

THE CALUMET AND HECLA COPPER MINE.

BY WILLIAM F. KIBBIE.

The Calumet and Hecla stamp mill, the largest of the kind in the world, is situated at Lake Linden, Mich.

There are practically two mills in one, of eleven ball heads each, and having a capacity of 6,000 tons conglomerate per day.

The metal is found deposited in the rock in all possible forms. The separation of the copper from the rock is effected by passing the stamped rock over a system of jigs, whereby the sand by its less specific gravity is floated off into a steady current of water, and the copper, being the heavier, settles and falls through the sieves. One line of jigs succeeds another, over which in succession the copper, which has just passed through a previous set of sieves, is made to pass, and the sand, which is sustained in the water, is carried away by the current of water to the lake by a system of sand wheels and launders.

The number of jigs and the velocity of the current are so regulated as to secure the desired separation, with very little loss of copper. The Evans slime table is an important adjunct in copper washing; its use in saving copper from the waste, that is, the small particles, is pre-eminent.

The head current of water coming from the stamp heads, in which float the light copper and fine dirt, is turned from the main launder into lateral ducts, which convey it to the large slime tables over whose conical shaped, slow-moving surface it is made to pass.

The stamp mills and copper washing machinery used at the copper mines on Lake Superior have reached a high state of perfection. The advance which has been made in this region in this department of mining work, from the crude iron shod wooden stamps and hand buddles of an early day to the stupendous structures with their intricate machinery that now successfully perform the work, is certainly wonderful. The simple mill, wherein could only be crushed and manipulated a few tons of rock per day, and at a cost too great for a profit, has given place to those with a capacity of 5,000 and 6,000 tons per day, wherein the manipulation is attended with but a tithe of the cost and difficulty which were inseparable from the earlier attempts.

This work has been so perfected that thirty-three cents per ton would cover the entire cost of treating a ton of rock in the stamp mill. Perfect and systematic as the mechanical manipulations in copper mining have become, there is yet a waste of copper in the tailings. This waste varies from one-fourth to one-half per cent, and this in the aggregate product of the Calumet and Hecla mill, which stamps 4,000 tons of rock per day, average, represents a very important value at the end of each year.

At the present time the Calumet and Hecla mill is stamping between 4,000 and 5,000 tons of rock per day.

The pumping engine Michigan, the largest in the copper country, has a capacity of 60,000,000 gallons every 24 hours. The engine is of the triple expansion pattern, has steam cylinders 18, 28½ and 48 inches diameter by 90 inches stroke, and is capable of lifting 1,400 gallons at every revolution. Its height from base to summit is 56 feet. The diameter of the flywheel is 25 feet and its weight 30 tons. The foundation upon which the engine rests contains 912,000 bricks, 3,000 barrels of Portland cement, and 300 tons of granite cap stones.

The big sand wheels are 50 feet in diameter, and have a lifting capacity of 30,000,000 gallons of water each and 3,000 tons of sand every twenty-four hours.

The sand from the mill carried out into the lake by a system of launders has made hundreds of acres of artificial peninsulas, while the lake itself, once a beautiful blue, is now dyed to a deep pink from the effects of the red conglomerate. The yield of refined copper at the Calumet and Hecla mine to cubic fathom of ground broken, is 850 pounds; yield of mineral per cubic fathom of ground broken, 1,130 pounds; yield of refined copper per ton of rock stamped, 52.78 pounds; percentage of copper in stamp rock, 75 pounds average.

During 1895 the Calumet and Hecla mill treated on an average 4,000 tons of rock per day, which yielded an average of 5,000 tons of mineral per month.

A conception cannot easily be formed of the tremendous displacement that is going on underground in this mine. Imagine a great trench two miles long,

ber in a week was 12 feet. The cost of sinking averaged \$25.70 per foot.

The hoisting plant at the Calumet and Hecla mine is probably the largest and most powerful of its kind in the world. The great Superior engine which operates the hoisting drums at the Calumet branch develops 4,600 horse power. The shaft of this engine is of steel, 16 inches in diameter, and the balance wheels, of which there are two, are 33 feet in diameter and weigh 40 tons each. The engine is run to a speed of 55 revolutions per minute.

The other hoisting engines, of which there are ten, have a horse power of 2,000 to 3,500 each. Five of these are of the triple expansion patterns, and are monuments to the master genius Leavitt.

The hoisting drums, around which the wire rope attached to the skips coils itself, are 30 feet in diameter. Electric indicators and bells tell the engineer when to start and stop the motion of the drum. At the Red Jacket shaft of this mine an endless wire rope measuring 9,800 feet conveys the skips loaded with copper to the surface.

From observations taken by the writer in the Calumet mine, it is found that the temperature increases only one degree in every 250 or 300 feet of descent, and the increase is barely noticeable in the bottom of the mine, except in some shafts, and even then is not op-

pressive, as is claimed.

The exact temperature at the bottom of the Red Jacket shaft when the drilling machines are working is 78 degrees, and when the machines are shut down, and have remained so for some time, the temperature does not exceed 81 degrees.

True, there are places in the Calumet and Hecla mines where the thermometer registers 105 degrees, and even 108 degrees, but this is in the pump rooms at the eighth, sixteenth, twenty-fourth and thirty-third levels of Nos. 4 and 5 shafts, and this excessive heat is caused not by the internal heat of the earth, but by the big four inch steam pipe which carries the steam from the boiler house on the surface to the various pumps underground, even to the very last one on the line, 3,300 feet below the surface.

A fact to which some will hardly give credence is that the temperature in these mines is lower in summer than in the winter time.

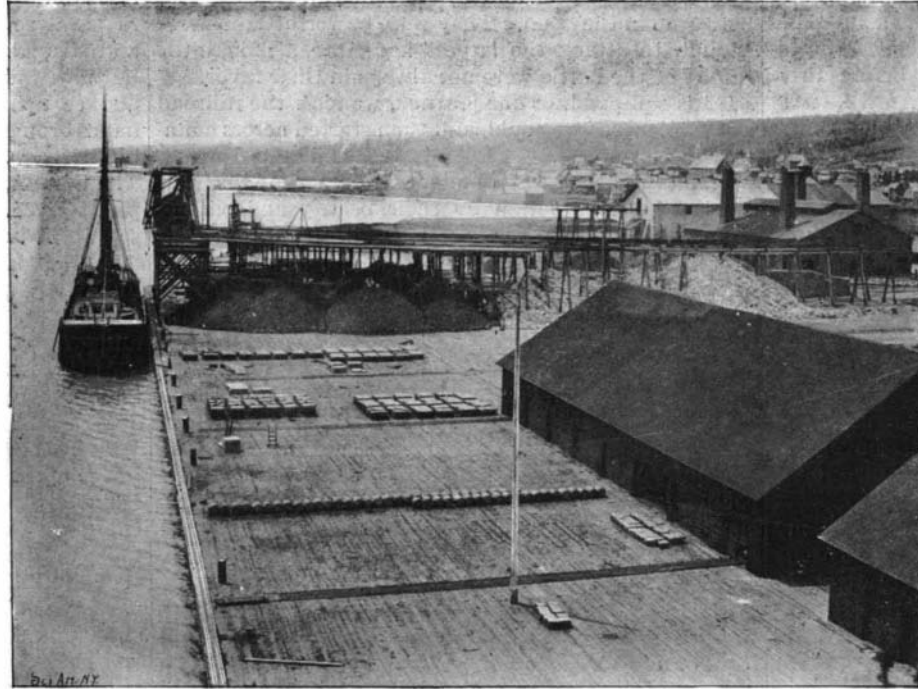
Fruit as Medicine.

Why for ages have people eaten apple sauce with their roast goose and sucking pig? Simply because the acids and peptones in the fruit assist in digesting the fats so abundant in this kind of food. For the same reason at the end of a heavy dinner we eat our cooked fruits, and when we want their digestive action even

more developed we take them after dinner in their natural uncooked state at dessert. In the past ages instinct has taught men to do this; to-day science tells them why they did it, and this same science tells us that fruit should be eaten as an aid to digestion of other foods much more than it is now. Cultivated fruits, such as apples, pears, cherries, strawberries, grapes, etc., contain on analysis very similar proportions of the same ingredients, which are about one per cent of malic and other acids, and one per cent of flesh-forming albuminoids, with over 80 per cent of water. Digestion depends upon the action of pepsin in the stomach. Fats are digested by these acids and the bile from the liver. Now, the acids and peptones in fruit peculiarly assist the acids of the stomach. Only lately even royalty has been taking lemon juice in tea instead of sugar, and lemon juice has been prescribed largely by physicians to help weak digestion, simply because these acids exist very abundantly in the lemon.—Pop. Sci. Monthly.

The X Rays in a Patent Suit.

In an action for infringement recently tried in England, the plaintiff submitted as an exhibit a "shadowgraph" of a box made with the Roentgen rays, to show that certain fasteners made by the defendants had the same function as those covered by the plaintiff's patent.—Illustrated Official Journal.

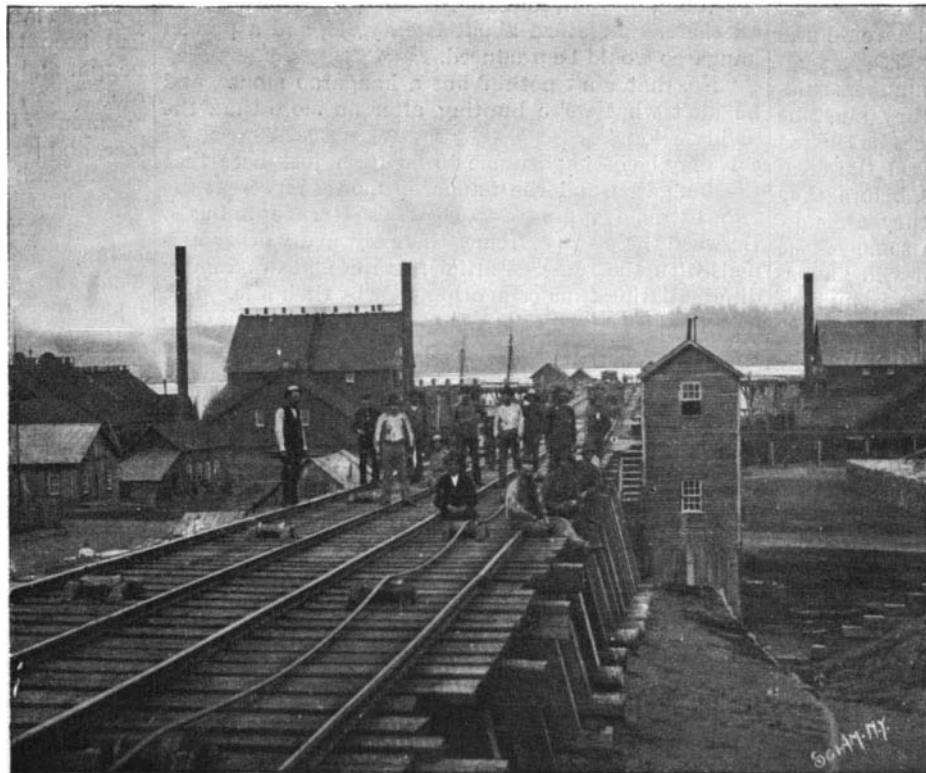
**ORE DOCKS OF THE CALUMET AND HECLA MINE.**

twenty feet wide and one hundred feet deep, and you may form some idea of the openings which the annual product necessitates.

Many persons will wonder how long the mine can last with such a great production. But when they are told that the mine is at present, opened up thirteen years in advance of the stopping, they will cease to wonder. Besides this, they have territory as yet untouched which insures thirty years more at the present rate of production.

The Red Jacket shaft of the Calumet and Hecla copper mine is the deepest in the world. Imagine a great hole measuring 14 x 22½ feet inside the timbers, penetrating into the bowels of the earth, straight as an arrow, for 4,900 feet. This shaft which has a capacity of four times that of the old shafts, is constructed after the following manner:

The first cross cut which connects the shaft is at a depth of 2,106 feet, has a length of 1,553 feet, and intersects No. 4 shaft at the 36th level. The second cross cut, at a depth of 2,290 feet, intersects the "lode" at the 39th level, while the third cross cut intersects it again at the 42d level, at a depth of 2,463 feet. From the latter intersection the levels range 90 feet apart, and afford access to all parts of the mine. Each level has three openings at the shaft proper, which is the main entrance, while on the northwest and south sides the

**CALUMET AND HECLA STAMP MILLS.**

openings are made with a curve until they reach the main drift, at a distance of 175 feet from the shaft proper.

The largest number of feet sunk in any one month was 69½, and in one week 17¾ feet, and the least num-

Refining Silver by Electrolysis.

The electrolytic method for refining silver, which was devised by Mobius some time ago, appears to be in successful operation now at the works of the Pennsylvania Lead Company and elsewhere. The process is distinctly interesting on account of the new features which it involves. The silver to be refined is first treated by ordinary well known metallurgical processes to reduce the quantity of other metals present (lead, copper, bismuth, etc.) to at most 2 per cent. It is then cast in sheets measuring 45 x 25 x 1.3 cm. and weighing 13-15 kilos. each. These serve as anodes. The cathodes are formed of thin, rolled sheets of pure silver, 33 x 55 x 2 cm. in size. The electrolyte is a solution of the nitrate of copper and silver, to which 0.5-1 per cent of nitric acid is added to prevent the deposition of the copper. Four cathodes and three anodes are placed in each cell at distances apart severally of 43 mm. The anodes are inclosed in muslin bags for the purpose of intercepting the undissolved matters which fall from them as the action proceeds. These consist of gold, bismuth, the principal portion of the lead (in the form of dioxide), and a little silver and copper. A sheet of woolen cloth stretched on a frame near the bottom of each cell catches the silver as it is removed from the cathodes by a mechanically moved wooden scraper. The intensity of the current employed is 18 amperes per square foot of cathode surface. The silver is collected from each cell at intervals of two days, the gold once a week. The silver is washed with water and then melted in graphite retorts capable of holding 560 kilos. each, and is thus obtained of a fineness of 999-999.5. The residue of gold, etc., after being melted, granulated and treated with acid, gives gold of a fineness of 996-998. In the above process, care must be taken that the amount of copper in the electrolyte does not exceed 4-5 per cent, as otherwise the silver is not obtained in a pure state.—The Electrical Review.

THE PROVIDENCE HORSELESS CARRIAGE RACE.

In the last issue of the SCIENTIFIC AMERICAN we gave an account of the first two heats run on the Narragansett Park track at Providence, R. I. Owing to a severe storm which swept New England during the race week, the plans of the managers were upset and

the electric carriage made the fastest five miles, covering the distance in 11:27. The prize money was reduced on account of the five heats not being run. The first prize, of \$900, was adjudged to the Riker Electric Motor Company, of Brooklyn, N. Y.; the second prize, of \$450, to Morris & Salom, of Philadelphia, Pa. The contest-



CALUMET AND HECLA SMELTING WORKS.

ants were anxious to run the other heats, in spite of the weather, but the management declined. The announcement of the success of the electric carriages created some surprise, as it has been thought lately that motors using some form of petroleum were best adapted for horseless carriage use, and the electric motor has been somewhat discounted. The electric carriage has made a record for speed, and the great ease of control and the absence of noise and odor will commend it to those who are anxious to purchase horseless carriages, but whether they are adapted for long runs or not still remains to be proved.

The entries were as follows (but in one case several carriages of the same make were entered under different names): Duryea Motor Wagon Company, Springfield, Mass.; Morris & Salom, Philadelphia, Pa.; W. Lee Couch, New Brighton, Pa.; Lewis Brown, Sawkill, N. Y.; J. Frank Duryea, Springfield, Mass.; George H. Hewitt, Springfield, Mass.; C. Mayhew & Son, Saratoga Springs, N. Y.; Riker Electric Motor Company.

Electric Farming.

The agricultural department of the Cornell University recently published the results of some experiments extending over a period of six years, upon the effect of the light of the electric arc lamp upon the growth of plants. There were two houses, both of which were exposed to sunlight during the day, and one of which received in addition the light from an arc lamp during a part of the night. The arc lamps were inclosed in clear glass globes. It has been observed that the effects of the light of one inclosed in a glass globe are markedly different, the former in some cases proving injurious instead of beneficial to the plants. It was found as a result of these experiments that there was a decided beneficial influence on the growth of lettuce, and that there can no longer be any doubt as to its advantages in forcing this plant. With seed sown under ordinary conditions, and the young plants placed under the influence of the light after they are well established, will show marked improvements up to a distance of forty feet. One curious thing was noticed, that the effect of the shadow of a beam or rafter cast by the electric light showed plainly on the leaves. It is stated in this report that Mr. Rawson, a fancy truck farmer near Boston, now uses the electric light in the com-

mercial forcing of lettuce. He has three lamps of 2,000 candle power each, which run all night. The hothouse covers nearly one-third of an acre. Mr. Rawson finds that he obtains a gain of five days per crop during the winter, which makes a gain of three weeks for the three crops during the winter. The gain from one crop, he estimates, is sufficient to pay the expenses of operating the electric lights during the whole season.

Prof. Bailey's experiments at Cornell confirm those of Mr. Rawson, as he states he finds many plants grow more rapidly when under the influence of the electric light at night. Among these are the daisy and the violet. He is convinced, he says, that the light can be used in forcing certain plants.

X Ray Experiments in Japan.

We have received from Y. Yamaguchi and T. Mizuno, professors of physics, Daichi Kotō Gakkō, Tokio, Japan, an interesting pamphlet containing numerous excellent



THE PROVIDENCE HORSELESS CARRIAGE RACE—THE START.

only one more heat was run, the winners being Morris & Salom; the Riker carriage was only a few yards behind.

The fastest mile was made by the Riker electric carriage, the time being 2:13. The Morris & Salom elec-

Brooklyn, N. Y., P. F. Olds & Son, Lansing, Mich.; and Fiske Warren & Company.

Great interest was manifested in the races, which were witnessed by 5,000 spectators. Our engraving shows the carriages lined up for the start.

half-tone reproductions of good X ray photographs. The text is entirely in Japanese, but the pictures speak for themselves, and indicate a high degree of skill of the Japanese investigators in this new branch of physics.