Company's pits are in part inter-glacial and in part pre-glacial, but probably all newer than the Horse-Fly gravels. The deposits near Lytton which are being worked by the Van Winkle Company are in the main still more recent, consisting chiefly of the river benches or terraces, by which the Fraser Valley is lined, and which have been formed by the gradual cutting down of the river itself after the close of the glacial period.

The geological conditions of occurrence of auriferous gravels in British Columbia, even as already known, are somewhat complicated and as work progresses great additions to our knowledge may be expected. The circumstances differ considerably from those met with in California, because of the general action of glaciation to which British Columbia has been subjected. The older gravels, where not covered by a basaltic capping, are often buried under boulder-clay, while above the boulder-clay or between two deposits of this kind, are to be found extensive masses of later gravels. The study of the facts relating to the glacial period are therefore here likely to have an important bearing on the economic problems of the gold placers and the tracing out of the old auriferous drifts.

## The Albert Mines and Capelton Chemical Works.

By Mr. S. L. Spafford, Capelton.

These mines and works are situated at Capelton, Que., and owned by the Nichols Chemical Co., of New York city, successors to G. H. Nichols & Co. The ore occurs in the pre-Cambrian formation.

Veins are the filling of cracks or fissures; these cracks or fissures may either extend through the earth's crust and divide it for long distances, or they may reach down only to a limited depth or be confined to single strata, so veins are exceedingly various in extent. They may be many rods in width or they may be very thin. Strata having been faulted, so veins also may have their faults and displacements. The subterranean movements that produce joints and fractures in rocks may give origin and peculiarities to veins. Faults may divide veins not only into parts that are little displaced, but into portions that are shoved hundreds of feet above or below, which of course is very perplexing to the miner.

Fissures, that have been filled gradually without eruptive aid, are veins of infiltration, and those through the agency of igneous eruptions are contact veins. The latter is considered the most prominent in depth. There seems to be a diversity of opinion as regards the formation of the veins at Capelton and Eustis, but let that be as it may, the work done by the Nichols Chemical Co. and the Eustis Mining Co. have proven the deposits to be of enormous extent.

There are a large number of ore deposits in the Capelton district, all of which are found running in a north-east by south-west direction.

About 32 years ago prospecting was first commenced at Capelton, and soon after that mining operations were commenced on lot 2, range 9, and at shaft known as No. 5 Hartford, which is now operated by the Eustis Mining Co.

My notes concerning the mines will now refer specially to those owned and operated by the Nichols Chemical Co. Their workings consist of shafts Nos. 1, 2, 3 and 4. The present depth of No. 1 is 2,100 feet on the slope of the vein, which averages about 30 degrees from the horizontal. When the above company first commenced operations sixteen years ago, this shaft was only 300 feet deep. No. 3 shaft is about 400 feet deep and No. 4 is about 700 feet deep. The longest level in the latter is a little more than 650 feet, following a productive vein all of that distance, except for about 50 feet where a cross course disturbed the lode, forcing the vein to the left, or back into the foot that distance. The cross course causes a displacement of the vein on the horizontal, forcing it either to the right or left. It is a matter of great importance to the miner to know in which direction he will find the vein. If approaching the cross course from the west it is usually a left hand throw, but there is no rule that can be depended upon.

The method of mining is by sinking the shaft about 8 by 12 feet in advance of the other workings. Levels are then extended on the vein and the ground is blocked out by sinking winzes or raising from a lower level to one above it. In distance apart these levels are from 65 to 100 feet, thereby giving very high and long stopes.

In No. 1 shaft the deposit has a length of about 300 feet, and varies in width from 2 feet at the ends to 45 feet at the widest place. Slides have been met with in different places. These faults merely caused displacements of the vein, the most prominent being an upthrow of 20 feet. The vein is also crossed by a very large trap dyke, which does not in any way disturb or affect the vein.

The selvage being wavy causes irregularity in the width of the vein. The dip, which is to the south-east, is very irregular also. In some places it is almost perpendicular, while in others it is nearly horizontal.

Large pillars of ore are left standing in suitable places to support the roof of the mine. Usually the ground is firm, but occasionally the heavy blasting loosens bands of slatey rock which are kept in place by heavy and very large timbers.

The bottom part of the mine is very free from water. The surface water is caught in large cisterns near the surface. The pumps used were manufactured by Guild & Garrison of New York. The water being strongly charged with copper in solution, which is very destructive to iron, it is necessary to have the water end of the pumps made of bronze, and the piston, piston rod etc., made of brass. Three inch cast iron pipe is used for conducting the water to the surface.

The battery of tubular boilers at No. 1 shaft consist of seven set parallel with each other. Four of them are 80 horse power each, one 60 horse power, and two 50 horse power each, making a total of 480 horse power. For steam purposes bituminous coal is used entirely.

Two Air Compressors, one a compound Norwalk, main 20 x 24 in. cylinder, the other an English duplex 16 x 36 in. cylinders furnish the compressed air for drillling. There are three large air receivers, the largest being 6 feet by 30 feet, and the air is carried from them down the shaft in 5 inch and 4 inch pipes where it is at different points diverted in smaller pipes to the many different workings where power drills are in operation. Ingersoll-Sergeant and Rand power drills are used.

The hoisting engine is a double friction winding engine, 20 x 24 in. cylinders, 250 horse power, speed 700 feet per minute, with two drums 6 feet in diameter, each drum has a powerful spur wheel keyed on drum shaft, which meshes the driving pinion on engine shaft.

The hoisting rope used on these drums is made of the best plough steel, breaking strain 30 tons. It is 1 in. diam. has 6 strands with 19 wires in each strand and hemp centre.

Automatic dumping hoisting skips are used, which are made of heavy steel plate, and have a capacity of 3 tons.

The machinery in the concentrating plant is driven by an 18 in. x 24 in. single straight line engine, having a driving wheel 24 in. by 10 feet.

The plant also has a 400 h.p. surface condenser, the circulating water being supplied by a compound pump, having an 8 in. suction and a 6 in. discharge.

The head house is 75 feet high. The ore discharges out of the skips on to a series of bar screens, after which the very largest pieces pass through a 15 in. x 30 in. ore breaker. The ore of proper size for hand picking passes from the screens on to a travelling picking table, 4 ft. wide by 32 ft., which is driven by an 8 in. belt. A few boys stand on each side of the table and pick out the rock while the table is in motion conveying the ore and discharging it into two 6 in. x 20 in. ore breakers, and these break it down to proper size for transportation. The fines, which include all that pass through a one inch screen, is conveyed by elevator to a revolving screen, which separates the fines from the half inch and larger. The latter for further sizing down is put through the Cornish rolls which are 15 in. x 30 in., and it is then conveyed to the last revolving screen, delivering each size to their own jigs. The concentrating plant produces three sizes of ore, viz:—lumps, smalls and fines.

Shafts No. 3 and 4 are each equipped with two 75 horse power tubular boilers, and each has a 75 horse power friction drum winding engine. The two air compressors at No. 1 supply all of the compressed air required. The distance between No. 1 and No. 4 is about 1,500 feet.

The hoisting and concentrating machinery was supplied by Mr. Earl C. Bacon of New York.

The ore is transported from the mine by wire rope tramway to the stock sheds near the Boston and Main siding. The tramway in use was patented by Mr. Hodgson. Its construction consists of an endless wire rope, one inch diameter, and 9,400 feet long, running on grooved sheaves, 24 in. diameter, which are secured on the cap piece of the bents or supports. In order to make the grade as regular as possible the bents are from 15 ft. to 50 ft. high and they are 100 feet apart. At each end of the line there is an 8 ft. sheave around which the rope runs. The buckets in which the ore is carried are made of wrought iron and each holds 350 lbs. At each terminal there is a fixed rail. The box heads or saddles which carry the buckets, have two small wheels on the side, and when the bucket arrives at either end the wheels ride on the fixed rails and the bucket can be filled or dumped while the rope keeps in motion. The buckets are hung on a wrought iron hanger which is secured to the box heads. The loading end of the line is about 500 ft. higher than the discharge end. The speed is controlled by a 15 h.p. engine which is geared to the pinion or driving sheave shaft. The capacity is 200 tons in 10 hours. The coal consumed at the mine is also conveyed by this tramway.

The owners of the mines have always utilized the whole ore product, the first treatment being converting the sulphur contents into Sulphuric acid.

Brimstone was first used for sulphuric acid making but since cupreous pyrites has come into market, brimstone is to quite an extent driven out of sulphuric acid works. The sulphur in pyrites must be driven off before the copper can be obtained, consequently its sulphur will probably always be cheaper than brimstone.

Pyrites for sulphuric acid making was first used in 1818. Considerable difficulty was experienced in lighting the kilns because it was attempted from below. It was discovered by accident that lighting them from the top was the quickest way and since then that method has been used.

It is said that in 1614 the apothecaries produced sulphuric acid by burning sulphur in moist vessels with access of air. The price of acid at that time was $6.00 per pound or $12,000 per ton. In the year 1740 acid making was carried on near London and the price was reduced to 45 cents per pound.

In 1746 Dr. Roebuck of Birmingham introduced the first lead chambers. In France the first lead chambers were erected by Holker in 1766, while in Germany they were not introduced until the year 1820.

Chemical works were first constructed at Capelton in the year 1887. The works were designed by Mr. J. B. F. Herreshoff of New York City. The main buildings are 175 feet long by 75 feet wide and 3 stories high. These buildings being very wide made it necessary to use the truss roof, which is covered with slate supplied from the quarry near Richmond Que.

The kilns are constructed of fire bricks and have cast iron fronts, each burner being independent of the other. The percentage of sulphur in the ore controls to quite an extent the quantity of ore which can be burned per superficial foot of grate surface.

Usually the results are from 30 to 45 pounds per square foot in 24 hours. The ore should be used neither in too large nor in too small pieces. If the pieces are too large the sulphur would not properly burn out, and then would remain green cores in the interior of the cinders. In the other case if the pieces are too small they prevent the proper access of air.

The oxygen of the air being transferred to sulphur dioxide ($So_2$) through the interposition of the acids of nitrogen and with the aid of a vapor (steam) produces sulphuric acid as a final product. The substances coming into question here, except the final product are in the state of a gas or a vapour. For reaction it takes a certain time, therefore there must be a large chamber space given so the gas can remain for some time. The gases and acids being very strong, quickly destroy wood of any kind, anb it is necessary to construct all acid chambers of lead.

The Glover Tower, which in its special structure is patented by the Nichols Chemical Co., occupies an intermediate position between the kilns and chambers. It is a rapid and economical concentrator, besides being valuable for dinitrating.

Pans are used for concentration of the sulphuric acid. The final products are oil of vitriol and extra concentrated or 98% acid. The former comes largely into use for refining oil and the latter for mixed acid making is an important factor.

To suit the requirements of the trade the product is shipped either in carboys, iron drums or tank cars. To retain its transparentness oil of vitriol must be kept free from dirt.

In the superphosphate industry sulphuric acid is also largely employed.

With the agriculturist, if production is to be cheap it must be rapid and plenteous. We all know the progress of unaided nature is slow, but as we are familiar with the elements essential to plant growth, the farmer may assist and hasten the natural processes. Canadian phosphate which comes from the Buckingham district is used at Capelton for manufacturing fertilizers.

The phosphate is first dried, then ground to a fine powder in the Griffin mill. This mill employs in its construction the principle of a rigid roll, on a suspended shaft running against a ring or die. This rigid roll on a revolving shaft has freedom to swing outward against the die by the use of a universal joint. By centrifugal pressure there is great force brought to bear on the material being pulverized between the roll and die. This mill will grind about two tons per hour. After being ground the apatite is dissolved with sulphuric acid, after which ammonia and potash is added to make the complete fertilizer. It is then put through the disintegrator and then screened again.

We manufacture five different brands or grades of artificial fertilizers. The Capelton and No. 1 brand as superphosphates, and the Reliance, Victor and Royal Canadian are complete fertilizers. The goods are shipped in sacks 200 pounds each, and in conformity with the law the brand and guaranteed analyses is plainly printed on each sack.

The Herreschoff water jacket smelting furnace is used for extracting the copper in the burned cinders. The capacity of the furnace is 50 tons per day. The matte produced is shipped to Laure Hill, Newtown Creek, L.I. The buildings are lighted by electricity; the mines and the chemical works each have their own dynamo.