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THESIS

MINE OPENING AND TIMBERING

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Thesis

upon

Mine Opening and Timbering

by

George W Cole.

Mune Opening my Timbering.

I will train by replaning the meaning of the term "Toplation". "y This Term is morand The process by which The valuable numeruls and ones are procured often at great depths tolow The surface. a common Error in That a rime two a more " A cavation in The ground without law or rule. Tothing can be non mong; for to open a nime if on a vin or deposite of or and have ut a more excavation open to the air is quite min possible Frequer at is necessary to go brow The most moderale depotos Such is particularly The case with ristalliferous vins and which the superficial portion is often of far less value than that brutash it, and frequently of no value at all, 1 More over The richest part of a vine is usually of limited Extent and can only the procured In penetraling to great depths The next Thing to consider in how to got The on To the surface. This requires powerful machiney which must by fixed on Junu ground directly over The vin. also The surface water must be kept from running unto The recaration which could not be

Mine Opening and Timbering.

I will begin by explaining the meaning of the term "exploitation."

By this term is meant the process by which the valuable minerals and ores are procured often at great depths below the surface. A common error is that a mine is a mere excavation in the ground without law or rule. Nothing can be more wrong; for to open a mine if on a vein or deposit of ore and have it a mere excavation open to the air is quite impossible because it is necessary to go below the more moderate depths

Such is particularly the case with metalliferous veins in which the superficial portion is often of far less value than that beneath it, and frequently of no value at all. Moreover the richest part of a vein is usually of limited extent and can only be procured by penetrating to great depths The next thing to consider is how to get the ore to the surface.

This requires powerful machinery which must be fixed on firm ground directly over the vein. Also the surface water must be kept from running into the excavation which could not be

avoided were The nume open all The Time again the freeing of a nime of water its a very Expension Speration and Therefor great care should be Exercised to get in of it easy and with as little ripense as Toppible In account of The fact that only a limited number of persons can work in a mine at vice it is necessary The nime should be worked day and night. Care must also Ir taken That a system of mulilation by kept up. all of which at will be seen easily would be impossible whe the nue a nere recaration open To the air. Par first Thing to be done the opening a nucle us as a grueral Thing To remove the surface water by mruns of an "adit-level" or horizontal gallery, which must be commenced in some adjacent valley which is abour The hight of inundation and This can draw all that portion of The work abon it. Vu large nues large senne are often expended in getting red of The water. When There are a mucher of names adjoining often a simple adit of great lingth is driven at Their your repease." No pumping of machinery for pumping is required as long as the working is above The adit and shen below it the water is pumper only to that point.

avoided were the mine open all the time. Again the freeing of a mine of water is a very expensive operation and therefore great care should be exercised to get rid of it easy and with as little expense as possible.

On account of the fact that only a limited number of persons can work in a mine at once it is necessary the mine should be worked day and night. Care must also be taken that a system of ventilation be kept up.

All of which it will be seen easily would be impossible were the mine a mere excavation open to the air.

The first thing to be done in opening a mine is as a general thing to remove the surface water by means of an "adit-level" or horizontal gallery, which must be commenced in some adjacent valley which is above the height of inundation and thus can drain all that portion of the work above it. In large mines large sums are often expended in getting rid of the water.

When there are a number of mines adjoining often a simple adit of great length is driven at their joint expense.

No pumping or machinery for pumping is required as long the working is above the adit and when below it the water is pumped only to that point.

Thus the very large names Every fout Through which a large body of water has to to raised which can to sand is of great importance. In some cases where The adit is plauned with Judgement several hundred fort of drawing v can for obtained I possible it should be driven on or aside of The Vin so that The richness of The vine can be ascertained from time to time I sufficient advantages present Themselves for the location of machinery at the month of the "adit" for washing and drawing The orr, at may to courry of our tram-road laid in The level; and Thus saw The necessity of hoisting it to The surface. as a general thing The adit - lend is more only to remore The surface water as very from nimes have The greater portion of the work above it. The necessity of mutilation will not allow The adit-level its fr drive to any great distance without some communication with The surface. Thuse reavations must be commenced on or mear The line of the vins thich may intersect the adit or some live leading its at an which are carried its a still greater depth its open and word The mine Lese recurations are called shapes There is no regular angle of unclination for

Thus in very large mines every foot through which a large body of water has to be raised which can be saved is of great importance. In some cases where the "adit" is planned with judgement several hundred feet of drainage can be obtained.

If possible, it should be drawn on or aside of the vein so that the richness of the vein can be ascertained from time to time. If sufficient advantages present themselves for the location of machinery at the mouth of the "adit" for washing and draining the ore, it may be conveyed on a "tram-road" laid in the level; and thus save the necessity of hoisting it to the surface. As a general thing the adit-level is used only to remove the surface water as very few mines have the greater portion of the work above it. The necessity of ventilation will not allow the adit-level to be driven to any great distance without some communication with the surface. Hence excavations must be commenced on or near the line of the veins which may intersect the adit or some level leading to it and which are carried to a still greater depth to open and work the mine.

These excavations are called shafts. There is no regular angle of inclination for

for The shaft. When The vin is perpendicular The shape is Tritical at The dimes at its unclined # 50 Whether The shaft shall to soul on the view of aside I it depends on various circumstances. I The run-store can to worked with as much Gacility as The adjacent work by The loste is wide "It should to such un the vein repectatly of the country" is saled no That lutte ground new h Left to support the walls Then The inclination is 45° at tremes a question whether The shape to equally unclined and decend perpendicularly until at intersects the view. The latter method I think as used nove I the dep to show The depth to which the shape will have to be such can be estimated. In English numes The machine of surving shape uclines to The lode has not three generally adopted although when ut can the dorce, a large automit of unprofitable rearration in crosscutting from The share to The lode can to sand, I's order To raise the on the the latter case a double tram-was should by laid un the shape and the or hauled up in care which have from The levels on to platforms mounted on in herels on which they are haused to surface

for the shaft.

When the vein is perpendicular the shaft is vertical.

At other times it is inclined 45°. Whether the shaft shall be sunk in the vein or aside of it depends on various circumstances. If the vein-store can be worked with as much facility as the adjacent rock and the lode is wide it should be sunk in the vein, especially if the "country" is solid so that little ground need be left to support the walls. When the inclination is 45° it becomes a question whether the shaft be equally inclined and decend perpendicularly until it intersects the vein. The latter method I think is used most. If the dip be known, the depth to which the shaft will have to be sunk can be estimated. In English mines, the practice of sinking shafts inclined to the lode has not been generally adopted, although when it can be done, a large amount of unprofitable excavation in crosscutting from the shaft to the lode can be saved. In order to raise the ore in the latter case a double tram-road should be laid in the shaft, and the ore hauled up in cars which run from the levels on to platforms mounted on wheels in which they are raised to surface.

The dimension of shafts are variable When at in to be need for winding up trackets of our and at The same time as an engine shaft it should to from 12 to 14 Just long by is usually prova 640 The mide. Then a chatt has partly or whally to by dishred it is rectaigular the shape Those hult up with stone work are round. In This country wood in universally used. The hinders are roughly known and laid one upon The other For a distance from 50 to 100/32t The or can be raised to the surface by man, of the would as morped by hand on Which a kope is would so that one bucket ascends while The other descends. The same means are suployed in surking a wings or an excavation from one level to another not retending to the surface. When how wer The depth of a shaft breaker great. steam pour must be deves a horse- power. Our of The common machines for This purpose is The Use this Ningo which which consists Na vertical drum around which The rope winds and a horyoutal bar at The bottom of the drum To rach und of which is hetched a horse. When The depth brownes greated than 200 hit at is enclowery to use the steam shim The drum on which The rope or chain is would trung place harizontally. The steam rugine is not thought unto use the working a muse mulil

Steam - Whice

The dimensions of shafts are variable. When it is to be used for winding up buckets of ore and at the same time as an engine shaft it should be from 12 to 14 feet long and is usually from 6 to 8 ft wide.

When a shaft has partly or wholly to be timbered it is rectangular in shape. Those built up with stone work are round.

In this country, wood is universally used. The timbers are roughly hewn and laid one upon the other For a distance from 50 to 100 feet the ore can be raised to the surface by means of the windlass worked by hand on which a rope is wound so that one bucket ascends, while the other descends. The same means are employed in sinking a "winze" or an excavation from one level to another not extending to the surface. When however the depth of a shaft becomes great, steam power must be used or horsepower. One of the common machines for this purpose is the Horse whim winze whim which consists of a vertical drum around which the rope winds, and a horizontal bar at the bottom of the drum to each end of which is hitched a horse. When the depth becomes greater than Steam whim 200 feet it is customary to use the steam whim. The drum on which the rope or chain is wound being placed horizontally. The steam engine is

not brought into use in working a mine until

There is good reason to suppose That The mine will be projetable athe the shares the lines may h driven tuto the raw itself or by the site of it according the uto width Eisture "I cetera The contents of a block of ground Thus prepared are remond by what is called stoping" of working in steps: The object of which is to dake out all that sortion The via which reserving for the one. There are two suchods The over hand and The under hand, The deference tring That by The Jonmer surther the new its taken down by working from felow utwards and in other excavations flow above down wounds, The proper timbering of nines Finibring is a matter of great idespirance in their management Then The work us post and liable to immand crushing The side Timbers require to be per apart by fieces land across from abour and helow The first great replosion as Sun fouder which is a niveture of callfebre rulphur and chareval a Runsmider good Jouder must Joaces The following Jusperties; Firm hard augular and of right sized grams. Powder may he equiled by unpact that with great difficulty Sun Catton The next us bun catton which us a nitro compound preparer by reposing dry catton for a sufficiently long time to the action of a mighter of rubric asis with sulphure acid and Then Thoroughly maching

Experins

there is good reason to suppose that the mine will be profitable. Like the shafts the levels may be driven into the vein itself or by the side of it according to its width texture, et cetera The contents of a block of ground thus prepared are removed by what is called "stoping" or working in steps: The object of which is to take out all that portion of the vein which reserving for the ore. There are two methods, the over hand and the under hand, the difference being that by the former method, the vein is taken down by working from below upwards and in other excavations from above downwards. The proper timbering of mines is a matter of great importance in their management When the rock is soft and liable to inward Crushing, the side timbers require to be kept apart by pieces laid across from above and below The first great explosive is Gunpowder which is a mixture of saltpetre, sulphur and charcoal. A good powder must possess the following properties: firm, hard, angular and of equal sized grains. Powder may be ignited by impact but with great difficulty. The next is Gun Cotton which is a nitro compound

Gun Cotton prepared by exposing dry cotton for a sufficiently long time to the action of a mixture of nitric acid with sulphuric acid and then thoroughly washing

Stoping

Timbering

Explosives

Gunpowder

The gun cutton to remore The species of acid Its hat affect is produced when apploded they a detoualor For Firing it me a gruner as needed made of a cake of The dry with a Fuluturality Juse attached. On hung reflocked gree catter huns to water and gas without leaving aspeciable residue dust surve or blackning Mitro-glycerine titro-glycerine us The most nutorland of the refloring companieds of The day In housforting at ap advisable to fact it in large suther jars with a layer of water on top. By an accident it was discovered that rute -glycerine when fully arigealed in difficult do reflect no instance has how recorded of miles-gly curine decomposing aportaneously then properly made and Jure. The firing fourt is maintained do the 360°76 It is a denotrating not an equiting compound Is full affect can only the produced completely by The chock caused in reploding some other replosion compound un sufficiently close provinity to it, so that the concussion effected aly the latter shall froduce sympathetic liflosin Dynamite is a mixture of intro-glycerine with Dynamote any day solid substance wheth vigetable or numeral to Julveryrd and muxed that on the

the gun cotton to remove the excess of acid. Its best effect is produced when exploded by a detonator.

For firing it wet a primer is needed made of a cake of the dry with a fulminating fuse attached. On being exploded gun cotton turns to water and gas without leaving appreciable residue, dust, smoke, or blackening

Nitroglycerine Nitroglycerine is the most important of the explosive compounds of the day In transporting it is advisable to pack it in large earthen jars with a layer of water on top. By an accident it was discovered that nitroglycerine when fully congealed is difficult to explode. No instance has been recorded of nitroglycerine decomposing spontaneously when properly made and pure. The firing point is maintained to be

Dynamite

360°F.

It is a detonating not an igniting compound Its full effect can only be produced completely by the shock caused in exploding some other explosive compound in sufficiently close proximity to it, so that the concussion effected by the latter shall produce sympathetic explosion. Dynamite is a mixture of nitroglycerine with any dry solid substance wheth vegetable or mineral so pulverized and mixed that on the

The rue hand the minture contains sufficient sutw-glycume to Jour an officient reflorin compound and of the other hand The proportion of the absorbut used is sufficiently labor to hold The milew-glycerine against cleakage. Supreaul rarth has so for him formed to weel all other outstances Tries as hhow truts. Dualin Quality is a mixture of Hillo-gly circus cawdust and retrate of potassa. Oft is non sensition to heat Then dynamite fome of the names of the other replosins are Rent Rock Mica Powder in which The mica Jourder To the abjorbuit - Stis also claimed that in The latter as the much scales gives an almost impinite number of comparationly clear interstitial to spaces feterin the individual scales of The mixture this condition mables The flame and mitration of the zeploder to reach shere fortion of the carthidge mu non quickly than with The same might of June Sutro-gly cerim in liquit form. Resp solfully Subuilles Sings What To Major G. D. Eulerson Grogensor in Civil Eugeneering.

Dualin

the one hand the mixture contains sufficient nitroglycerine to form an efficient explosive compound and on the other hand the proportion of the absorbent used is sufficiently large to hold the nitroglycerine against leakage, Infusorial earth has so far been found to excel all other substances tried as absorbents.

Dualin is a mixture of nitroglycerine, sawdust and nitrate of potassa. It is more sensitive to heat than dynamite. Some of the names of the other explosives are, Rend Rock, Mica Powder in which the mica powder is the absorbent, -- It is also claimed that in the latter as the mica scales give an almost infinite number of comparatively clear interstitial air spaces between the individual scales of the mixture this condition enables the flame and vibration of the exploder to reach every portion of the cartridge even more quickly than with the same weight of pure nitroglycerine in liquid form.

То

Major G. D. Emerson, Professor in Civil Engineering.

Respectfully Submitted, George W Cole

Rock Drill Rock Drill Su 1813 Richard Trenthick The distinguished English sugineer is said to have suggested rock drilling by machinery the Singer drill as now un Ellusis is considered to have been the forse successful machine for its purpose In the ordinary methos of horizing holes for Hasting by sticking at the rus of the Har with Kenny hanners a great Fortion of the affect in lost by what is commonly called "levertia" of The bar. For over come This Her Waxaugth proposed to count The har wato a fiston work to more tim an air light cylinder Through a stuffing hox. They this means when the fistow is drawn to The sud of the cylinder The pressure of The atmosphere will give ut back again with an accumulating velocity and The How struck will have much greater affect The prot american serenssion rock drill was unruled by Couch of Philadelphia. In his duill the duill bar Jasow the directly through the jiston of the sugue and was alternately caught, drawn back by thrown like a lance against The rock. Some of characteristics of a good rock dull are i It should be sumple the completion I strong in every fait " " consist of few farts " I'v tight in might No other fart them The fiston should be reposed to malei shocks.

Rock Drill

Rock Drill

In 1813 Richard Trevethick the distinguished English engineer is said to have suggested rock drilling by machinery. The Singer drill as used in Illinois is considered to have been the first successful machine for its purpose. In the ordinary method of boring holes for blasting by striking at the end of the bar with heavy hammers, a great portion of the effect is lost by what is commonly called "inertia" of the bar. To overcome this Mr Nasmyth proposed to convert the bar into a piston rod to work in an air tight cylinder through a stuffing box. By this means when the piston is drawn to the end of the cylinder the pressure of the atmosphere will force it back again with an accumulating velocity and the blow struck will have much greater effect. The first American percussion rock drill was invented by Couch of Philadelphia. In this drill [the] drill bit passed th directly through the piston of the engine and was alternately caught, drawn back and thrown like a lance against the rock. Some of characteristics of a good rock drill are: It should be simple in construction & strong in every part consist of few parts be light in weight

No other part than the piston should be exposed to violent shocks.

M Hewt 12 $(4 \times 3) \times + (1 \times 3) \times = (1 \times$ 15. 2 65 A+65 1 65 + 4 65 3/4 - 10 4 = 4 1 1 = 4 + 6 v 4 11 $\frac{11}{44} = \frac{36}{44} + 65$ - 25 = 65 40 - 25 JOSTO (23 40 - 25 JOSTO (23 10=3 46 % × ۲

[CALCULATIONS]