THESIS

DRAINAGE & MINES.

W.P. KIMBLE.

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Drainage of Mines

The subject of drainage is one of the most important of all practical mining operations, since in a mine when there is a surplus of water it is necessary to prevent this accumulation before it can be worked with profit to the owners or safely to the workmen. In no respect do mines differ from each other, more than in the quantity of water which they contain or is met with either in obtaining access to or subsequent working of the mineral. The quantity of water which may find its way into a mine cannot with any degree of certainty be estimated beforehand. One may judge somewhat of this amount, by the character of the rock which is intend and the capacity of the country for furnishing springs or wells. Yet this is no certain for the ground may burst at the
surface and dry beneath and vice versa. The capacity of the rock for furnishing water varies, some rock being very dry as lime stone, trap rock, granite etc. while some other kinds furnish an abundance of water. In some cases a layer of clay or slate may prevent the influx of water and in other cases a layer of sand or gravel alluvium, which contains immense quantities of, and is easily penetrated by water. In coal mining, water having measures of a almost fluid consistency must be passed through in some districts, while in other places, comparatively tight measures may be at once enjoyed. The deepest mine in this state (the C stylus mine) is perhaps the best. The roof being formed of dry tight strata.
The Lake Superior copper mines are mostly in trap rock and they are comparatively dry. When the rock is stratified and having considerable dip, it is generally dry at the higher
orgions and cut at the lower portions of the rock. If the rock is stratified and lays horizontal there is generally a porous amount of of the water in the hilly portions of the country the in the level surface. In all instances it may be stated that the amount of water in a mine increases with the extent of workings apart from any other cause which may influence it.

There are two general ways by which mines are drained or freed of their surplus of water. 1st. By adits. 2nd. By mechanical means. And it is often and generally the case that these two processes are combined. By Adits: An adit cannot be used when there is no natural outlet for the water, below the portion of the mine which is to be drained. This can only be obtained in hilly and mountainous countries. The advantages of the use of adits are viz. 1st. A complete system of drainage for...
all parts of the adit on the level of the adit. It furnishes the best possible means of ventilation. 2d They furnish the best and cheapest means of transportation of the ore from out the mine. An adit will also furnish water power for the pumping of water from the workings below its level, if the workings extend beyond this level. Among some of the German mines there are adits running six miles from 6 to 25 miles, none of which have an average depth of 2000 feet below the surface, and are used for drainage, ventilation and as a canal for the transportation of the ore. The Sydney tunnel is another example where the shafts are taken advantage of, viz. drainage, ventilation, and transportation.

Mechanical Means— Before the practical introduction of the steam engine, the modes of removing the water from underground
excavations were very incomplete as well as laborious. The chief ways were by the application of horse power or a water wheel to an endless chain, or to the winding of water in ox-skins or barrels. There was little advance made in this direction from the beginning of the 16th century up to the latter part of the 18th century, and even still later some of our mines labored under the disadvantage as of old in their pumping work viz. that it was supposed water could not be raised more than 33 feet at a lift with an ordinary pump, and other pumps were employed they were divided into lifts of about 30 ft. each. This multiplication of machinery necessarily crowded the shaft, and the cost of such a pump system was very great and the annual expense of keeping it up almost equaled the first cost. However, of late, years much
Innumerable has been spent in various directions in order to obtain cheap, safe and reliable means for the lifting of the water from out of mines. The simplest form of machinery and one that has been and is used to a considerable extent, in this and other countries, is known as the tub and windlass. This being used is precisely the same manner as the mineral is lifted from the mine. A large tub is sometimes substituted for the tub and arranged with a valve in the tunnel, which opens and allows the water to fill automatically when it reaches the pump. This method was employed at the Alcadder mines in ammonia water from a depth of 100 feet. The tube employed was cylindrical in form and made of iron and sliding tube upon guides along the incline. This simple process was employed in many of the mines along the Cornstock lode. The tub when it reached the surface was...
impelled as simple as it was filled, a launder laid upon
rails on either side of the shaft, was pushed six inches under it, the stone
was then allowed to descend and rest upon the cross-trees and by rais-
ing the valve the water was discharged into the launder and con-
veyed away, without the necessity of removing the tub from out
the line of the shaft. This method is used in France with an ad-
ditional improvement in the manner of impelling the tubs, instead
of coming to a rest, is allowed to descend slowly until it strikes
a removable frame or "knocker" (see Fig. Page 8) which throws open
a separate discharge valve and allows the water to escape.
By this means as much as 3800 gallons of water has been raised
from a mine 600 feet deep. By Syphons—An other simple
method for the drainage of small mines and one that is ofter
used in quars is by the application of the syphon.
This horse is not applicable when the water is to be raised more than 30 feet and can be used only where thin cans be obtained for the delivery end of the pipe, an assisted hour than the surface to be drained. A very good illustration of this manner of drainage has been successfully and economically employed in the town of Cal. A clippers was used here on 100 feet in length and 4 inches in diameter. The water was raised 15 feet and had a fall of 40. With a difference of 22 feet between the two levels of the clippers, the ends were controlled by stop-cocks, which regulated the flow of water. This means of drainage when feasible may be recommended for its simplicity and cheapness.

By pumping engines. The engines employed at present in the pumping of water from wells and from reservoirs and dams, but these are but three principal types, viz. —
1st. The single acting balance beam engine, known as the Cornish engi
2d. The single acting actuating engine, working the pump rods
direct without a balance brace. This is known as direct actuating "Bell"
3d. The double acting engine placed in the interior of mines.

Of the various forms of "pumping engines" the Cornish engine
is considered to be the best and most available for mining
purposes. For economy in the use of fuel and efficiency
At the consolidated mines England from 2500 to 3000
Gallons of water an raised 1200 feet per minute. These engi-
ines being provided having a total horse power of about 4000.
about half of which is constantly in use. This brings the
average duty of the Cornish pumping engine to about 60,000-
1,000 pounds of water lifted 1 foot height in consuming one (1)
bucket (80 pounds) of coal, which is nearly 800 tons lifted 500 feet.
in the consumption of one ton of fuel. This duty com-
pared with other engines gives very favorable results.
As being double that of the direct
acting, or "bull" engine and from three to four times that
of the ordinary engines employed. But taking into con-
sideration the simplicity of the direct acting and its perma-
nent and reliable character, with the abundance and che-
apness of our coal, I think that these engines are superior and
fitter adapted to the mines of our country. The bull or direct
acting engine is a simple cylinder whose piston connects direct-
ly with the pump rods. These cylinders when used in a vertical
shaft are placed directly over the column of pumps, and if used in
an inclined shaft they are placed with the pump rods at the col-
umn of pumps. The straw is applied directly to the lifting of
the code, and the pressure upon the piston must be equal to or greater than the column of water in order to raise them, and the weight of the code, and must be equal to or greater than the column of water in the pumps, since the out of the code allow raise or force up the water. Due concomitantly the two above named engines we have the advantages for the two viz.

1st for the Cornish engines—This form is better adapted when a great diameter of cylinder is required, because they do not obstruct the mouth of the shaft, because of the stability of their foundation, being at some distance from the shaft, and because access can be had more readily to the different parts of the machinery for cleaning and repairing. 2d advantages of the direct acting engine—They have been found to give that result to which the diameter of the pistons does not exceed 60 inches
and that of the pumps 20 inches, the placing of them is more simple, they occupy less space, and are in most cases to placed in one compartment of the shaft used for hoisting, and they do not require a separate building, the engine throughout is much more simple than the other types. The double acting engine placed in the interior of mines, has been used in France at depths of from 300 to 600 feet and for quantities of water as high as 21,000 hectoliters per day. The engines are placed from 30 to 40 above the level of the bottom of the mine, to avoid the flooding of the pumps in case of an accident to them. The water is lifted from the pump to the pumping engine by ordinary lift pumps. There is but little to be gained in the use of these pumps the chief gain is in a deep mine where there is not room for a
double column of pipes and whenever is not sufficient to drain
the mine. By the use of the double acting pumps, steam is em-
ployed in lifting and forcing the water, by this process
the same column of water made to throw double the amount of
water as it would with a single acting pumps. There is but
little difference in the construction of the pumps and one is
not subject to derangement more than the other. Precaution
in a mine which produces 500 gallons of water per minute.
or now less it is a bad policy to trust its drainage to a
single pump of 500 gal. per minute capacity. As all mi-
n ing machinery wears perfect it may be subject to
accidents in various ways, and a few days delay in the
pumping machinery would be sufficient to inundate the
pumping machinery mine which would result perhaps
will the loss of life, and an enormous expense to put the mine in a satisfactory working condition. As a general rule I will state this fact, which after full consideration I think I will try to meet. In any deep and extensive mine or one which furnishes any considerable amount of water, it is unsafe to trust the mine to less than double the pumping capacity required to keep out the daily surplus of water. And indeed it is unsafe to trust a mine with a single pump of double capacity. It is much better to employ two pumps of double each having the capacity to keep the mine clear of water and worked by independent engines. In addition to the danger of immediate from accident to the machinery, there is always a liability especially when a mine has been operated for a number of years and has become very extensive and deep, then it
of a sudden and unlooked for inundation of water, which is caused sometimes by the tapping of a spring or a subterranean stream, in advancing of the workings. But this inundation of water is caused more frequently from the sudden floods caused by long and heavy rains, which result in the caving in of the old and abandoned workings. The tainting of their old workings often opens channels for the admission of torrents of water pouring in from the valleys of the mountains under such circumstances. Hence for this reason it is that I say the best, safest, and cheapest way is the end its proof for mines, not only double pumping capacity—but independent pumps and engines.

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