no technical importance. From the drathammeren mine an adit is now being driven to the slate-vein "Skiffergangen" /Witt's shaft, which is now 12 meters deep/. According to the plan of the mines this adit will in a straight line be 155.8 meters long and will come in at a depth of 34.7 m. below the surface /22.7 m. below the bottom of Witts shaft/. At my visit the adit was, including bends, about 130 meters long. There thus remains about 25-30 meters before the schist vein is reached. The cost per meter adit is about Kr. 80.- including carbage, rails &c. The remaining costs will thus amount to Kr. 2,000.- to Kr. 2,600.-. There is in my opinion no reason why this adit should be continued. When one already has a large and promising deposit then work and capital should not be split up in simultaneously prospecting deposits of small promise.

Christiania, 24 Aug. 1907.

sgd. Johan H. L. Vogt.

Professor.

[illegible] öfver de vid [illegible] belägna kopparfyn- [illegible] tillhöriga Nordiska Graf- [illegible]aktiebolaget.

[illegible].

Kåfjordens kopparverk [illegible] i Kvalsunds [illegible] i Finnmarken [illegible] 70°27' [illegible] af [illegible] 1°.[illegible]. [illegible] kopparförekomster [illegible] från [illegible] till fjordens botten. [illegible] i [illegible] ligger [illegible] vid fjorden [illegible] 5 à 6 [illegible] från [illegible] [illegible], [illegible] 7 [illegible] låg [illegible] [illegible] vikti[g] [illegible] [illegible] har [illegible] [illegible] till [illegible], [illegible] [illegible] bli[r] [illegible]. [illegible] till Kvalsund, [illegible] i [illegible]. [illegible] torde blifva svårt, hvarför [illegible] i tillfälle af drift blifver [illegible] att [illegible] motor- eller [illegible], som [illegible] till Kvalsund. Vi [illegible] i [illegible]. [illegible] öfrigt [illegible] [illegible] I, som [illegible]. Generalstabens kartor öfver trakten [illegible], men konceptkartor finnas och jag tror [illegible], till [illegible] lilla karta vara tillräcklig. [illegible] vid fjor- [illegible] botten finnes [illegible] stor [illegible]. Fisket i fjorden [illegible] att [illegible]; [illegible] lappar vistas i trakten [illegible] billigt [illegible] an- skaffas. Sist [illegible] viktigt är att det [illegible] lättast kan anordnas post- och telefonstation [illegible] platsen.

Historik.

[illegible] vet [illegible] för [illegible] af lappar, som [illegible] till [illegible] i Hammerfest, af hvilken Nor- diska Grafitaktiebolaget i sin tur köpte för ett pris af Kr. 25.000:-; [illegible] att [illegible] att [illegible] af [illegible] varaktigt ensamt [illegible]

fyndigheterna m.m. Dessa hafva dels köpts af andre eller funnits af bolagets egna skerpare. Försöksdriften började 1904, men först 1905 visade sig några vidare goda resultat och detta genom arbeten på platser, som ägde mindre betydelse [illegible] i början.

MARK OMRÅDEN.

Af statens mark har intet exproprierats, ej det synes vara onödigt, något som är fullkomligt borde reflekterat, ty marken är ju värdelös för staten och genom en expropriation får man inga andra än bruksrättigheter. I bolagets koncession heter det också att bolaget får taga grufdrift inom det omnämnda området, staten förbehåller sig blott att vattenfall skola lösas särskildt.

Af privat mark är ännu ingen köpt, men den egendom, som ligger på fjordens södra strand, och begränsas af Ariselv i SÖ, Dybelv i NV samt "Naermeste Holtet Fjelde" i S och SV, har kontrakterats om att bolaget har rätt att få af denna egendom den mark, som behöfves, för anläggningar. Enl. uppg. skall betalas härför i årligt arrende Kr. 50:-

JORDÄGARE.

Staten är öfverallt jordägare och har således rätt till 1/10 af alla fyndigheterna; huruvida denna rätt af bolaget är inlöst eller ej är mig obekant. Exempelvis bör jag att få omnämna att i Naeverfjord grufvans saken så, att staten för sin tiondedel fick Kr. 4:- per ton metalliskt koppar, som kunde framställas ur den skeppade eller på annat sätt tillgodogjorda malmen.

SKEPPNING.

Någon skeppning i egentlig mening har ännu ej ägt rum. Förra året sändes en proflast å ca. 70 ton till William, Foster & Co. Swansea, resultatet häraf är mig dock okänt. För närvarande finnes en del malm liggande både vid grufvorna och vid fjorden dock icke af något större värde.

BYGGNADER OCH ANLÄGGNINGAR.

Följande byggnader äro gjorda:

Via Ulveryggen, Eriks stoll, 1 barack.
" Bratthammeren , 1 " och 1 magasin
" Johan Adolfs gr. , 1 [illegible]

Under byggnad är:

Vid fjorden 1 byggnad till kontor och stigarbostad.

Projekteradt och ämnadt att bygga [illegible] närmast:

Vid Ulveryggen, vid nya stollen, 1 ny barack.

GRUFVEGENDOMEN.

Till Nordiska Grafitaktiebolaget höra ca. 100 st. inmutningar, af hvilka 47 st. äro belagda med utmål.

Utmålen äro:

1/.	Renvalgangen på Svartfjellet	5	utmål
2/.	Mellan denna och V. Arisgang	1	"
3/.	Östre Arisgang vid Ariselv	5	"
4/.	Vid Arisvand	1	"
5/.	Bergsgruben	3	"
6/.	Johan Adolfs gang	7	"
7/.	Skifergangen	3	"
8/.	Rone grube	1	"
9/.	Mattis gang	4	"
10/.	På en parallel med forrige.	1	"
11/.	Bratthammeren	5	"
12/.	På en parallel med forrige.	1	"
13/.	Ulveryggen	7	"
14/.	På en parallel med forrige.	2	"
15/.	" " " " "	1	"
	Summa	47	utmål.

Å den geologiska kartan äro utmålen inlagda med röda streckade linier och några inmutningar med prickade röda linier.

Af inmutningar må nämnas Vestre Ulveryggen, Stenfjellet och Rødfjellet.

GEOLOGI.

Förekomsterna äro belägna i närheten af en kontaktzon mellan en yngre eruptivbergart, grönsten /gabbro, diorit/ och äldre bergarter, sandstenar, skiffrar och dolomiter, som af Dr. T. Dahll anföres

till dels Kalpas-system af devonisk ålder och dels Jatuls-system, nedersta delen, konformande sig till Irles-ö byns, eller kolformationen.

Till Kalpas-systemet hörer och å kartan utmärkta sandstenen. Denna är vanligen till färgen ljusare eller mörkare grå, som ibland öfvergår till svagt röd eller grön. Hufvudsakliga beståndsdelen är kvarts och glimmer; ibland uppträder äfven fältspat i större mängd och ibland finnes olivin och epidot. Strukturen är vanligen finkornig till medelkornig, men ofta blir bergarten porfyrisk med strökorn af kvarts; och ofta taga dessa kvartskorn alldeles öfverhanden, så att bergarten kan betecknas som en kvartsit, som ofta blifver konglomeratartad.

Denna sandsten [illegible] att afgöra [illegible] vid kontakten af en serie eruptivmassiv af en gabbroliknande grönsten (möjligen dyserit) af ljusgrön färg med mörkare hornblendestänglar väl utbildade i massan.

Sedan man passerat kontakten har man för sig bergarter dels lika med diorit och dels dioritisk skiffer, den senare antagligen en omvandlingsprodukt af den förra. Denna dioritiska skiffer håller ofta ganska mycket talk och blir då mera sågig i brottet och får mindre tydlig skiffring. På många ställen, der skiffern är mera tät och svart blir skiffringen mera regelbunden och skiffern klyfves lätt tafvelformigt.

Den ej omvandlade grönstenen är här en tät diorit till färgen mörkt grön, nästan svart.

De förefintliga kopparmalmerna kunna lämpligen indelas på grundval af deras relativa ålder på följande sätt:

I) Yngst äro de malmer, som bestå af kopparkis och svafvelkis, dels i körtlar af kvarts och kalk och dels i gångar af kvarts och kalk, liggande i tät grönsten eller skiffer. Det kan anmärkas att i kalken ligga kiserna mest i ränder och i kvartsen ligga de mest i klumpar (1, 2, 3, 4, 5, 7, 8, 11, 12).

II) Kopparkis i kontakten mellan grönsten och kvartsig sandsten. Hit hör vestra Ulveryggen (ej [illegible]).

III) Kopparkis och brokig kopparmalm, som impregnation i grön skiffer. Impregnationen är ganska jämn och finkornig. (7, 8, 9, 10).

IV) Kopparkis, brokig kopparmalm och kopparglans, som mycket finkor-

nig impregnation i sandsten (13, 14, 15).

NÄRMARE BESKRIFNING AF FYNDIGHETERNA.

Jag vill först behandla de små obetydliga fyndigheterna, vid hvilka endast mindre försöksarbeten äro utförda, antagligen därför att förekomsterna äro så obetydliga; alla tillhörande kategorierna I) och II).

[illegible]. Ca. 2 km. från fjorden. Här finnes stora kvartskörtlar delvis förande kopparkis.

[illegible] mellan [illegible] och A. [illegible]. Föra också kopparkis i kvartskörtlar. Såväl de förutnämnda fyndigheterna äro ej bearbetade och se ej heller vidare lofvande ut.

A. [illegible] för kopparkis i kvarts och kalk. En mindre sänkning finnes ca. 5 m. djup der dock kvarts[illegible] utkilade i botten.

Vid [illegible] kopparkis i kvarts; ej arbetadt.

N. [illegible] i kontakten mellan grönsten och kvartsig sandsten, visade sig hålla små sprickfyllnader af kopparkis i grönsten. Obetydlig förekomst.

JOHAN ADOLFS GÅNG. På en rad större kvartskörtlar förande kopparkis äro 7 [illegible] tagna och på det mest lofvande stället är förekomsten undersökt med en sänkning och tillhörande orter. (se vidstående skiss). Strykningsriktningen tyckes vara SV till NO och stupningen vertikal. Största mäktigheten är ca. 2 m. och då jag 1906 besökte grufvorna var det mycket vacker malm i dagen, men denna aftog hastigt. Något närmare undersökande var mig omöjligt, då sänkningen var vattenfylld. Fyndigheten torde ej vara af någon betydenhet

[illegible]. Här är en verklig gångbildning i grönstenen. Gångmassan utgöres af 2 väl skilda, men tätt till hvarandra liggande skikt, som tillsammans bilda gången. Det öfre skiktet af kvarts, förande kopparkis och något svafvelkis i klumpar. Det nedre skiktet af kalk förande kopparkis och temligen mycket svafvelkis i ränder. Strykningen är N 60° O och stupningen 15° – 18° mot S. Gångmassans största mäktighet är 0,6 m., för öfrigt tyckes denna vara ganska va-

riabel och en tydlig fältstupning åt VSV kan förmärkas.

Sedan en mindre sänkning utförts (se kartan) innanför en stoll från dagen och fyndigheten blef uppfaren i fält med orter till en längd af ca. 55 meter. Det visade sig nu att mot VSV blef gången till slut fördelad på några sterila kalkbrunna sprickor och mot ONO blef den en rostrand ca. 1 cm. tjock.

En mindre sänkning gjordes och därifrån drefvos orter 6 m. under stollgångens nivå. Vid min befaring var emellertid allt detta under vatten.

Från öfre fältorten är påbörjad en stoll ämnad att drifvas till genomslag med Witts synk på Skiffergången. Denna stoll Storstollen är nu indrifven ca. 75 m. och har genomgått en steril kvartsstrand och för resten blott grönsten

Under antagande af en längd af 53 meter och en bredd af 0,3 meter få vi en malmareal af ca. 16 m² eller vid en eg. v. af 2,8 ton pr. m³.

45 ton gångmassa pr. afsänkt meter.

Ett generalprof af denna gångmassa har gifvit   % Cu. (Enligt Kirkhus uppgift 4 % Cu.). Enligt Harstadskontorets uppgifter ca. 3,15 % Cu..

För att utvinna denna malmkvantitet måste ca. 53 m³ berg uttagas hvadan <u>malmprocenten</u> torde blifva <u>ca. 30 %</u>. Någon skrädning af gångmassan kommer ej ifråga utan endast utskrädning af grönstenen. Priset per ton berg kommer antagligen att hålla sig omkring Kr. 5:-, hvilket ger oss ett pris per ton malm af Kr. 15:- fritt kaj vid Kopperfjord. Nu kunna dessa siffror möjligen ställa sig gynsammare, då grufvan brytes i samband med en annan större sådan.

Med de nuvarande höga priserna på koppar kan ju detta bära sig, men om priserna skulle falla, blifver förtjänsten ingen, såvida ej gången skulle öka mot djupet, något som man ej har rättighet att tro.

<u>HATTIS OCH HANS GÅNGAR.</u> Båda föra kopparkis och brokig kopparmalm i skiffer och äro undersökta på 2 ställen med mindre sänkningar ca. 3 meter djupa, hvadan man således har ringa kännedom om dessa malmer. Hans ser dålig ut; Hattis bättre, men blott ett smalt parti

på ca. 3 m. var malmförande.

En annan sänkning ... parallel till hattlagren visade

brokig kopparmalm i en ... förande ... Sänkningens SV

...varvet var ... .

...skifferzonen...

... till ca. 400 meter ... i zonen som undersökt

skola andra sänkningar. ... vid

... att ... kopparkis i kvarts. ... brokiga ...

kvartsen ... meter, ... vid närmare undersök-

ning, att i skiffern fanns impregnation af kopparkis och brokig kop-

parmalm. Den malmförande skiffern ... af kalkstenar, som

... i ... skiffern ... lätt ...

... speciellt ... kontakten med ... berget. Vid

sänkningen m var den malmförande skiffern 1.5

meter mäktig, hvaraf ca 0,7 meter temligen god

impregnation, 2 - 3 % koppar, resten fattig.

... lilla varpen var fattig. Utmalt sträck-

er sig ca. 100 meter NO om m.

Vid n (ca. 60 meter SV om m) är utförd en

liten skärning visande kopparkis i kvarts, men

ingen brokig kopparmalm i skiffern.

Vid o (ca. 70 meter SV om föregående) fanns en liten skär-

ning med kvarts och kopparkis, men ingen brokig kopparmalm.

Vid p är ... ... 12 meter djup och 1.5 m^2

samt med en tvärort mot NV ca. 1.6 meter lång,

visande en mäktighet på malmen af ca. 2,3 me-

ter (d.v.s. den malmförande skiffern). Här

togs ett generalprof af det upplagda berget,

som skulle vara malmhaltigt alltsammans.

Vid q (ca. 40 m. SV från föregående)

fanns en liten sänkning ca 3 meter djup med ca.

1,60 meter kopparkis och brokig kopparmalm. Malmimpregnationen blef

svagare mot djupet.

Vid r eller ca. 400 meter SV om sänkningen m fanns en ca. 4 m.

djup sänkning med kopparkis impregnation i skiffer. Malmhalten före-

föll ganska rikt och ett påstående af stigaren att generalprof skul-

le hålla 4 % Cu torde allt behöfva reduceras i verkligheten.

Af ofvan anförda beskrifning framgår att man har att göra med ett skifferparti förande impregnationer af kopparkis och brokig kopparmalm. Impregnationens utsträckning är ännu ej undersökt; det ordnas dock för närvarande på ett genomslag från Bratthammeren till Witts synk, ett genomslag, som är ämnadt att synken på en afvägning af ca. 20 meter under dagytan vid synken (se kartan). Som Witts synk är nedgrifven på det mest lofvande stället är det ju af största intresse att se huru malmen skall visa sig på 20-meters nivån, speciellt som man har af ganska stor misstanke på att brokig kopparmalm ej skall hålla sig mot djupet. Ej heller är man på det klara med någon lagbundenhet för de rikare partiernas fördelning inom den malmförande bergarten. Om man får döma efter det som visar sig i dagen skulle den malmförande delen af skiffern få en längd af ca. 300 meter. Medelmäktigheten får då sättas till ca. 1,0 meter och malmarean blifver då 300 m² eller

<u>ca. 900 ton malmtillgång per afsänkt meter.</u>

Brytningen bör blifva billig och utforderingen sker genom stollen till Bratthammeren. Någon sovring kommer ej heller ifråga, utan malmen sändes som den är till hytta eller anrikningsverk. Jag tror ej att kopparhalten kan sättas högre än ca. 1 % Cu..

Om malmen visar sig vara oförändrad vid det blifvande genomslaget skulle det således finnas minst 15.000 = ca. 14.000 ton malm till stollens nivå, som alltså kunna direkte utforderas genom denna. Vid normal brytning af grufvan skulle detta räcka i ca. 4 år.

Af utförda analyser må nämnas:

Generalprof af Witts synk och 3 andra närliggande					1,5 %	Cu.
"	"	"	"	sorbert	1,69 %	"
Witt	"	"	"	"	0,46 %	"

Denna grufva kommer således att brytas samman med Bratthammeren och torde härigenom bägges värde något ökas. Under alla förhållanden äro dock bägge ej af något <u>större värde</u>, men goda att hafva i en hand med en annan större grufva, så att administrations- och andra allmänna omkostnader ej falla så tungt på dem.

Ulveryggen.

är otvifvelaktigt den bästa af alla närvarande förekomster. Här föreligger nämligen en impregnationszon eller flera linsformiga massor i en sandsten, som stryker N 45° O och stupar ibland 80° åt NO ibland 80° åt SV eller emellanåt nästan hela tiden står vertikalt. Mäktigheten af denna impregnationszon har sitt maximum, såvidt man kan se i dagen, vid A, där den är ca. 40 meter; dock är att märka att någon skarp gräns till omgifvande bergart sandstenen finnes ej åt NV, men däremot åt SO är den ganska tydlig.

Den impregnationsförande sandstenen är grå ibland med dragning åt rött ibland svagt grönaktig, dels troligen beroende på kopparkarbonat och dels på närvaron af olivin och epidot, båda svagt grönaktiga mineral. I dagen är den mycket förvittrad och visar ofta stora af malakit grönfärgade ytor, som gifvit anledning till upptäckandet. Strukturen är fin- till medelkornig, men blir ibland gröfre och t.o.m. porfyrisk med strökorn af kvarts.

Kopparen förekommer som kopparkis brokig kopparmalm och kopparglans, oftast i mycket små korn jämt fördelade i bergartens massa; blott då denna är porfyrisk synes kopparmineralen ansamlade vid strökornen.

De rikare partierna, påträffade på 2 ställen med stoll, tyckas vara linsformigt fördelade i impregnationszonen. Den hittills vunna erfarenheten tyckes ge vid handen att dessa partier ligga närmast zonens SO kontakt. De rikare delarna hålla ca. 3,2 % Cu de andra från 0,24 % till 1,5 % Cu..

Största mäktigheten är som sagdt 40 meter dock ej sammanhängande. Angående fyndighetens djup, så borde detta ju vara stor då malmmineralet är en ingående beståndsdel i bergarten och således torde vara bildadt på samma gång som denna; men å andra sidan har man en sorglig erfarenhet af kopparglans och brokig kopparmalm att dessa malmer ej bruka gå djupt, hvarför jag tror att man ej får ansätta djupet så stort.

På Ulveryggen äro 7 utmål lagda, däraf ett enligt uppgift i luften, hvaraf följer att fyndigheten får en längd af ca. 1600 meter, som hela tiden kan följas i dagen om den äfven på sina ställen ser mycket fattig ut.

De utförda arbetena inskränka sig till 2 stollar (dessutom en nu påbörjad) och diverse jordtrossar i dagen. Här nedan följer en öfversikt af dessa arbeten.

Eriks stoll (belägen c:a 340 meter O.N.O.) se kartorna, är drifven som tvärslag till malmen ca. 27 meter. Sedan drefvos Klems och Mortons fältorter, den förra med 2 tvärslag mot NV och den senare med 1 åt SO och ett åt NV, från hvilket senare en stigort är drifven ca. 6 meter högt. Af kartan framgår bäst läget af den rikare delen af impregnationen. Följande analyser äro utförda:

Mortons ort. Tvärslag No. I.

Generalprof af de 4,5 första meterna	3.24 % Cu
" " " 4,5-7,8 meterna	1.51 % Cu
" " " 7,8-12,0 meterna	0.42 % Cu

Tvärslag II mot malmen.

" " " 4.5 första meterna	0.24 % Cu

Klems ort. Tvärslag No. I.

" " " 4.5 första meterna	1.50 % Cu

Eriks stoll. Mitt kontrollprof.

På hela malmbredden i stollen.	1.13 % Cu.

Något nytt rikt parti har ej med Klems ort påträffats, oaktadt denna är indrifven ca. 17 meter i den fattiga malmen. Alltså se vi att afståndet mellan de rikare partierna kan vara ganska långt.

Johns stoll, belägen ca. 200 m. SV om Eriks stoll, och med en nivå af ca. 40 m. högre än förstnämnda stoll. Johns stoll är indrifven ca. 22 m. som tvärslag till malmen. Först genomgicks

5 m. god malm om	3.25 % Cu.
sedan 4 m. " " "	1.4 % Cu.
och så 3 m. " "	0.36 % Cu.

Alltså en samlad malmmäktighet af 12 meter om i genomsnitt 2.04 % Cu. Detta är ett vackrare resultat än vid Eriks stoll, men fältutsträckningen af det goda partiet är ännu okänd. Fältorter äro dock påbörjade åt båda håll i den bästa malmen. Några resultat af dessa torde man ej kunna få på en tid.

En mindre stross finnes utförd ca. 15 m. V. om gränsen mellan utmålen 2 och 3 visande mest malakit och omvandlingsprodukter af kopparglans och brokig kopparmalm.

Vid A ca. 85 m. SV om gränsen mellan utmålen 2 och 3, likaså flere i samma linje finnas dagstrossar förvarande och största kända mäktigheten af ca. 40 meter. Generalprof af dessa strossar var 1,64 % Cu.. Ca. 30 meter under detta ställe är en stoll påbörjad, som efter ca. 50 meter skall träffa malmen.

I en stross ca. 140 m. meter om gränsen mellan utmålen 4 och 5 fanns det i dagen kopparkis och brokig kopparmalm till en mäktighet af ca. 6 meter.

Ca. 30 meter öster om samma utmålsgräns fanns det mest kopparkis i en porfyrisk bergart. Strossen var ca. 2 meter bred och låg på en afvägning af ca. 210 meter ö.h.. Ca. 100 meter SV om denna stross är högsta punkten på Ulveryggen belägen ca. 410 meter ö.h..

Vid utmålsgränsen mellan 5 och 6 finnes en liten stross ca. ½ meter djup med ca. 10 meter god malm och 3 meter bredd. Ett generalprof gaf 2,17 % Cu..

Ca. 100 meter SV om sistnämnda stross synes synligheten i dagen såsom malakit och brokig kopparmalm i en temligen ljus sandsten. Sandstenen var mörkare och mera kvartsitisk. Strykning N 45° O och stupningen ca. 80° åt NO..

Ca. 75 meter SV om denna plats ligger Lille-Ulveryggvand (ej utsatt på kartan) och på andra sidan af detta vand kunde spåras samma impregnationszon, men här var intet arbetat ännu.

Af föregående profbeskrifning visas tydligt, att man här har att göra med en kopparfyndighet af ganska ovanlig utsträckning och mäktighet i dagen. Den totala längden är, som förut nämnt, ca. 1680 meter på de 6 utmålen, men huruvida brytvärd malm finnes hela vägen är ju ännu oafgjordt. Af kartan framgår att i utmålen 3 och 4 är ett stycke om ca. 350 meters längd, på hvilket intet arbete är företaget. Samma bergart finnes ju, och här och där malakit i dagen, men om kopparhalten håller sig hela tiden är ovisst. I utmålets no. 1 fortsättning åt NO har man vid Torvmyrhaugen och vid Arnelv funnit samma sandsten med malakit i dagen, det kunde ju vara en fortsättning i fält af Ulveryggen och i så fall blifver ju längden ansenligt ökad, ända upp till flera tusen meter.

Då jag är i saknad af noggrannare kartor och likaså har att

invänta analys- och borrningsrapporter kan jag ej nu utföra några närmare planer och beräkningar, men jag vill dock angifva några siffror som kunna vara af intresse. Jag utgår då från början från att den blifvande anläggningen kommer att blifva efter Elmore's system med eller utan hjälp och att malmen transporteras ned till verket vid sjön med linbana. Elmoresystemet känner jag tyvärr så litet till att jag ej kan göra några kalkyler med det.

Vid tillverkning tror jag att man kan räkna med en mäktighet på malmen af ca. 12 meter, och medelhalten af koppar får sättas till 1-2 p Ct. och längden till 1500 meter; alltså malmarea 18.000 m².

Genom profilkartan se vi att malmen på Johns stoll ligger ca. 40 m. högre än Eriks stoll, som ca. 40 meter lägre än fyndighetens högsta punkt. Om vi nu räkna djupet till Eriks stolls nivå så få vi en genomsnittlig siffra af 40 meter, d.v.s. en malmkvantitet af 2.520.000 ton. I min första lilla rapport antog jag mindre djup, men högre kopparhalt, hvilket ej torde vara riktigt.

Låtom oss antaga en malmprocent af 80 och total brytning pr. år af 125.000 ton, så få vi årligen 100.000 ton malm och skulle då fyndigheten räcka i ca. 25 år. Under förutsättning af borrmaskinanläggning torde det malmhaltiga berget kunna levereras vid verket vid sjön för Kr. 2:- pr. ton. Inberäknadt alla kostnader, äfven amorteringar. Kanske vil det visas sig att allt går för sig billigare om berglossningen kan blifva bättre än jag beräknat, hvilket är antagligt då bergarten såsom varande sandsten är ganska inhomogen.

Erforderliga anläggningar skulle vara:

Kraftcentral för ånga eller petroleum (storleken beroende på vidare anläggningar).

Borrmaskinanläggning	Kr. 18.000:-
Linbana (7 km.)	" 150.000:-
Kaj och magasin	" 30.000:-
Bostäder till en början	" 50.000:-

Alla siffror äro emellertid endast förslagsvis uppsatta, då allting ännu är så obestämdt. Likaså kan ej heller någon värdering gifvas.

Säveion den 10 Sept. 1906.

Aug. Siljeström.

aus Bericht 4483

Schürf-Ergebnisse (Bericht Goldkuhl)

östl. Ulveryggen. Am Tage zwei Erslinsen von zusammen 2330 qm mit 1,5 % Cu.

Olles-Erze. Am Tage acht Linsen mit zusammen 789' qm und 1,36 % Cu oder bei Hinzunahme ärmerer Randpartien 10510 qm mit 1,66 % Cu. Linsen zeigen in allen Horizontalen plötzliches Absetzen. Der 12 m u.O. angeschlägene Quadratstollen erbrachte zwar ein Erz von 1,4 % Cu aber augenscheinlich keinen Zusammenhang mit den zutage anstehenden Erslinsen. Eine an seinen Feldort niedergebrachte Bohrung von 176 m zeigte nur Spuren von Cu.

Das gleiche Schicksal fanden drei an dem weiter östlich angesetzten Stollen niedergebrachten Bohrungen, die die Zonen der Tageslinsen ergebnislos durchfuhren. Der 30 - 40 m u.O. angesetzte Olle-Stollen unterfuhr ergebnislos 3 reiche Tageslinsen.

Johns-Erze. In diesen Gebiet wurden 3 Linsen mit zusammen 1669 qm und 1,91 % Cu ausgemacht. Im flach angesetzten Stollen wurden 3 Erslinsen festgestellt, die aber mit den Tageserzen keinen Zusammenhang hatten. Ein in ihn getriebenes 14 m Gesenk fand ein reiches Erzgestein mit 2,5 % Cu.

Eriks-Stollen. Im Eriks-Stollen wurde ein 500 qm grosses Erzareal mit 2,04 % Cu gefunden. Ein im besten Erz angesetztes 20 m Gesenk zeigte als Durchschnitt 0,66 % Cu und ein kurzes Gesenkort 1,o % Cu. Ein 34 m tiefes Bohrloch verlief im Tauben. Dagegen wurden in einem Gesenk mit Gegenort gute Aufschlüsse nachgewiesen.

Haus-Stollen. Weder über Tage noch in Stollen irgendwie nennenswerte Erzfunde.

Narvik den 13 sept. 1907.

Kopparförekomsten vid Kopparfjord.

Inledning: Kopparen uppträder i form af bornit och kis samt andra förvittringsprodukter, såsom finkornig impregnation i sandsten. Den från sydvest till nordost sig sträckande sandstensmassan är flere kilometer lång och 100 till 200 m. bred samt klassificeras såsom paragmit. Synbarligen är hela paragmiten försedd med spår af koppar,- på sina ställen är detta fallet i högre grad, så att linsformiga förekomster uppträda. En afgränsning mellan den torra, fattiga och hopade paragmiten är icke förhanden, och endast för det öfvade ögat äro olikheter i bergartens kvalitet förnimbara. Synbarligen har icke heller något system konstaterats i linsernas lagring och storlek.

Öppningar: De hittills verkställda uppdagningsarbetena bestå i ett antal gångar, omkring 25, hvilka på en längd af 2 km. äro fördelade i paragmiten och anlagda lodrätta för att bestryka densamma. Mellan gångarna, hvilka räta 10 till 35 m. och hafva ett djup af omkring 1 m., äro i många fall kopparspår synliga, så att man kan sluta till sammanhängande malmmassor, det kan likväl ej konstateras, om vi hafva att göra med några stora eller många små linser.

Vidare hafva 4 stollar slagits på tvären i bergsväggen, medelst hvilka några linser, hvilkas tillvaro var bekannt genom gångarna, framförts och delvis utförts (undersökts).

I Olles stoll blef på 60:de metern en lins af 14 m. mäktighet framförd. Man har ej vidare undersökt den, utan driver tvärslaget vidare mot norr för att gå under en andra 2dra utholkning.

I Johnsstollen framföres en lins. Densamma innehåller vid en bearbetningshöjd af 20 meter omkring 20000 tons malm å 1,5% Cu. (koppar).

I Erikastollen framföres (undersöktes) en lins, hvilken vid en bearbetningshöjd af 24 m. innehåller omkring 14000 tons malm med en halt af 1,6% Cu.

I Hansstollen framföres på 5te metern en lins af 4 m. mäktighet. Stollen bearbetas vidare.

Upplysningar [illegible]

Kopparhalt: Enligt uppgift har Nordiska ej låtit analysera några prof från urholkningarna.

De på uppdrag af Skandiakobber anställda undersökningarna hafva gifvit följande resultat:

Den västliga gruppen af urholkningarna gaf:

0,7 0,8 0,5 1,0 1,5 1,1 i medeltal 0,8%

Den mellersta gruppen vid Ollesgrufvan:

1,4 1,1 1,1 2,4 1,4 1,8 1,7 i medeltal 1,5%

Den östliga gruppen vid Eriks & John gaf:

1,7

0,4 0,4 0,7 i medeltal 0,8%

I Ollesgrufvan :

1,1 0,8 1,3 i medeltal 1,0%

I Johnsgrufvan ur linsen :

3,6 1,3 1,1 1,6 0,3 0,8 i medeltal 1,5%

I Johnsgrufvan den angränsande bergarten:

0,3 0,3 0,7 0,2 0,0 0,1 0,6 i medeltal 0,3%

Eriksgrufvan ur linsen:

1,8 2,4 1,3 1,1 1,3 i medeltal 1,6%

Eriksgrufvan det angränsande berget:

0,26 0,18 0,1 0,3 0,23 0,39 i medeltalt 0,2%

I Hansgrufvan:

0,2 0,1 0,8 i medeltal 0,4%

Af dessa profver, hvilka i allmänhet öfverensstämma med Nordiskas analyser, och de bifogade planerna framgår, att den vida största delen af gruffältet innehåller mindre än 1% Cu och följaktligen icke kommer i betraktande, under det att den mellersta delen vid grufdrift torde komma att gifva 1,5 % Cu. Ett skiljande för hand af det större "Hauf-verk" synes outförbart, däremot måste driften oupphörligt kontrolleras analytiskt.

Det föreligger inga bevis för fortfarandet resp. för upphörandet af malmhalten på djupet, och den omständigheten att i ett borrhål i Eriksstollen och en förs änkning i Johnsstollen ett aftagande af halten

visade sig,för ej väga för tungt i vågskålen,då två resultaten icke äro nog för att därpå uppbygga en teori.

Metallurgi: Malmen i sig själfver särskildt i de öfre lagren många förvittringsprodukter af kopparn, vilka lätt äro lösliga i förtunnade syror. Genom försök med olika malmprof,som vore sammansatta af 50 olika prof af alla slag,fastställdes,att i en 1,-tig svafvelsyrelösning i kallt på 5 minuter lästes 90% af den i malmen innehållna kopparen.

Af ett rostadt malmprof lästes genom en 5,-tig lösning af SO_4H_2 på 24 timmar 99% af den i malmen innehållna kopparen.

Af dessa försök framgår,att vid användandet af Elmoreförfarandet äro betydliga kopparförluster oundvikliga,om ej den rulna malmen först tvättad med förtunnad SO_4H_2.

En annan förbehållningsmöjlighet för utvaskningen af den rostade malmen,- i båda fallen kan urskiljandet af kopparen ur lösningen följa såväl genom cementation med järn,som äfven genom elektrolys enligt Siemens & Halske.

Vattenkrafter äro,åtminstone under sommaren,i tillräcklig mängd för handen.

Konklusionen: Undersökningarna i besvarandet af frågan,om Skandia,motsvarande optionen,skulle köpa Kiffersfjordgrufvorna för ett pris af 1.500.000 kronor. Denna fråga måste besvaras nekande,då de erhållna resultaten ej motsvara priset. Äfven är det ej möjligt,att detta till den 1 November skall blifva fallet. Öfverhufvud representera grufvorna i sitt nuvarande skick intet faktiskt,utan endast ett spekulativt värde,om ens man kan förskaffa sig en klar bild af malmkropparna och rentabiliteten,äro utomordentliga arbeten erfordrliga,hvilka minst torde att år i anspråk och skola kosta 100000 kronor.

Men en förlängning af optionen med den ofvan angifna tiden skulle endast i det fallet vara att rekommendera,om det köperis,som skall betalas för grufvorna,undergingo en betydlig nedsättning,ty sannolikheten talar för,att de bearbetningsvärda malmmassorna utgöra endast en liten del af hela impregnationszonen. Genom urkalkningarna har en

Afskrift.
(4)

af c:a 5000 kvm. 1½ % malm påvisats. För bergkunnet af de i utsikt stående malmförekomsterna felar för närvarande studier, då beskaffenheten af malmförekomsten på djupet ännu är för litet bekant.

Ingeniörteknadt A. von Gernet.

Geokjemiske undersökelser

Repparfjord 1959.

I. Innledning.

Sommeren og hösten 1959 ble det gjort en del geokjemiske undersökelser i området rundt kobberforekomstene ved Ulveryggen, Repparfjord.

Initiativtager til undersökelsene var statsgeolog Paul H. Reitan ved Norges geologiske undersökelse. Reitan bestemte hvilke arealer som skulle dekkes, og utförte med sine folk fra NGU prövetakingen. Forövrig ble undersökelsen utfört etter Statens råstofflaboratoriums direktiver, og SR var ved sin geokjemiker ansvarlig for den praktiske gjennomföring av oppgaven.

Denne rapport skal gi de viktigste data om de undersökelser som er gjort.

II. Geografi.

Det undersökte område ligger i Kvalsund herred i Finnmark fylke, og således mellom 70. og 71. breddegrad. Höyden over havet varierer mellom 0 og ca. 450 m. Middeltemperaturen er + 1.5°C og middel nedbör 676 mm pr. år. Terrenget er småkupert, tildels meget bratt og har tallrike bekker og småvann. Spesielt de höyere liggende deler av feltet er praktisk talt uten lösavleiringer. Av denne grunn er vegetasjonen også ytterst sparsom.

III. Geologi.

Geologisk hörer feltet til Raipas formasjonen, som er et grunnfjellsvindu i overskjövne kaledonske bergarter. Malmmineralene er hovedsakelig bornit og kobberkis. Kuprit, kobberglans og malakitt forekommer ofte nær dagoverflaten. Malmmineralene opptrer finfordelt i en arkosisk sandstein. De enkelte malmmineralkorn er oftest så små at de er meget vanskelige å se med det blotte öye. (Se Vokes, NGU, nr. 200/Årbok 1956, s. 74-111, Reitan, NGU, nr. 203/Årbok 1957, s.76-79).

IV. Hensikt med undersökelsene og plan for arbeidet.

Kobbermineralenes finkornethet gjör det vanskelig for geologen i felten å skille mellom mineralisert og umineralisert sandstein. Det er dette forhold som - til tross for at svært meget fjell er blottet - gjör det önskelig med en indirekte malmletingsmetode i feltet.

Hensikten med de geokjemiske undersökelser var derfor:

1. Studere brukbarheten av geokjemiske malmletingsmetoder i det foreliggende felts spesielle geologiske og geografiske forhold.
2. Forsöke å finne eventuelle nye kobbermineraliserte soner.

I overensstemmelse med dette ble det planlagt, först å konsentrere prövetakningen rundt de kjente kobbermineraliseringer, og senere eventuelt dekke de omliggende mindre kjente områder.

V. Prövetatt område, antall pröver, tidsrom.

Det prövetatte område er et vel 10 km^2 stort areal av raktangulær form, og hvis grenser mot SÖ og NÖ dannes av henholdsvis Vestre Ariselv og kystlinjen fra Ariselvens utlöp til Repparfjord poståpneri. Området ligger i arkositten, og Ulveryggen danner det sentrale parti. Som kontroll er det også tatt en del pröver i Östre Ariselv som renner i grönnstein.

Det totale antall pröver er 44. herav er 46 tatt i fra Ö Ariselv.

Prövetakningen er utfört av 2 mann på 12 dager i tidsrommet mellom 15. juli og 25. august 1959.

VI. Prövetakning.

I det dekkede område ble det gjort systematisk prövetakning av sedimentene fra alle bekker.
Bekk defineres da som: Rennende vann og tört bekkefar.

Bekkesediment defineres som: Lös avleiring, uorganisk eller organisk i eller nær bekkeleiene.

En uorganisk prøve tatt under vann og med silt sammensetning ble foretrukket, men i mangel av slik prøve ble det tatt prøve av sand, grus eller humus, i eller utenfor bekkeleiene, alt etter som forholdene på hvert enkelt prøvested var.

Avstanden langs bekken mellom prøvepunktene varierte mellom 100 og 400 meter med ca. 250 m som det vanligste tall.

Prøvene ble puttet i nummererte prøveposer. Posene ble pakket i små Al-bokser, som igjen ble satt i trekasser. Prøvene ble i denne emballasje sendt til SR's feltlaboratorium i Kautokeino (de siste prøvene direkte til Trondheim).

Alle data om prøvene ble notert ned på SR's standardformular for dette bruk.

VII. Tørking og sikting.

Ved laboratoriet ble prøvene tørket ved ca. 80°C. De tørre prøvene ble siktet gjennom 80 mesh sikt av rustfritt stål. Den fineste fraksjon ble puttet i ny papirpose og tatt vare på for analysering og arkivering.

VIII. Analysering.

Prøvene ble analysert etter Holmans metode. Dette er en halvkvantitativ metode med følgende prinsipp:

Et kjent volum av sedimentprøven rystes med et 2 fase-system bestående av a) Vannfase: Ammoniumcitrat-puffer av pH 2, og b) Organisk fase: En oppløsning av dithizon i white spirite. Dithizon er et organisk farvestoff, som gir sterkt farvede forbindelser med de fleste tungmetaller bl.a. kobber. Ammoniumcitrat-pufferen sörger for ekstraksjon av de önskede metaller fra sedimentene, og gir samtidig den rette pH for selektiv kobberbestemmelse med dithizon.

Man får ved Holmans metode således löst ut bare

en bestemt, mindre fast bundet fraksjon av det totale kobberinnhold. (For nærmere detaljer henvises til Bull. Inst. Min. Met. oktober 1956, side 7-16).

Metoden er meget hurtig, idet 1 person vanligvis gjör 3-400 enkeltbestemmelser pr. dag. I dette tilfelle gikk analyseringen betraktelig langsommere på grunn av de höye kobberkonsentrasjonene.

Gjennomsnittlig analysefeil er under 30 relativ % i området fra "0" (d.v.s. < 1) til 100 ppm (parts per million).

Analysefeilen ble hele tiden kontrollert ved analysering av standardprøver puttet inn på tilfeldig plass i hvert 20. antall prøver.

IX. Resultater.

Resultatene av Holmans pröve finnes på de 2 medfölgende plansjer.

Plansje 1. M = 1:20 000 viser tallene for bekkesedimentenes kobberkonsentrasjoner i parts per million (vekt/volum).

Plansje 2. M = 1:20 000 er de samme resultater fremstilt mer oversiktlig, idet forskjellige konsentrasjonsintervaller er gitt tegn av forskjellig störrelse og farve.

Av plansjene fremgår det at man her er i et område med höy kobberbakgrunn, idet denne i arkositten er 8-10 ppm.

De kjente gruver og skjerp gir seg til kjenne med anomale kobberkonsentrasjoner i de nærmeste bekker (opp til 600 ppm).

Mot nord-vest i det dekkede felt er det også et lite område med höye kobberkonsentrasjoner.

X. Diskusjon av resultatene.

Man har andre steder i Finnmark höstet den erfaring at geokjemiske metoder er meget følsomme i områder med sparsomt overdekke. Dette understrekes av de her foreliggende resultater. Det er enkelt å forestille seg at sporelementene

forholdsvis lett löses ut av det faste fjell i godt blottede områder på grunn av vannets og luftens uhindrede virkning. Det må dog her gjöres helt klart at den höye bakgrunnsverdi for kobber ikke bare kan skyldes manglende overdekke. Man har godt blottede områder andre steder i Finnmark, hvor bakgrunnskonsentrasjonen for kobber er adskillig lavere. Grunn for den höye bakgrunn i områdets bekkesedimenter er derfor etter alt å dömme, også et generelt, relativt höyt kobberinnhold i det faste fjell.

De höye tall rundt de kjente gruvene kan skyldes store fjelloverflater på grunn av sprengningene. Mot at dette er hele forklaringen taler det faktum, at man også utenom de kjente forekomster har et område med höye kobberkonsentrasjoner (N - V i det dekkede felt).

5. Konklusion.

Det dekkede område er så lite, at man bör være forsiktig med å trekke altfor vidtgående konklusjoner. Jeg finner det likevel riktig å si at resultatene oppmuntrer til videre undersökelser.
En mer eksakt vurdering kan vanskelig gis, för man har dekket et större areal, og anomaliene er fulgt opp med detaljerte geologiske undersökelser.

Trondheim, 27. november 1959.
Statens råstofflaboratorium

Björn Bölviken
Björn Bölviken

Repparfjord

Case History

Metal: Copper.

Dispersion Type: Secondary, stream sediments.

General Locality: Northern Norway.

Source: Internal report by Björn Bölviken, Statens råstofflaboratorium, Trondheim, Norway.
Vokes, F.M., 1957, N.G.U. Nr. 200, p. 74-11.
Reitan, P.H., 196-, N.G.U. Nr. 2--, (in preparation).

1. Location: Repparfjord, Kvalsund, area of Finnmark district, Norway.
Lat: 70°30' N. Long 24°E.

2. Physical Features:

a) Topography and drainage:

Hilly country above ca. 200 m. Below 200 m. steep slopes to the sea. Altitude variation 0-450 m in 10 km^2. Numerous small streams.

b) Climate:

Seasonal rainfall 676 mm, montnly variation from 29 to 95 mm.
Mean temperature range + 1.5° C, extremes: Jan. - 5.2° C, July + 8.9° C.

c) Vegetation:

Very little. Moss and heather. Birch forest up to ca. 200 m a.s.l.

3. Geology:

a) Geological setting (App. SR 108):

Arkosic sandstone, greenstone and green schist of a Precambrian window in overthrust Caledonides.

b) Mineralization:

Mainly bornite and chalcopyrite in the arkosic sandstone. The copper minerals are often so finely disseminated that the can hardly be seen in the specimen. Covallite occurs as a supergene replacement of bornite; thin incrustations containing malachite, azurite, and chrysocolla occur on the surface of mineralized sandstone.

4. Weathering and Overburden (App. SR 108):

Depth of weathering of bedrock and mineralization negligible. Above ca. 350 m the overburden is minimal. Between ca. 350 and 200 m ca. 50 % cover by soil 5-10 cm thick; a side moraine up to 500 m broad crosses part of the area. Below ca. 200 m generally birch forest and considerable thin soil cover.

5. Geochemical Dispersion Patterns in the sediments (App. SR 109):

a) Background concentrations:

Background concentration of Holman test in - 80 mesh fraction of sediments is 10 ppm Cu.

b) Magnitude and form of anomalies:

Cu-concentrations are up to 600 ppm in streams draining area around old prospects. Anomalies can be traced for about 2 km downstreams. Anomalies in virgin part of covered area are maximum 60 ppm.

c) Special features:

The highest anomalies are supposed partly to be due to large rock surface areas, caused by old mining. This is probably not the whole explanation, due to the fact that a new anomalous area is found 2.5 km further N-W, where there has been no mining activity.

6. Field Technique:

a) Sampling:

Stream sediment samples, big enough to yield ca. 5 g dried and sieved material, were collected systematically along all streams at intervals of approximately 250 m. One sample was collected from each side of the stream at each sample site.

b) Analytical:

The samples were dried in air current about 80° C, and sieved through 80 mesh sieve of stainless steel. Analytical method: Holman test, lab.method. (Bull.Inst.Min.Met. 1956, 7-16).

7. Geochemical Field Organization:

The aim of the investigation was to try out the stream sediment method in the area. Sampling was done by two geologist's assistants in 12 days during summer 1959. Total number of sample sites 223 (446 samples). Covered area 10 km2. No other indirect prospecting methods used.

8. Results of Investigation (App. SR 110):

Significant anomalies obtained near known mineralization. One new anomalous area found, but anomalies there are of less magnitude than those near known mineralization. The cause of the anomalies which are not related to known areas of mineralization has not yet been investigated.

Trondheim, Norway, 18th December 1959.

Statens råstofflaboratorium

Björn Bölviken

Björn Bölviken.