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"The Institute as a body shall not be responsible for the statements and opinions advanced in the papers which may be read, or in the discussions which may take place at the meetings of the Institute or of the Federated Societies."—*Sec. 14, Par. vii., Constitution and By-Laws.*

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1898

CANADIAN MINING INSTITUTE.

The Second Annual Meeting of the Institute for the election of officers, the transaction of business and the reading and discussion of papers will be held in the Windsor Hotel, Montreal, on Wednesday, Thursday and Friday, 1st, 2nd and 3rd March, 1899.

Syllabus of Proceedings will be mailed to members in due course.

B. T. A. BELL,
Secretary.

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Mining Law and its Bearing on the Development of Mines and Mining Districts.

By Mr. Frank C. Loring, M.E., Rossland, B.C.

From the earliest historical period to the present day, there has been, and is, universally recognized a distinction between ownership of ordinary realty and that of mining property, especially property in mines of precious metals, copper, tin, lead, etc.

In ancient times the ownership and right to dispose of mines of these metals was vested in the Crown, or was the personal property of the ruler. During the fourth century the laws of the Emperor Gratian especially set forth the right to the Crown in mines of gold and silver and provided that all right to work these mines emanated from him, and that the proper royalties should be paid him in consideration of obtaining these rights.

The ancient laws of Spain recognized the deposits of gold, silver and precious stones as belonging exclusively to the Crown and as the private property of the King. Even though these deposits were discovered on the property of a subject, if the owner of the land upon which they were discovered worked the mine, he paid a royalty of one-tenth to the Crown; if they were worked by another, one-tenth was paid to the Crown and one-tenth to the owner of the land.

In France, from earliest time, all mines were at the disposal of the nation. From the moment a mine was discovered the right to work the mine was distinguished from that of the surface.

When Mexico became a republic in 1821, the Spanish law then in force was adopted by the republic. This provided that the discoverer of a new vein or district was entitled to three pertenencias or claims on the principal vein, a pertenencia being 200 yards along the course of the vein. A discoverer of a new vein in the same district was allowed two pertenencias. A discoverer was required to send a written statement to a tribunal of miners describing the position of the vein or mountain discovered, and to post notices on the doors of churches, government buildings and other public places setting forth his claim. He was

obliged to make an opening on the vein one and one-half yards wide and ten yards deep, that the proper officer might report upon, and from which he might ascertain the true course and dip of the vein or ore body discovered. If the vein departed from the vertical (as in all cases it did), a provision was made whereby it could be followed on its dip for an extreme horizontal distance of 200 varas, or yards, from the outcrop of the vein. This horizontal distance depended upon the dip of the vein and it was determined by the proper official to what extent the vein departed from the vertical, and the horizontal distance allowed, but it in no case exceeded 200 varas. If, after exploring to this distance, development showed that additional lateral rights were desired, if the ground had not been previously located, another claim 200 yards wide could be located by the owner. The owner was compelled to work at least four paid men for not less than eight months of the year. If this amount of work were not maintained, or if the mine became abandoned, it could be denounced and another could obtain the right to operate it under proper conditions.

The South American republics give concessions to mine, under conditions which provide that a property shall revert to the government after a certain time elapses, wherein work has not been prosecuted.

According to the common law of England, mines of gold and silver were the exclusive property of the Crown, and did not pass in a grant of the King under the general designation of lands or mines. In the case of the Queen vs. the Earl of Northumberland, which was tried in the year 1568 before the Barons of the Exchequer and all the Justices of England, it was held by their unanimous judgment: "That, by the law, all mines of gold and silver within the realm, whether they be in the land of the Queen or of subjects, belong to the Queen by prerogative, with liberty to dig and carry away all ores therein, and with other such incidents thereto as are necessary to be used for the getting of the ore." Some of the reasons advanced by the Queen's counsel seem to-day peculiar. The first was in respect to the excellence of the thing; "for of all things which the soil within this realm produces or yields, gold and silver is the most excellent; and of all persons in the realm, the King is in the eyes of the law most excellent; and because gold and silver are the most excellent thing which the soil contains, the law has

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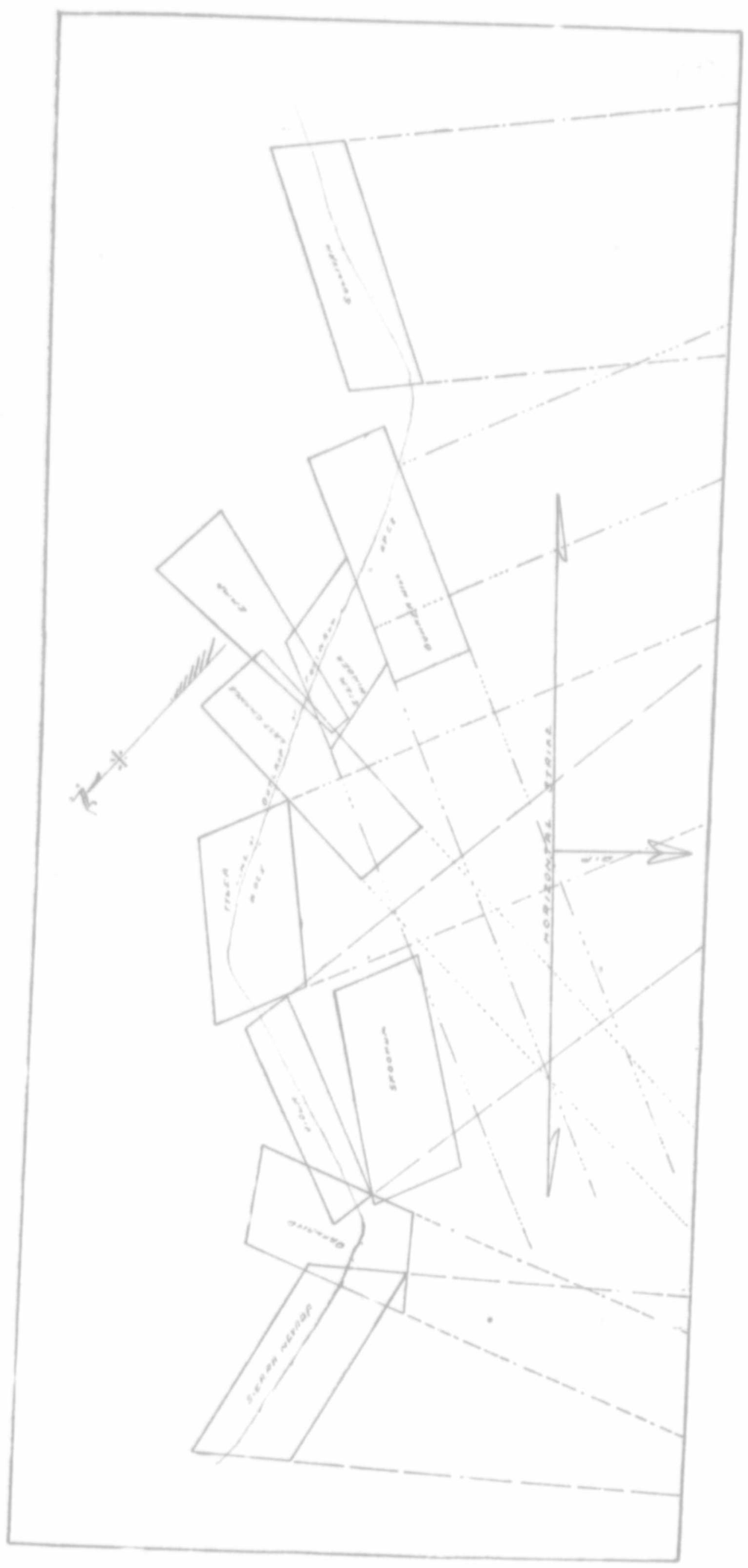

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appointed them (as in reason it ought) to the person who is most excellent, and that is the King."

The second reason was in respect of the necessity of the thing. "If the King is the head of the Weal-Public, and his subjects are his members, and the office of the King, to which the law has appointed him, is to preserve his subjects, and their preservation consists in two things, viz.: In an army to defend them against hostilities, and in good laws, and an army cannot be maintained without treasure, for which reason some authors call treasure the 'sinews of war;' and inasmuch as God has created mines within this realm as a natural provision of treasure for the defence of the realm, it is reasonable that he who has the government and care of the people, whom he cannot defend without treasure, should have the treasure wherewith to defend them."

The third reason is "that inasmuch as coining is a prerogative of the King, if a subject should have the ore of gold and silver which is found in his land, he could not coin it, for if he makes coin it is high treason."

By the common law in those days, persons were burned for forging or counterfeiting money, because it was high treason to the King, he having the sole power to make money.

In the mining of other than the royal metals, ownership of surface was best *prima facie* title to ownership of mines under the surface. The rights of ownership to the tin mines of Cornwall and Derbyshire were obtained by making application to the proper officer, by depositing with him a prescribed amount of the ore dug from the mine, by proper staking, and were distinct from the ownership of the land upon which the mines were discovered. A royalty was paid to the Crown.

The United States, with the vast extent and rapid development of its mineral bearing territory, the great variety and complexity of its ore deposits, and immense aggregate production of gold, silver, copper, lead, zinc, and other allied metals; the aggregate value of which amounts to an annual production of over two hundred million dollars, offers us the most varied and easily obtainable illustration of the complications arising in lode mining. There, as elsewhere, a distinction has been made between mineral bearing and other lands, and special statutes

have been enacted regulating the ownership and operation of mineral lands.

The law of 1866 limited the amount locatable by an individual on any one lode to 200 feet along the course of the vein, and by an association of persons to 3,000 feet, and provided that a U. S. Patent for mineral land gave title to only one vein. For the purpose of working this vein, surface ground not exceeding 25 feet on either side of the vein was granted. For many years there were no very serious objections to the operation of this law; but as ore deposits of more complex form were discovered its conditions were found to be inadequate. In order to meet new conditions the Mineral Act of 1872 was passed, which provided that a mineral location should not exceed 1,500 feet in length by 300 feet on either side of the vein discovered, and that no local law should restrict the width of a mineral claim to less than 25 feet on either side of the vein. In some parts of Colorado surface ground is still restricted to a width of 75 feet on either side of the lead.

The Act of 1872, which is still in force, provides: "That the locators of all mining locations . . . shall have the exclusive right of possession and enjoyment of all surface included within the lines of their location, and of all veins, lodes and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes or ledges may so far depart from the perpendicular in their course downward as to extend outside the vertical side lines of such surface location; but their right of possession to such outside parts of such veins or ledges shall be confined to such portions thereof as lie between the vertical planes drawn downward, as above described, through the end lines of their locations so continuing in their own direction that such planes will intersect such exterior parts of such veins or ledges. . . . On each claim located after the 10th day of May, 1872, and until a patent has been issued therefor, not less than $100 worth of labor shall be performed or improvements made during each year."

The idea in so granting all veins apexing within the surface boundaries of all claims to their extreme depth, was just in theory, and when the simple, well defined, easily traceable fissures then being worked

were under consideration, was eminently fair and not leading to many serious complications.

The lodes of California, Nevada, and of the old counties of Colorado, were of such a nature that this law in its operation created no great amonnt of litigation ; but the subsequent discovery and development of more complex ore deposits, and the complicated system of locations crossing each other, and of many forms, have led to such a vast array of litigation that the law, apparently so simple in theory and so just in operation, has been so discussed, distorted and adjudicated, that the mining decisions of the United States fill many volumes ; and the practice of mining law has become a distinct and exceedingly lucrative branch of the profession. Men of experience and acknowledged ability have written voluminous treatises on Mining Law. No two courts exactly agree as to the rights of the mine owner, and some of the most important points arising have never been absolutely decided by the courts of last resort.

The theory of the law of 1872 is : The locator discovers a well-defined lode or vein in place, which is so easily distinguished from the country rock that there will be no difficulty in recognizing the distinction. That this vein is so easily traced, and that it continues in a comparatively straight line for such a distance that the end centre posts of the location can be placed directly over its apex, and that the vein in its downward course can be followed without fault or other displacement to the depths.

Were this always the case no difficulty would arise in the development of a mine or between the owners of adjoining property. This is unfortunately not so. The result is that one editor alone has fifteen volumes of mining reports, containing only the most important cases, and tending to complicate rather than to simplify the serious questions arising between conflicting interests.

Dr. Raymond in his "Law of the Apex" has discussed the questions of apex and extralateral rights most exhaustively ; and many other authors have written learned and extensive works upon this subject. The result of all this labor is simply to emphasize the necessity for a radical change in the mining laws. At a mining convention held at Denver during the last year, a committee was appointed for this special

purpose, which has reported. Still there seems to be a question whether its report will tend to better matters to any great extent. The theory of the present law is: The lode is the property desired and that surface ground is purely an attachment for the convenience of working. Under this theory the mine owner should be allowed to follow his vein indefinitely, whether it depart from the vertical boundaries of the location or not. It does seem as though, after having developed a mine, and inasmuch as this is the property sought after and the source from which values are obtained, the mine owner should be allowed to continue in his development and extraction indefinitely. It is often the case that a mine has been developed at no great profit, and that were development restricted in depth and the owner compelled to stop upon encountering his side lines, the source of all profit to the mine owner would be at once destroyed, and in many cases it would be practically impossible to continue development from some adjoining claim. This in many cases would tend to shut down the mine permanently, and would have a tendency to lessen the amount of mineral wealth extracted, and in this way would be the cause of loss to the community. In many cases the depth necessary to sink before this ore body could be picked up from an adjoining claim would be so great that it would be a positive prohibition to a further development of the property, and further production would be permanently stopped. On the other hand, if the miner is allowed without restriction to follow what he claims to be his vein between the planes of his end lines, to an indefinite extent, what is to prevent his taking the ore belonging to another? The crossings of veins, faults, the union in depth of veins of different apexes, the difference in the courses of end lines, the departure in geological conditions from theoretically well defined fissures between walls, the occurrence of blanket deposits which necessarily materially modify the rule as to extra-lateral rights, the occurrence of ore bodies not in veins at all, but in masses without well defined limits, the difference between the course of the outcrop of a lode and its horizontal strike—and many other conditions —so complicate the question as to the right of ownership that the never-ending litigation referred to has been the natural result of the practical operation of the originally simple and apparently just law.

In order that some of the complications arising may be more easily understood, I will give you a few illustrations of possible and often occurring complications.

The prerequisite of a mining location in the United States is a discovery. A discovery has been ruled to be that which a miner would follow with a reasonable hope of finding pay ore. This construction is so broad in its operation that it often leads to much controversy; and in mining suits, depending on the validity of discovery, much conflicting testimony is given. No right can be acquired by location before the discovery of a vein or lode within the limits of the claim located. Should a mining location be made, and should another make a valid discovery before the original locator has done so, the first location becomes invalid, inasmuch as it was not a mining location under the provisions of the law. In many cases the original locator of a piece of ground has lost his location because of his failure in this regard. This often is a matter of evidence, and he who swears the hardest is often the most successful. If, however, a location otherwise valid should be made on a vein afterward discovered, no other rights intervening, the location would be valid to the limits of the claim.

The law provides that the end lines of all lode mining locations shall be parallel. It is seldom the case that the apex of a vein is of uniform course. In ascending and descending the sides of mountains, should the vein depart in the slightest degree from the vertical, the course of the apex necessarily changes, and in all cases where the dip of the vein is other than vertical, the true or horizontal strike of the vein and the course of the apex are different, the angle of departure varying with the grade of the mountain along the outcrop of the vein and the angle of dip. It is seldom that any locator on a vein places his end lines at right angles with the true course of the vein. The result of this is that as the various claims on any lode develop the courses of the various end lines cross each other, and much conflict of interest is thereby created. Some of the hardest fought mining litigation in America has depended on this questisn of the intersecting and crossing of end lines. In order to illustrate this and many other questions arising, I submit herewith a map, showing the mining locations on what is generally known as the "Bunker Hill and Sullivan vein," in Wardner,

Idaho. Nearly every possible complication exists in the mining locations and operation of the mines on this vein. Much hard fought litigation has already occurred, and unless all of the mines on this vein become the property of one owner more expensive litigation is bound to follow.

Following the outcrop of this vein westerly from the east end line of the Sullivan, we find that it extends nearly along the centre line of the Sullivan, down the mountain to Milo Gulch, thence crossing Milo Gulch ; and owing to the fact that it dips to the south at an angle of 45 degrees in climbing the mountain and passing through the boundaries of the Bunker Hill, Stemwinder, Emma, Last Chance, and part of the Tyler, its outcrop tends much to the north, although the horizontal strike of the vein remains the same. In passing over the mountain on the Tyler ground and descending its western slope, the apex bends sharply to the south, passing through the San Carlos, Skookum and Oakland claims, until it crosses Deadwood Gulch. After crossing Deadwood Gulch on its westerly course it again ascends the mountain, and again bends sharply to the north. The courses of the end lines of the various claims on this vein give a remarkable illustration of the conflicting rights of the various properties. Were the Stemwinder, the Last Chance or the Tyler allowed to follow its vein without restriction between the parallel planes of its end lines, it would completely cut off in the depths either of the other two properties in its development.

Among the bitterly fought litigation which has already occurred, is that between the Last Chance and the Tyler, and there has not yet been an absolute and final adjudication of the vein rights of these two properties. The Supreme Court of the United States has apparently avoided this most important question, and whatever decision has been made has been done on other matters. No litigation has yet occurred between the Stemwinder and the Last Chance directly, but a preliminary suit has been tried, involving the right to the surface ground west of the Stemwinder and south of the Last Chance, and unless these properties are consolidated the issue is bound to arise sooner or later.

All of these mining locations were made by experienced prospectors, who were supposed to understand their business ; and yet, had they so endeavored, they could not have created greater complications

than exist on this vein. It has been suggested that the law be so amended, that the course of the end lines of the first location on a vein absolutely establishes the course of the end line of all mineral locations on the same vein. Were proper exploration and development made before the course of the end lines of the original location were finally established, this amendment might operate well, and its passage would undoubtedly prevent many complications. If, however, the first location were made as it was in this instance on the Bunker Hill and Sullivan, it would work a hardship on all subsequent locators, and would be exceedingly unjust in its effect. The Bunker Hill, Stemwinder, Emma and Last Chance were located directly across instead of on the course of the vein. The result is that it is a question in what direction the Bunker Hill will be allowed to go in its deep workings. The Stemwinder has already anticipitated the inevitable, and long ago amended its location, making its former side lines its present end lines. The rights of the Emma have never been adjudicated; and in the case of the Last Chance, the side lines have become the end lines, and instead of following the vein in its deep workings on the line of its dip, it is compelled to develop more nearly along the course than the dip of the vein, and into the territory west of its west end line.

The all-absorbing question of extralateral rights is ever present when properties on this vein are considered. The location on the Sullivan was reasonably correct: in the case of the Bunker Hill it may be difficult to say what its rights are. The course of the horizontal strike of the vein, as is shown by an arrow on the accompanying map, and the course of the outcrop are quite different. Will the Bunker Hill be allowed to follow its vein between the side lines in a westerly direction to the depths, or will it be compelled to follow between the planes of the end lines drawn in to a point where the vein crosses the side lines to the depths; or will it be confined to its vertical boundaries?

In the case of the Last Chance and the Tyler, in spite of the immense amount of litigation already had, were the merits of the case decided entirely on the question of extralateral rights, it would still be difficult to determine the respective rights of these properties. If the location of the Last Chance were prior to that of the Tyler, it would

be allowed to follow its vein indefinitely to the west between the planes of its side lines. In this case the Tyler would be entitled to all of the vein, the apex of which is contained within its boundaries, up to the plane of the north side line of the Last Chance; and, leaving the ore between the north side line and the south side line to the Last Chance, it would be entitled to pick up its vein again south of the Last Chance's south side line and continue indefinitely in depth until it conflict with some better title. If the Tyler were prior to the Last Chance in date of location it would probably be entitled to follow its vein between the planes of its northwesterly end line and of its southeasterly end line, under and through the Last Chance, and so on indefinitely until it conflicted with some better title. This does not take into consideration the rights of the Republican Fraction or of any other adjoining claims, on other questions which have arisen and which complicate the issue. The ore bodies lying south of the Last Chance and west of the Stemwinder, perhaps 1,000 feet beneath the surface, to whom do they belong? In anticipation of possible controversy surface locations have been made on this ground, both by virtue of surface discovery and of discovery based on ore found in the depths of the vein.

I do not pretend to express an opinion as to whom the ore in this region belongs, but unless these two mines become one property there is ground for controversy before a final decision is arrived at. In short, along the entire course of this vein, from the Sullivan to the Sierra Nevada, there is a mass of conflicting interests and possible trouble.

This same state of affairs exists in every mining camp in the United States In districts like Leadville, Cripple Creek and Aspen, many geological questions arise which create additional difficulties. Owing to faults, slides or other displacements, the pinching or the crossing of veins, the fact that in some cases the true apex of the vein may not be the highest point at which ore has been discovered, and for numerous other reasons, many additional conditions seriously complicate matters. Where the boundaries of one claim are allowed to cross those of others, as in Gilpin County, Colo., Leadville, Butte and elsewhere, still other complications arise.

At the mining convention held in Denver, Colo., during last summer, the subject of the revision of mining laws was discussed, and

a committee was appointed to draw up new laws to be submitted to Congress. This proposed bill provides, amongst other things:

"That all the precious and useful metals, minerals, and ores thereof, also the following: Petroleum, asphaltum, brea and all other forms of hydrocarbons, monazite, bauxite, magnesite, soda, saltpeter slates, Mexican onyx, marble and building stone, phosphates, guano, clays, kaolin, gypsum, asbestos, sulphur, infusorial earths, natural pigments, peat, talc, mica, pyrite, corundum, emery, manganese, graphite and chrome, in public lands of the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration, and surface and subterranean prospecting.....That any mining claim located after the 31st day of December, 1898, shall be bounded as to surface by straight lines, and all right to mineral contained therein shall be confined within vertical planes, passing downward through said boundary lines.....A mining claim may equal, but shall not exceed, a square of 1,320 feet on the side, and the same may be in any shape, so that its width shall not be less in any place than 330 feet, nor the aggregate area exceed that of the square hereinbefore described. All future occupation, location, or purchase of public minerals lands, shall be governed by laws of Congress, to the exclusion of all local customs and regulations, and State or Territorial laws."

Any qualified person may acquire title to a mining claim by marking the position of his claim by monuments on the ground, and by posting notices thereon. Said monuments shall consist either of firmly set wooden stakes, not less than six inches square, and not less than three feet above ground; or of well-set piles of stones, not less than four feet high, posted at each exterior angle of the claim. Within ninety days after location, a lode, placer or other valuable mineral deposit must be discovered within the claim. Within ninety days a locator shall file the proper maps with the U.S Surveyor-General for his district, and shall deposit $50 in a United States depository, as an addition to the appropriation for the survey of the public land, together with proper affidavits of the locator and of two disinterested persons, as proof of the discovery of mineral. Within five years thereafter, the locator shall make application for a United States patent, and shall give proof that $500 worth of labor has been expended on each loca-

tion ; and upon payment of $5.00 per acre for a lode claim, and $2.50 per acre for placer or any other form of deposit, he shall be entitled to a patent.

It is proposed also that provisions be made for the establishment of proper mineral monuments, and for trigonometrical surveys, for the purpose of showing the relative positions of the various mining districts, and all the claims in each district. The locator is required to make an annual expenditure of $100 worth of work on each claim until patent is issued ; this work to be credited to him upon the total amount of $500 required to be expended upon each claim prior to issue of patent, with a credit for the first year of the $50 which was paid to the Surveyor-General."

The most important change in these proposed amendments is the abolition of extra lateral rights. This would undoubtedly work a great hardship in many cases, but would put a final stop to a large proportion of the litigation now existing.

Dr. Rossiter W. Raymond is of the opinion that the requirement of a discovery is practically a farce. "That all that is really exacted is a declaration without proof that a discovery has been made, and if this declaration were a mistake or a lie, there is no way of correcting it after the issue of a patent, except the cumbersome proceeding of a direct attack on the patent by suit to offset it. The patent cannot be collaterally attacked in any other proceeding. It would be much simpler and better to let any location of mineral land be made without discovery. Possessory ownership of it would have to be maintained by annual work, or payments, as the law might provide ; permanent ownership would have to be got by purchase. In either case, the United States would not be damaged if there were no discovery made before the title was granted. The private owner of a supposed piece of mineral land would scarcely be such a fool as to say to a proposing purchaser, 'If this land is valuable I will sell it to you for so much an acre. If it is worthless, or if you have not found out whether it is valuable or not, I will not sell it to you at all.' Yet that is what the requirement of a discovery amounts to."

With reference to the annual assessment work of $100, Dr. Raymond says : "The assessment work now done is admitted in most cases

a mockery. The money, if really expended, is practically squandered unless much more is spent than the law requires, and it might as well be paid into the treasury of the government as wasted on the surface of the ground."

It seems to me that if no discovery were required, even if in many cases it be a farce, the result would be that the locations could be made covering extensive territory with much more ease than at present, and that the development of a mining district would be materially retarded, operating seriously against the public interest if this provision were abandoned. If it were possible that each location could be examined by a properly qualified officer as to the merits of his discovery, and also as to the amount of assessment work done, much of the objections to these provisions would disappear. I am strongly opposed to making the appropriation of the public mineral lands more easy than it is at present, and it is certainly not to the public interest and tends to create a monopoly in these lands. Although I freely admit that there is much fraud practiced in both of these matters at present, still there is a tendency toward somewhat of a showing which would be entirely annulled if all restrictions were raised. The proposed revision would allow a locator to have a length of 5,280 feet on the vein if he chose to have a width of only 330 feet. This, it seems to me, would be unjust. I believe that a total length of 1,320 feet is sufficient and for the general good, and I would be in favor of restricting the width to less than 1,000 feet. By this means there would be more locations made in a district and the opportunities for prospecting would be greatly increased, and blanketing the country with 40-acre tracts would be more difficult.

I have gone into the conditions existing in the United States somewhat extensively, because conditions there are the best object lesson we can obtain of what difficulties are to be encountered in the location and development of mines in Canada. My special object in writing this is for the purpose of considering the state of affairs in British Columbia.

It has been said of the British Columbia legislature, that no session is deemed complete until some additional provision or amendment is made in the mining laws of the Province. The first Mineral Act was passed in 1884. This Act provides: That surface ground 1,500 feet long, by 600 feet wide, may be located in the form a rectangular paral-

lelogram by any Free Miner. The Mineral Act of 1891 repeats this provision, and provides : That the end lines shall be parallel, but that the angles shall not necessarily be right angles. This Act sets forth : That three legal posts shall be placed as nearly as possible at equal distances from each other along the center line of the claim ; that legible notices shall be placed on these posts, etc.; that during each year after location $100 worth of work shall be done ; that proper affidavit shall be made recording this work in the office of the Recorder or Gold Commissioner, and that if work has not been done the claim shall be forfeited ; that no Free Miner shall be entitled to hold either in his own name, or that of another, more than one claim on the same vein, except by purchase ; that the owner shall have the exclusive right to all surface ground included within the boundaries of his location, and of all veins or lodes throughout their entire depth, the top or apex of which shall lie inside of such surface lines extending vertically downward, although such veins or lodes may so far depart from the perpendicular in their course downward as to extend outside the vertical side lines of such surface location ; but his right of possession to such outside parts shall be confined to such portions as lie between vertical planes downward through the end lines of his location so continuing in their direction that such planes will intersect such exterior parts of such veins or lodes. If a location is so made that its center line crosses the vein instead of following on its course, the locator is entitled to as much of the vein as actually crosses the surface of the location, and the side lines become the end lines. A location shall be deemed to have been laid crosswise when the smallest angle made by the center line falling on the vein or lode is greater than 45 degrees. This Act continued in force until 1892.

This Act undoubtedly follows the United States laws with but slight changes. Instead of the locator being compelled to place posts at the corners of his location, he places three posts along the centre line. This, I think, does not give such complete notice to the public as the United States custom, especially where side center posts are required, as in Colorado.

I think this objection of indefiniteness in marking and staking is one of the great weaknesses of all of the British Columbia laws that have been enacted to the present time. It is very difficult at best for

anyone to trace the boundaries of a mining claim, and this is especially the case when locations 1,500 feet square are made. The law cannot be too particular in this matter. This is one subject which the British Columbia legislature has not dwelt upon sufficiently and the requirements of which are not severe enough.

In the Rossland district the mines first located there, as the Le Roi, War Eagle, Center Star, Iron Mask, Josie, etc., have been located under the provisions of the Act of 1891. There is at present litigation between two of these properties as to their respective rights in following the vein beyond the vertical side lines of one of the claims into the other. In this case there are apparently two apexes and a meeting of two veins, which somewhat complicate matters. The provision for the rights of veins running across the location is in conformity with the decisions of the courts of the United States, providing for a 45 degree line.

In 1892, and in subsequent years, the legislature has provided: That locations 1,500 feet square can be made, rectangular in form and and having no extra-lateral rights. This law much simplifies matters, but it has a tendency to retard the development of a district. I am of the opinion that locations 1,500 feet square and containing over 50 acres of land are altogether too large, and therefcre tending to retard the development of a mining district and not for the public good.

In the Rossland recording district there are nearly or quite 5,000 mining locations recorded. Undoubtedly most of these were made with the knowledge of the locator that they did not contain, so far as he knew, mineral of value, and were made solely for the purpose of securing ground for speculative purposes. There is no provision in any of the British Columbia Statutes for development work at the point of discovery. This is is a very important point to be considered. I am of the opinion that no one should be entitled to reserve for himself a 50-acre tract of land, or any other amount, without making a showing that the land so reserved is of sufficient value to warrant the Government allowing him exclusive right thereto. Experienced, honest and skilled officials should be appointed for the purpose of inspecting and passing upon the value of all mining locations. A locator should have ample time wherein to prove the value of his claim, say 60 or 90 days, but

unless it be so proven he should not have the right to monopolize and and set aside this land from other prospectors more skilful or fortunate than himself. It certainly does not tend toward the expeditious and proper development of a country.

The provisions of the various laws passed by the British Columbia Legislature, from 1892 to the present time, require: "That two posts shall be marked; that a line shall be blazed between these posts; that proper notices shall be posted, etc." In other words, for the purpose of giving notice to the public that a tract of 50 acres of land has been set aside for his special benefit, the locator is compelled to more or less distinctly mark a line 1,500 feet long, to erect two posts thereon, to place a notice at the alleged point of discovery, and to record a notice of location; and this is the sole notice which the world has of the boundaries of the tract so appropriated. This line may be 1,500 feet from the extreme boundaries of his claim in one direction, and in no case does it in any marked degree so define his claim that any other prospector can, without extreme difficulty, and often great expense, ascertain its limits. This insufficiency and indefiniteness of marking has also a tendency to put a premium upon dishonesty. It is a comparatively easy matter to destroy posts or to shift lines so marked. Much trouble has already arisen from this cause. Proper monuments should be placed at each angle and along the boundary lines of each claim. These lines should be distinctly blazed, and as soon as possible an official survey should be made. If land is of sufficient value that a locator appropriates it to himself, as against the rest of the world, it is of sufficient value to compel him to do all that is just and necessary, not only to maintain his own right, but to notify the world of that right.

No plea of hardship to the prospector changes the weight of this argument, because in order to create value on his property the owner has to undergo much expense in any case, and the public domain is too valuable to allow any person, from speculative or other motives, to reserve it to himself without showing good intent.

I think that in the two important questions of the mineral value of the land, proper location and definition of boundaries, the law cannot be too severe, especially when one considers that in British Columbia no price is set upon mineral land, and all that is done in the way of

expense is for the sole benefit of the owner. Even were a price of so much per acre placed upon mineral land, the necessity for these restrictions for the general public good would still hold good.

Much sympathy prevails regarding the poor prospector, and there exists a tendency to aid him in every possible manner to perform his most important part as a pioneer in the development of the wilderness. No one can be more forward than I in rendering him the honor due. We owe to him more than to all others the credit of giving to the world the vast stores of mineral wealth produced in America No hardship is too severe, no region too distant or inaccessible, no danger too great, to appal him. Were it not for the prospector there would be few permanent settlements in the west. The first incentive to the farmer and to the home builder is created by the discovery of gold or silver by some lone prospector, who, long before the agricultural, grazing or manufacturing resources of a country have been considered, has explored its extreme boundaries. The growth of the mining industry, resulting directly from his discoveries, has made possible the creation of cities, the establishment of factories, and the advent of the farmer, the mechanic and the capitalist. The hardships of the Arctic and African explorer are small compared with what the prospector often bears without murmur, and usually without reward; and while I believe that every facility should be given him to realize from his mineral discoveries, still, after having made these discoveries, it is not only to his interest, but to the interest of all, and public policy, that his rights and the rights of the community should be well defined, distinct and definitely prescribed.

Regarding annual assessment work, I go so far as to maintain that no one has a right to the exclusive possession of mining property without continuous and systematic development, and that no one should be enabled to set aside tracts of mineral land for speculative purposes, or for any other reason, and prevent their development; but that he should be compelled either to lose this special right, or so develop his property that its value will be proved within a reasonable time; or, if he is not able or competent so to do, that another should have the privilege.

The broad, liberal and wise policy adopted by the British Columbia and Dominion Governments in the facilities offered and the protection given to the miner in the pursuit of his business, cannot but

result in great benefit to the country at large, and will cause a rapid development of the vast region yet unexplored, which is destined to be one of the very greatest producers of mineral wealth of the world.

NOTE.—Much of the information contained herein has been obtained from "Lindley on Mines," and from the reports of mining cases in the United States, from which sources liberal quotations have been made.

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Some West Kootenay Ore Bodies.

By J. C. Gwillim, Slocan City, B.C.

The object of writing this paper is to offer some observations upon West Kootenay ore bodies in general and some in particular. Some of the chief types of ore bodies as so far explored have been already dealt with by officers of the Dominion and Provincial governments in their annual reports. So that there is little more to be said about them at present, and they will not be referred to at length.

Neither will any new and particular theories of ore genesis be offered. Always bearing in mind that passage in Kemp on "Ore Deposits" which reads:

"It is, however, true that among the subjects on which, human "imagination, often superstitious, has run to wild extremes, and on "which cranky dreamers have exercised their wits, the origin of ore "deposits stands out in particularly strong relief."

The productive nature of this district is shown by these rough values for the last five years, including 1897: $300,000; $800,000; $2,200,000; $4,500,000; $8,300,000.

The ores which produced these values are of three main classes. The argentiferous galenas of Slocan—Kaslo and Ainsworth primarily; The pyrrhotite copper gold ores of Trail Creek secondly; and the silicious dry ores of gold and silver which are more especially found in southern Slocan and Nelson divisions, but which also occur as subsidiary ore bodies in every mining division of the district. Another large contributor is the Silver King with its copper-silver ore; this, however, is a somewhat unique deposit as far as productiveness is concerned.

These principal ores are not confined entirely to certain areas, but each has its own chief centre and its particular characteristics in form and value.

In considering the galena ores one may begin with those of the Ainsworth division as these, in 1883, were the first to cause attention.

They occur chiefly in a narrow strip of schistose rocks and slates which run along the west shore of Kootenay Lake and extend backwards into the mountains from one to four miles, where they form a contact with the great granite mass which lies between Kootenay and Slocan lakes.

Along this narrow strip there are many rich ore bodies, both galena and dry ores of silver. The galena itself is not of as high grade as that of the Slocan, whilst the dry ores of pyrite, argentite and native silver in the same vicinity are often exceptionally rich. These ore bodies appear to have formed usually in fissures and shatter zones which strike most often in the same direction as the country rock, which here runs north and south. The country rock is composed of wide bands of green and grey schists, products of volcanic action, and argillites and limestones. Across the lake in an older series of banded rocks very large exposures of low grade galena have been found. Excepting that of the Blue Bell, none of these are much developed. Going north from Ainsworth, the productive galena bearing zone recedes to the westward and is chiefly concentrated about the upper waters of Kaslo Creek and Carpenter Creek, near the summits of the range.

There appears to be little doubt of the true fissure origin of those Slocan veins. They have fairly direct courses with a general tendency to striking north-easterly. The veins cross the slates and limestones and also certain sets of dykes. The walls are free, with a small amount of gangue as a rule, and the dips are at high angles. No faulting of much account has occurred since the filling of these veins. Occasional dykes interfere. These, at times, appear to have some effect in causing local mineralization; they cause very little displacement.

The gangue matter is a true secondary deposit, derived in part from the broken walls, and chiefly from limey and siliceous solutions, together with a considerable amount of spathic iron and some barite.

The spathic iron and galena are at times banded, but more usually there is a patchy mixture of all the constituents of the vein, at the same time the galena is chiefly concentrated along one or other of the walls.

This is especially true of the variety "steel galena" which may often be seen bearing the slicken-side marks of movement on the vein walls. Such may be seen in the White Water, Idaho and Enterprise. The best illustration of a clay seam seen in this section is at the White Water. Here, on a well worn foot wall of 45° dip may be seen a thin parting of clay, then upon this a regular band or slab of dark dull steel galena of about one foot thickness. This is clean and smooth, over this comes a foot of stiff blue clay containing fragments of wall rock and galena. Above this again is a second vein of mixed quartz, spathic iron, and patches of a bright crystallized galena. This brighter galena is said to be the richest. It contains a little grey copper and some dense fine grained zinc blende.

The country rock is composed here of soft finely laminated slates containing very little lime.

An analysis of such found in the Wellington, which lies near by, gives:

$Si\ O_2 = 49.57$; $Mg\ O = 3.22$; $Fe_2\ O_3 = 8.74$; $Al_2\ O_3 = 24.64$; $Ca\ O = 0.47$.

This mass of slate which abuts a serpentine mass immediately to the north shows signs of a slow movement, at the present time, and is full of minor faulting planes with cousiderable selvage clay.

Whilst mentioning this White Water section something may be said of the numerous quartz bodies here met with. These ramify the slates as small segregated stringers and sometimes crop out in wide bodies of a character somewhat like those gold bearing quartz veins of southern Slocan. These, however, have so far been found to be very barren. So far as explored none of the galena veins have been followed into the granite which bounds this area of slates, nor has any change of country rock or ore which amounts to much been observed in the deepest levels yet gained, none of which exceed 750 feet.

Although the galena ore bodies are, as a rule, regular, there is a distinct localization of the valuable ore. This forms shutes which follow pretty much on the dip. They vary greatly in width. That of the Payne being the widest so far found; intermediate portions of the vein are but poorly mineralized.

Beyond the limits of the Slocan area of slates very few veins of wet ore are found. Those which occur, such as some on Ten Mile Creek, as the Enterprise, and on Kokanee Lake, as the Molly Gibson group, show exceptional richness and promise. These veins are of true fissure origin. They dip at high angles, and have a gangue matter chiefly of quartz and calcite, with the ore well collected along the walls. In these veins there usually appears to be some richer constituent than the galena. At times this is carried in the associated zinc blende, and also in the cleavage planes of the galena, as argentite or other sulphide of silver.

The much criticized Two Friends mine on Springer Creek carries a very high grade of galena, more especially localized in the neighborhood of an interfering mica trap dyke. Some experiments made with this galena gave the following results, assays being all from one hand specimen piece :—

1. Picked small cubes with a greenish stain or crust upon them..... Ag.=335. oz.
2. 80 mesh siftings from coarsely crushed ore of pea size..... Ag.=298. oz.
3. Picked granular or wavy galena.. Ag =231. oz.
4. Picked cubes brushed and clean.. Ag.=181. oz.
5. Coarse remainder of above, which would not go through a 40 mesh sieve..... ..... Ag.=176. oz.

These results seem to point to some rich interstitial matter, and are borne out by the visible occurrence of a dark dull matter which is adherent to some of the cube faces of the galena.

It may here be said that the chief producer of value in West Kootenay is the silver-lead galena ore of Slocan—Kaslo and Ainsworth. It is greater than that of all the other ores combined.

While speaking of the galena ores it becomes necessary to take into account those large deposits of the Lardeau country which has, so far, produced very little owing to want of roads.

This district was visited by Mr. Carlyle during the past summer. His report will probably be out before this paper is read, and will anticipate the remarks made here to some extent.

This district has been in the waiting stage of mining for several years. A good deal of development has been done but very little shipping.

The ore bodies, both galena and dry ores, show a considerable conformity to the strike of the country rocks. In many cases they follow contact lines. Certain bands of rock appear to influence the mineralization. The strike and dip of these rocks are wonderfully regular. The former is north-west and the latter in crossing from the Silver Cup to the head of Gainer Creek, some ten miles north east changes from 20° N.E. to 15° S.W., the valley of the south fork of Lardeau being between these points.

Very large bodies of clean and concentrating galena occur on the upper branches of the Lardeau River, and also smaller ore bodies of mixed galena, zinc blende and grey copper, these last being usually of high grade, whilst much of the heavier galenas are not as high grade as in Slocan; they are more varied in value and depend a great deal upon the amount of grey copper present. There is also a higher gold value than in Slocan galenas. Mr. Jamieson, late engineer of the L. & F. R. Gold Fields Co., writes of the Alpha as being a true vein some 45 feet wide, of quartz containing galena, having a slate foot wall and serpentine hanging wall. There is, however, a contact of much greater magnitude in the matter of ore production. This is the great band of limestone, locally known as the "Lime Dyke," which cuts across the country between the upper waters of the Lardeau and Duncan rivers.

This consists of a massive limestone which rises at times 500 feet above the more broken down schists and pitches under them at a dip of 15° from the vertical to the south-west, the strike being N 65° W. Along this "lime dyke" are located many of the principal groups of claims, such as the Abbot, Black Prince, Bad Shot and Glengarry, some of which are massive galena bodies and some high grade grey copper and zinc ores with a well crystallized calcite gangue.

Some of these ore bodies are on one side and some on the other of the limestone, which is a few hundred feet thick, also some follow the contact and some dip into and across the limestone, then forming

lenticular masses of high grade ore connected by stringers. In these there do not appear to be free walls, the ore being cemented more or less to the country rock. Ore bodies of like character in schists and limestones somewhat similar occur east of Kootenay Lake.

So much has been said of the copper gold ores of this district that little need be said here, the most accepted theory of their nature is that of replacement of the country rock along the course of fissures. Sometimes the mineralization appears to be concentrated about apparently interfering dykes, as is the case with some galenas in this district.

Here as elsewhere certain characteristic ores are much confined to certain rocks. An analysis made upon a prevalent fine grained grey rock found in the tunnels gives:—

$Si\ O_2 = 49.16$; $Ca\ O\ 13.69$; $Mg\ O\ 9.15$; $Fe_2\ O_3 = 10.13$; $Al_2\ O_3 = 16.27$.

Going westwards, there are many changes in the rock, but upon Big Sheep Creek, at the Velvet, ore bodies of the same apparent origin occur. That is to say there is a main seam, or fissure, along which massive ore is concentrated together with a zone of partially replaced country rock, there being no vein filling as ordinarily understood. This ore is chiefly copper pyrites, the pyrrhotite being less evident in this section. The soft green grey country rock containing this ore gives on analysis:—

$Si\ O_2\ 62.62$; $Al_2\ O_3\ 20.26$; $Fe_2\ O_3\ 5.75$; $Mg\ O\ 3.60$.

A second series of quartz veins occurs in this section, they appear to cut some of the more basic deposits.

Concerning the third class of silicious dry ores these have been studied in more detail than the foregoing, especially those which occur in the main granite mass which lies between Kootenay and Slocan lakes. The silicious dry ores of West Kootenay are represented very widely. So far, they have not been mined to any great extent, and many expensive experiments have somewhat discouraged investment; when they are properly understood they will become an important factor as producers. Amongst such ore bodies are the O. K., Fern, and Poorman, the dry ores of Slocan granites, and some of the Ymir section.

In these the values are gold and silver, some as the native metal, and some freed by oxidation, also in auriferous copper and iron pyrites, grey copper and argentite. These veins usually vary much in width, seldom exceeding six feet. The strike has no general tendency and the dip appears to be more or less inclined, according to the district. There are many dipping at angles of under 45°; this low inclination is often attributed to a process known as "breaking over," a somewhat complicated arrangement, considering the nature of the rocks in which they occur.

In these ore bodies the valuable portions are concentrated into shutes and pockets; considerable care and experience is necessary in order to sort out ore which will pay to ship—or $75 to $100 rock. When the whole quartz body can be treated by some milling process yet to be devised, a large field of operations will be opened up, for the veins are very numerous in some sections.

In the section of country drained by Twelve Mile, Springer and Lemon Creeks, there is a very pecuiiar and characteristic ore body. This is composed of a coarsely crystallized quartz from a few inches, and sometimes a seam only, to five feet wide. At the surface these veins usually dip less than 40° from the horizon. No depth as yet gained—about 100 ft.—has proved them to become more nearly vertical.

Many small displacements have taken place along cross faulting planes. As far as seen the ore body always leaves a continuity either along a fault plane, or along a seam where only a thin streak of selvage exists. It has been said that these are segregation veins pinching out into solid wall rock. This also lacks confirmation.

The values are contained in pyrites, argentite, oxides of iron, and free gold and silver. The gold value which is as 1 to 5 of silver north of Springer Creek changes to equal values along the north slopes of Lemon Creek, and further south still, as at the Alpine, Black Prince and Maple Leaf, the gold is chief and the silver unimportant. Along the walls of these veins the dark grey granites have been altered serietic and kaolinized matter. At times there is a free wall and selvage matter, and at times the quartz is apparently cemented to the

granite. As both these conditions occur on the same wall within a few feet of one another, it becomes rather puzzling to explain the matter, however, on gaining depth to the undecomposed portions of the vein the walls are much more free and definite, the "frozen" walls being due in a great extent to a cementing of the wall rock owing to decomposition; there is not much evidence of movement upon the walls. The whole granite mass shows signs, under the microscope, of great strain and crushing. At times there is a well defined comb structure in central portions of the vein, this cavity is usually filled with a frangible, somewhat granular pyrites, in some cases marcasite. The iron is rarely well crystallized, it occupies interstices and is penetrated by large and well formed quartz crystals. Argentite occurs in little wedge-like bunches fixed in the spaces between quartz crystals, more especially within the zone of decomposition, which extends to some 25 feet in. Below this point the gold and argentite occur in a very finely divided state associated and intermixed with the iron.

There is a concentration of value in the oxidized portions. It is not often greater than that which may be expected to result on the decomposition of pyrites into oxide of iron. The ore, both pyritous and oxidized, varies very greatly in value without any visible change in appearance. Pyrites within five feet of one another may go $5 and $150 respectively.

On the oxidation of the pyrites there is a collection of the freed gold; it appears as visible pin points and scales which do not pass through the sieves. Something of the same kind appears to take place with the argentite, causing the malleable crystals to form. However, as the mineralization of these veins varies so much it may be only a coincidence which makes this appear so. Concerning the many minor ore bodies now being developed, very little has been done. There are some very interesting associations of the richer silver ores with silicious flint-like gangue matter; and some in connection with a system of dykes which traverse this granite area. These will speak for themselves bye and bye.

For the analysis of the country rocks I am indebted to Mr. W. S. Johnson, who is now making some further experiments upon the dry ores of this district.

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Odd Notes on Mining, &c.

By Mr. A. H. Holdich, Nelson, B.C.

The object of these notes is rather to suggest a few subjects for discussion than to offer anything very startling or novel, hence it is hoped that want of continuity in the chain of expression will be pardoned.

It has been suggested by more than one person that the present size of claims, 1,500 feet square, is too large, and that a return to the old conditions of 1,500 by 600 feet is desirable. If it were possible or usual for any claim-owner to thoroughly prospect his 52 acres and use it for its legitimate purpose, *i.e.*, mining, there need be no objection to his holding such a large tract of land; but we are all well aware that in the majority of cases one or two small prospect holes constitute the owner's idea of work, and the ground is simply held for speculation in the hope that some adjoining claim may prove valuable and so increase the value of his own unused property. It is not easy to suggest a remedy for this state of things, as even if an inspector of mines was appointed he could do very little, and even in one district only he might be quite unable to inspect every claim and see if the sworn assessment was really done, but nothing less than that would seem to be sufficient.

And, notwithstanding the small amount of work done, the value asked for the propertyis usually enormously out of proportion. Why a claim owner who has done little or nothing to open up his prospects should imagine that capitalists will cheerfully plank down their money on the off chance of getting some return eventually, it is difficult to say, but it is undoubtedly the prevailing idea. If the owner would agree to take chances together with the capitalist, that is, to take his money largely in shares, things would be much better for the country in general, as many more mineral claims would be opened up and in all probability valuable mines discovered.

But few seem to take into consideration the situation of their claims in asking a price for them. Transportation, access, timber and water are all most important points, and a really good vein may easily be rendered of very little value by the want of one or more of these necessities.

None of us are infallible, neither can anyone see an inch into the ground further than his neighbor, but it certainly does seem as if some of the mining experts would be improved by a study of elementary mineralogy and mining, and an addition of ordinary common sense. We should then hear less of the "millions of dollars in sight"—at the end of a tunnel generally—when actually no ore is blocked out at all, nor even its presence certain in other directions. Misleading and extravagant estimates do far more harm than good, and we in British Columbia cannot afford to lose the confidence of the English investor, a result that will surely happen if more attention is not paid to facts and less to a brilliant imagination.

The writer would like to ask what has been the general experience of mining men with copper and gold propositions [not necessarily together]. Do these mines usually improve with depth or not, or is there any rule to guide one in guessing at the probable future of the vein? Experience alone can teach one to estimate probabilities, and it will be interesting to know what the experience of our members has been. This is the more important now that smelters are becoming almost common, and it is so indispensable for the right working of a furnace that the ore supply shall be abundant and continuous. For many varieties of copper ore the only possible treatment is by fusion, and a small smelting plant might be in some cases erected near the ore deposit and the mineral "matted" on the spot. Of course other considerations must be borne in mind; *i.e.*, the presence of an ample water supply, also cost of fuel, and the conformation of the ground itself so as to handle materials as far as possible by gravity. Convenience of transport again must not be forgotten, as high freight rates will speedily reduce the profits to a vanishing point.

But, given all the necessary facilities, there is no need for any government, corporation or city to subsidize a smelter—if it is properly

managed it is a highly profitable undertaking and has no need for any outside assistance. The reason why certain smelting plants that have been started in British Columbia are idle, is because they were not properly managed; some of the vital necessities of a smelter may have been absent, or the metallurgist in charge did not understand his business, or at least failed to modify his previous experience to suit the needs of that particular plant.

Another very important matter in connection with smelting is the assaying department. Analyses, as well as assays, must be made continually on the ore that is being raised, in order that any sudden variation in the character of the rock may be known and utilized, or guarded against beforehand; hence the prudent manager will always have his "mixtures" bedded, and the composition known before smelting, instead of afterwards when trouble happened at the furnace. [It is within the writer's personal knowledge that this somewhat extraordinary system of smelting has been practised in British Columbia.]

But the assayer himself must be trained as well as the manager, and it is a matter of congratulation that a step in the right direction has been taken by having public examinations for those wishing to act as assayers, although so far, I believe, it is not absolutely compulsory for candidates to submit themselves. It might be better if it were so.

In conclusion are appended analyses of a few samples of milk sold by a dealer to the inhabitants of this city, and any remarks from analysts accustomed to that kind of work will be most welcome to the writer. The dealer was fined $25.00.

No.	Sp. Gr.	Total Solids. Per cent.	Fat. Per cent.	Solids not Fat. Per cent.	Ash. Per cent.
1	0.9562	13.63	6.56	7.07	0.394
2	1.009	11.85	4.83	7.02	0.376
3	0.993	13.20	5.93	7.27	0.491
4	0.943	10.45	3 01	7.44	.....

Mining Machinery in the Slocan.

By Howard West, A.R.S.M., New Denver, B.C.

The Slocan mining division of West Kootenay has been well and fittingly described as a poor man's country, which assertion does not necessarily indicate that a man without means can come in and develop his claim from the proceeds of ore obtained direct on the surface, for such instances are few and far between even here; but because in comparison with other camps, the minimum amount of working capital is required as a rule before commensurate returns are shown. The Slocan of yesterday is not, however, identical with that of to-day, such rapid progress is the district making, and the designation which was applicable when the country was first opened up by no means holds good literally at the present time. Originally the surmised extent of the mineral belt was limited to the galena bearing argillites stretching from Kaslo on the east to Silverton on the west, but later discoveries have proven that this supposition was far too restricted in its character. Flanking the slates to the south is a mass of more recent granite, which penetrates the older strata, and protrudes in places through the argillites, forming knobs, and occasionally basins of granite, where denudation has done its work effectively.

This granite, at first boycotted, so to speak, by prospectors and others, for no apparent reason beyond insane prejudice, includes within its borders many now well known mines and prospects. The ore-character, however, is not the same, although in places galenas predominate as in the slates; consequently mining in the dry-ore belt, as it is termed, assumes new and somewhat different phases from that which obtains in the Sandon district. The major portion of the granite area has been recently severed from the Slocan proper, and included in what is now known as the Slocan City Mining Division. As, however, the two regions are largely operated by the same men, and moreover present at least some points of similarity, it may be as well for general purposes to summarize the whole as the Slocan, more

especially in view of the fact that by reason of past association they are indissolubly connected in the public and professional mind.

I commenced by saying that the Slocan has been known as eminently a poor man's country from its earliest discovery, and one of the determining factors to this distinction, omitting for the present the question of the proximity of high grade ores to the surface, has been the extreme ease and facility (I am referring now to the area covered by the sedimentaries) with which the ground could be mined by indigent prospectors themselves, with the aid frequently of merely a pick and shovel, in marked contrast to the Rossland camp, where the country rock is abnormally hard. Such a condition of affairs naturally, and in one sense fortunately, militates against the introduction of heavy and expensive machinery. This results not alone from the fact of machinery being deemed superfluous, but the conditions tend to keep the locators from seeking the assistance of outside capital, without which it is impossible to go to any great expense in the matter. The favorable nature of the country, however, is only one of a number of advantages which this section of Kootenay possesses in common with others. The general topography and natural contour of the ground admits of the most economical exploitation and development by a system of horizontal tunnelling, consequently each opening serves not only to remove the ore, but acts also in the capacity of an adit, so that the necessity for introducing elaborate hoisting and pumping machinery is obviated at the start.

In these important respects Kootenay is to be warmly congratulated, and it would be well for intending investors to bear this in mind when considering the relative merits of other localities.

Coming to the consideration of the original subject, namely, the machinery now in use, we will divide it roughly, for convenience, into four classes: 1. That used in breaking ground. 2. For hoisting, pumping and ventilation purposes. 3. In transportation. 4. In preparation of the ore for the market.

1. As previously observed, the slate wherein most of the shipping mines are found is extremely soft and easy of working, and therefore it is not surprising to find that rock drills are in little demand; in addi-

tion, the veins usually contain small but rich chutes of ore, and the object is to extract these with as little breakage as possible. In the granite area, where drills would be an unquestionable advantage, more especially in driving long cross-cuts, few mines are as yet sufficiently advanced to warrant their introduction, but doubtless in the future we shall hear of many properties, in the working and development of which they are destined to play an important part. The only instances of the contemplated use of rock-drills in the Slocan which have come under my notice are at the Galena Farm and the Slocan Star. Each of these mines is equipped with a four-drill compressor, but in the former instance no drills have so far been connected, although the ground is fairly hard, while at the Star they have, I understand, only been employed intermittently, more as an experiment than anything else.

2. *Hoisting and pumping.*—These two are considered together, because conditions which effect the one almost invariably effect the other also. On account of the sloping nature of the ground which exists at practically all the mines, neither hoisting nor pumping is necessary. In some few instances where winzes are sunk, having no connection with the surface except at the upper end, a bucket attached to an ordinary hand windlass is sufficient to cope with the water, and also to raise the ore and waste. True shafts are, generally speaking, conspicuous by their absence, but may be observed at the Arlington, Galena Farm and the Dardenelles. A boiler has been recently conveyed to the former, which it is proposed to use for hoisting and pumping purposes, but as yet the plant has not been fully installed. The work at the Galena Farm, however, presents many features of interest, which are certainly deserving of more than passing mention.

Whatever may be said or thought about the merits of the mine, or the action of the promoters in floating the property with such an enormous capital, there can be no doubt that, given opportunities, the company is prepared to operate on a liberal scale. They intend evidently to mine in the true acceptance of the word, therefore do not hestitate as so many do about necessary preliminary expenses. Their splendidly timbered double compartment shaft, now down to a depth

of 230 feet, would be hard to beat in any district, and a visit to the shaft house, which is unique in the Slocan as regards equipment, well repays the trouble involved in making the trip. Until quite recently buckets only were used in raising the stuff to the surface, but the limit having been reached where these could be economically employed, a single deck cage of the usual platform type for vertical shafts has been installed, on which the car is raised, being held in position during the operation by two hooks, one of which is caught in a loop hole on each side of the car. The cage is supported by a round wire rope of medium size, which passes over a five-foot groove pulley at an elevation of 42 feet above the shaft head to a drum four feet in diameter. This latter, on which the rope is wound, is of the flat type, having a flange at each end. Power is imparted by means of two water wheels, a Pelton and a Risdon, which correspond in measurement, being each six feet across, and are both connected on the same shaft with the drum. The power house also contains a boiler and a four-drill compressor, for use when occasion demands. Water is brought from the creek underground in an eighteen inch pipe, which tapers to sixteen where it enters the bulkhead, two hundred feet distant from the shaft. From here it is conducted in nine inch pipes to where it impinges on the wheel through inch and a half nozzles. With a head of 320 feet, 150 H.P. can be readily generated, which is ample, not only for hoisting and pumping, but will suffice to run the concentrator when erected.

I regret that I have had no opportunity of personally visiting the Dardenelles, but I am informed that a Knowles pump is also in operation there. The shaft exceeds two hundred feet in depth.

I inadvertently omitted to mention before this, that water raising appliances at the Farm consist of two small force pumps, one a Cameron and the other a Knowles, which furnish a continuous discharge through a two inch pipe. It is probable, however, that machinery of greater capacity will be required as work progresses.

2. *Ventilation.*—Natural ventilation is relied on almost exclusively, and in the present stage of development where the levels mostly reach daylight is all that can be desired. In one instance which came under

my notice at the Enterprise mine, a small fan stationed at the foot of an upraise is propelled by power obtained from water which is conducted direct from the surface. This furnishes quite a current of air, and being inexpensive and extremely simple of construction, might, I should imagine, be copied with advantage at other mines.

3. *Transportation.*—The ore is hand sorted as a rule at the mouth of each tunnel, and there being no necessity to concentrate it all at one point on the surface, shoots are generally employed to conduct the material from the stopes to the level below, and very rarely is local hoisting gear of any description required. For clearing out the tunnels wheelbarrows are mostly used in the initial stages, but as the workings become more advanced, and the necessity arises, rails are put down. Sometimes these consist merely of strap iron laid flat on the runner, but more frequently perhaps of rectangular steel rails standing on edge. The common guage is twenty inches, to suit the waggons, which are made of steel, and hold something less than a ton, depending on the specific gravity of the material trammed. Some slope to the front, and are so arranged that they can be tipped at both end and sides; others again are almost square in longitudinal section, the front being designed to open on hinges, while when closed it is kept in position by a vertical bolt. Human power only is used for underground transport, and can hardly be improved upon under present conditions. To convey the ore down the mountain side to the railway, packing on mules' backs was the primitive method originally employed, and is still used to some extent. An exception was made in the winter, when raw-hiding was permissable if the trail was in sufficiently good condition. With the construction of waggon roads to the mines this was improved upon to hauling in waggons in the summer and in sleighs in the winter. As the mines developed and became capable of larger and more regular production, a new and enlightened era began to dawn on the industry, which gradually burst from its cloud of obscurity, and invoked the aid of machinery in lessening the expenses incident to these old-fashioned methods. It is but natural that any developments should take place along the line of the utillzation of gravity, and the arrangement which has found most general acceptance so far is the

three-rail gravity tramway, which in the eyes of mine owners would appear to present marked advantages over others, judging by the frequency of its adoption. Those already constructed may be seen at the following mines: The Slocan Star, Payne, Washington, Alamo and Alpha. The arrangement differs in no particular from that ordinarily employed elsewhere. A wire rope, to which the cars are attached, passes over a drum at the upper end, being supported on the ground by wooden rollers. Switches are made at suitable intervals for the cars to pass, and the weight of the descending car filled with ore suffices to pull up the empty on the other end, which may be loaded up to a certain limit with materials for the mine. A brake is of course attached to the drum above, and the speed can be regulated at will by the operator. It is sometimes found inconvenient to have the rope too long, and for that reason the line at the Alamo is divided into two portions, each about 3,500 feet in length, the ore being dumped down a shoot into the car below, at the junction of the sections.

Another method of transportation which is gaining favor, owing to its adoption and successful operation by the Noble Five Co. at Cody, is the bucket system or aerial ropeway. There are, as everybody is aware, many types of wire tramways, but the time at my disposal will permit of no more than a hurried reference to the one here mentioned. It is built on what is known as the Finlayson plan, and consists of two stationary ropes, on which the bucket carriers run, and an endless rope below directing the motion, attached to which are the buckets themselves. The total length of the tramway is, roughly, 6,000 feet, the supporting towers being erected at suitable intervals, varying of course with the nature of the ground passed over, amounting, in one exceptional case, to as much as 900 feet. The usual height of the towers is from 50 to 75 feet. The buckets carry from four to six hundred pounds weight, and are suspended at intervals of two hundred and fifty feet. The whole action is automatic, from the loading to the unloading of the ore, the rate of speed being controlled by powerful brakes on the drums. When run to its full capacity, over four hundred tons can be handled in a day of twenty-four hours, at an approximate expense, exclusive of wear and tear, of considerably less than twenty-

five cents per ton, which contrasted with the old style is an enormous reduction

4. *Preparation of the ore for the market.*—Rough sorting is carried on underground to the extent usually of sacking the likely looking material, and keeping it distinct from what is undeniably waste. At the entrance to the tunnels as beforesaid ore sorters are stationed, who effect a more complete separation by means of an operation known in Cornwall as cobbing, which consists merely of breaking the ore on a rock bed with a small hammer, which is held in the right hand, and picking out the valuable material, which in this case is immediately sacked ready for shipment. While this arrangement has its advantages in a small mine, where sufficient ore is not available to warrant the erection of a concentrating plant, and serves to prevent what might otherwise be absolute loss on a shipment, the tedious and wasteful nature of the performance is at once apparent, and it is therefore natural to find that the richer mines and those having large reserves of low grade ore which it is impossible to convert into a shipping product by these means, have either already adopted, or intend to do so at no distant date, some form of mechanical concentrator. Four such plants are now in operation in the Slocan, namely, at the Slocan Star, Noble Five, Alamo and Washington mines, and if half those who have already announced their intention of so doing really erect concentrators, at least six more will have to be added to the number before the end of this year. Those above-mentioned have all been designed and built by the same man, Mr. Thomas L. Mitchell, and consequently we shall not be surprised to find in each a degree of similarity in details of construction. Power is supplied in each case from a Pelton water-wheel, although the water supply is occasionally found insufficient, and at rare intervals freezes, necessitating a temporary closure. At the Star a 40 H.P. engine and boiler provides against any such contingency. The heads of water obtainable at the different works are as follows: Alamo, 224 feet, Star, 471 feet, Noble Five, 562 feet; the Washington measurement I have been unable to obtain.

The ore is delivered to the mill by means of a wire ropeway at the Noble Five, while at each of the others a three rail gravity tramway is employed.

Bins from 150 tons capacity at the Star and Noble Five, to 1,500 at the Alamo, receive the ore, which then passes over a grizzly direct to the crusher. This consists of a nine by fifteen Blake (Reliance pattern) at the Star and Noble Five, of a four by ten Blake at the Washington, and a small Comet at the Alamo.

As it would be tedious to describe each mill in detail, I will give a general description of that at the Star, which I recently had the honor of inspecting thoroughly, and explain wherein the others differ. After passing through the crusher into a receiving bin below, the ore is supplied to two sets of coarse rolls by means of an automatic cam feeder ; from here it is raised through an endless elevator to a revolving screen, which separates it into four products. That passing through the smallest mesh of three *m.m.* is conveyed at once to hydraulic classifiers, which effect a separation into three parts.

The material from here is sent direct to six Collum jigs, the overflow being carried to V shaped settling vats, which supply two double-decked slime tables of the circular type, being each eighteen feet in diameter. The other three sizes from the trommals pass respectively to two Hartz jigs. The middlings from the four coarser jigs are then put through middling rolls, and pass again to the elevator, while those from the other two go to fine rolls, and thence to elevator No. 2, from which it is delivered to the classifiers. The middlings from the Collum jigs are passed through the finest rolls, and thence to elevator No. 2 on their way to the classifiers again. The finished material is taken to bins, where it is allowed to drain thoroughly before being sacked, preparatory to shipment.

The Noble Five mill differs little in general principles from that at the Star. The one at the Washington, which gained distinction from being the first built in the Slocan, is also of somewhat the same pattern. At the Alamo a Comet crusher is employed in lieu of the Blake at the others. Another difference consists in the fact that the middlings from the jigs pass to a Huntington mill for further comminution instead of rolls. Lake Superior classifers are used and there are four double decked slime tables as against two in the newer mills. The introduction of Collum jigs as auxiliaries to the Hartz, is only to be observed in the later patterns. The Star and Noble Five mills have a daily capacity

of 150 tons of crude ore for the twenty-four hours, but the other two being smaller, are only designed to put through one-third of this amount.

One feature worthy of mention in view of recent controversy on the subject, is that all are situated on side hills and are carefully arranged so as to obtain the maximum assistance from gravity in transporting the ore from one operation to another.

All of the concentrators work satisfactorily on the class of ore for which they are intended. There is unfortunately sometimes a lamentable though unavoidable loss of silver in the tailings, due to the fine state of subdivision and the friable nature of the associated minerals particularly certain varieties of copper and antimony. At one time the tailings from the Star were reported in the local papers to assay up to twenty-two ounces in silver, but this was doubtless exaggerated, as much of the original ore is of lower grade than this. The loss of lead is trifling and the separation from zinc-blende leaves little to be desired. The degree of perfection obtained necessarily depends largely on economic considerations, and there seems little prospect in the near future of effecting a more thorough saving in values than is done at present. The zinc in most cases would not pay for shipment even if it were in sufficient quantity, and the mills could be adapted to retain it. The flouring of the grey copper and antimonial combinations can hardly be avoided and there is a consequent loss, to recover which is next to impossible.

In order to omit nothing of interest I wish to refer incidentally in closing to the sluicing operations at the Wonderful and also to the use made of small gasoline engine at one of the mines.

In the former instance as many are aware, regular sluicing operations have been carried on, with the result that a large amount of galena in the shape of rocks and small boulders has been recovered from the loose overlying deposit and shipped to the smelter.

At the Payne which is now by far the largest producer in the Slocan, a gasolene engine is regularly employed to work a small crusher which renders rough ore sampling comparatively easy. That engines of this type will receive more general attention from mine owners when

the large number of uses to which they can be put are thoroughly understood, goes I think, without saying.

I should not be doing my duty if I allowed this opportunity to pass without some reference to the demands of the Slocan Lake section of the country. Here is found a large variety of ores the majority of which are palpably adapted to local treatment in preference to smelting. The introduction of properly designed mills, the suitability of which for the purpose having been fully established beforehand, would give a tremendous impetus to the mining industry and largely increase the present output. Here is an opportunity for eastern manufacturers to come to the front, and demonstrate beyond a doubt that these ores can be economically handled right at the mines; great caution is necessary more especially in the details of design and construction to insure success, but I am confident that no difficulties are of an insurmountable nature, and I therefore respectfully submit this for the consideration of all interested in the future welfare of the country, whether financially or professionally.

In concluding, I hardly feel it incumbent upon me to apologise for the manifold shortcomings and possible errors which may have crept into my paper unobserved. I have tried to avoid doubtful statements as much as possible; but our worthy Secretary will bear me out when I say that I have contributed this under difficulties and was only persuaded to make the effort on the assurance that any minor slips would be pardoned.

That the Slocan is destined to become a marvellous producer of the precious metals under more favorable conditions, greater even than present returns appear to warrant, no one who has thoroughly examined the district will venture to deny. The responsibility which devolves upon the engineer in the matter, is manifestly proportional to the greatness of the industry and it therefore behooves investors to use the greatest care in the selection of the men who are to help build up and control the staple industry of our western province.

Notes on the Albertite of New Brunswick.

By JOHN RUTHERFORD, M.E., Windsor, N.S.

Over forty years ago, much interest was aroused over a dispute as to the character of a mineral found in the carboniferous formation in New Brunswick. There was also some doubt as to its relationship to the series of rocks forming the lower division of the coal measures.

One peculiarity was its position in a considerable deposit of calcareo bituminous shales, which shales contained much bituminous matter; but a still greater peculiarity was the mineral itself. So much did it differ in its characteristics from ordinary bituminous or anthracite coal, that the point in dispute, arising from a question of ownership, was whether it was a true coal or asphaltum.

It is needless to dwell on the strong opinions expressed by able experts on each side, in support of their respective views; the trial is a *cause celebre* in the mining world, and to this day there is probably a remnant of difference of opinion. Perhaps the latest decision is that given by Professor Bailey and Dr. Ells, of the Geological Survey of Canada, who, in 1886-7, reported fully on the mineral and the geological structure of the locality in which it was found and expressed their opinion in the following words: The albertite "is in no sense a true coal, but rather an oxidized hydro-carbon, related to, though not identical with asphalt, and at one time existing like petroleum, in a condition of partial or complete fluidity."

The position of the albertite in the shales is another peculiarity, which has given rise to diversity of opinion with respect to its origin. By some it was maintained that the enclosing rocks constitute a true bed and roof, although tilted into a nearly vertical position, and indicated an original horizontal deposition, as of ordinary coal seams. By others the space occupied by the mineral was considered to be a fissure, caused by the elevation and general disturbance of the strata, and subsequently filled with the albertite when in a fluid condition. It is specially in connection with this last named supposition that the fol-

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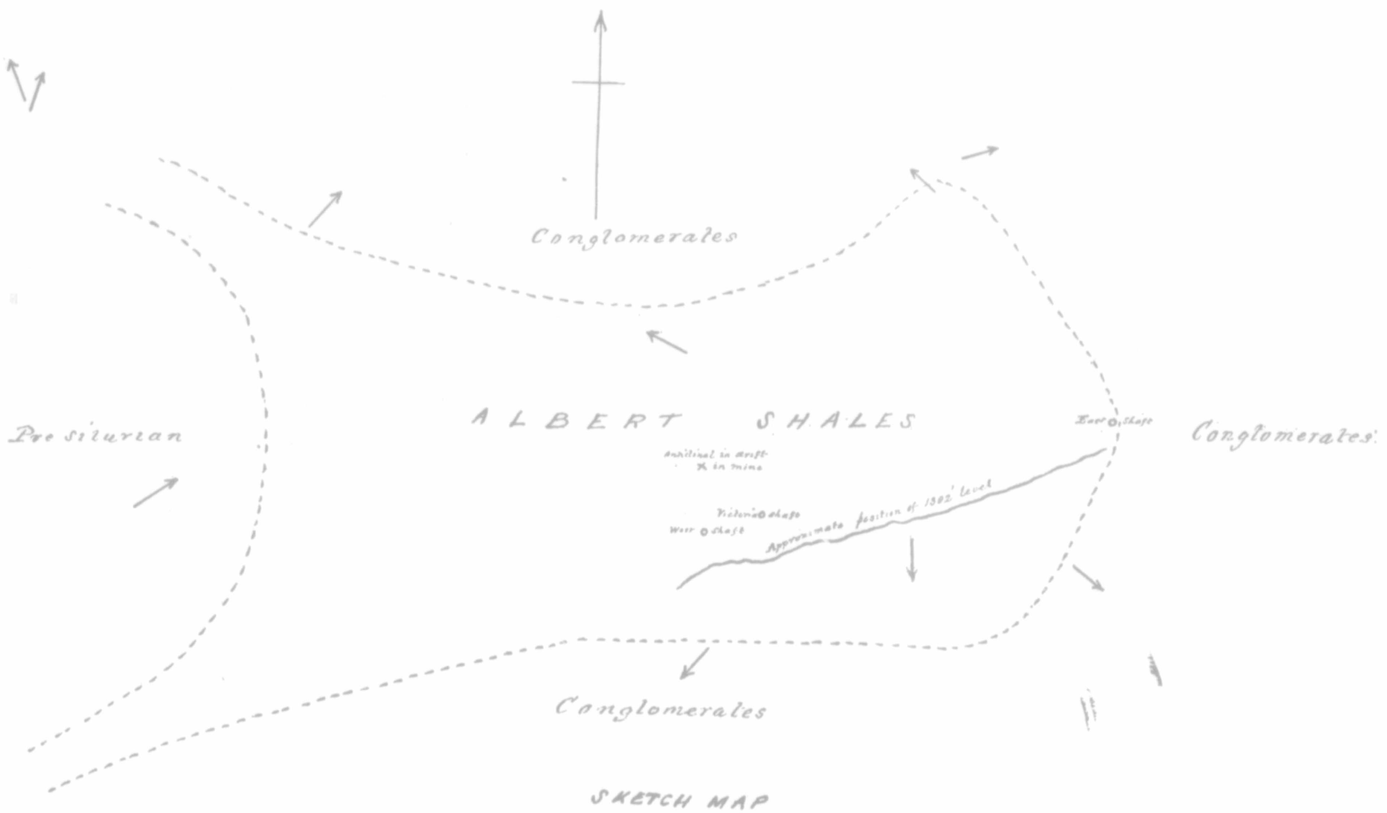

SKETCH MAP
showing position of the
ALBERT SHALES
and course of ALBERTITE
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lowing description of the result of the mining operations at the Albert mine is given. The writer visited the mine and went through the workings when it was in fairly active operation. Later, in 1881, he was requested to make a thorough examination of the then condition of the mine, and to report on the expediency, or otherwise, of a further continuance of the explorations then being made. The facts of position were so clearly brought out by the examination, that an adverse report was handed to the board of directors, and shortly after all operations were brought to an end. The writer is thus in possession of information that may be of interest to those who still hold undecided views on the manner of deposit.

Mention has been made of the bituminous shales in which the albertite is embedded. Apart from their strong impregnation with bituminous matter, and an abundance of fossil fishes in the shales, the evidence of great disturbance is very striking, not only in the anticlinal form of the strata, but also in the folded structure of the beds, and the polished slickensided appearance of the rock in many places.

Another feature to be noticed is the somewhat limited extent superficially of the Albert shales; for, although shales of the same character are found in other localities, some distant from the Albert mine from five to eight miles in an easterly direction, the exposed extent of the shales at the mine is only about 250 acres.

The sketch map No. 1, enlarged from the map of Bailey and Ells, shows the superficial extent of the Albert shales, and the diversity of dips they exhibit. The area of the shales is bounded on the north-east and south by the underlying conglomerate rocks, but at the west end they abut against a superficial termination of an extensive high range of pre-silurian rocks. Having thus as briefly as possible outlined the geological position of the mineral, some details will now be given relative to its form as developed in the course of mining. The general course of the vein from end to end is N.E; its direction is crosswise with respect to the strike of the shales, their dip at the west end of the mine being to the S.W., and at the east end a little south of east. It is almost vertical in some parts of the mine; the general inclination of the dip is, however, to the south. The thickness of the

vein varied considerably throughout the entire range of the workings, from a few inches to eighteen feet; and these changes were of frequent occurrence. The extent of the workings in an east and west direction is about 1,000 yards; the lowest level is at a depth of 1382 feet from the surface. From this level, in consequence of the thinning out of the vein and the passing through a considerable space of barren rock and impure coal, several exploring holes were sunk to the dip, the results of which will be given.

Plan No. 2 shows the actual position and shape of some of the interruptions met with in the course of mining. It does not, of course, show every interruption of this kind, but at the west end of the mine two characteristic shapes will be observed, the massive form in one case, and the peculiar isolated shape of the other, these last being apparently detached fissures. The irregularities in the thickness of the vein, and the occasional barren spaces were notable at an early period of the mining operations, and became more frequent as the openings were driven at greater depths. In the 980 foot level, *i.e.*, 980 feet from the surface, the opening to the west of the west shaft passed through a series of nips, as they were termed, meaning thereby spaces occupied by the shales, which in a horizontal respect would represent a succession of somewhat parallel gashes, varying in width and length, and in some cases running to a point at each end. Even from the surface nips have been traced to their termination at a considerable depth. Another feature in the lower levels was the increased extent of impurity of the vein, caused by an admixture of shale, and the position of the albertite in a pure state, only in what are termed pockets.

An increase in all these circumstances seemed to be so indicative of an approaching termination of the deposit in a descending direction that the explorations now to be described were undertaken in order to arrive at a decision in this respect. Down to a depth of 675 feet the yield of coal was pretty uniform; at that depth the length of the level worked was 2,085 feet, and on that distance there were nips of barren ground aggregating 102 feet in length, thus reducing the productive ground to 1,983 feet. Each foot in height, in this distance, yielded 289½ tons of coal. A steady reduction in yield was found as the

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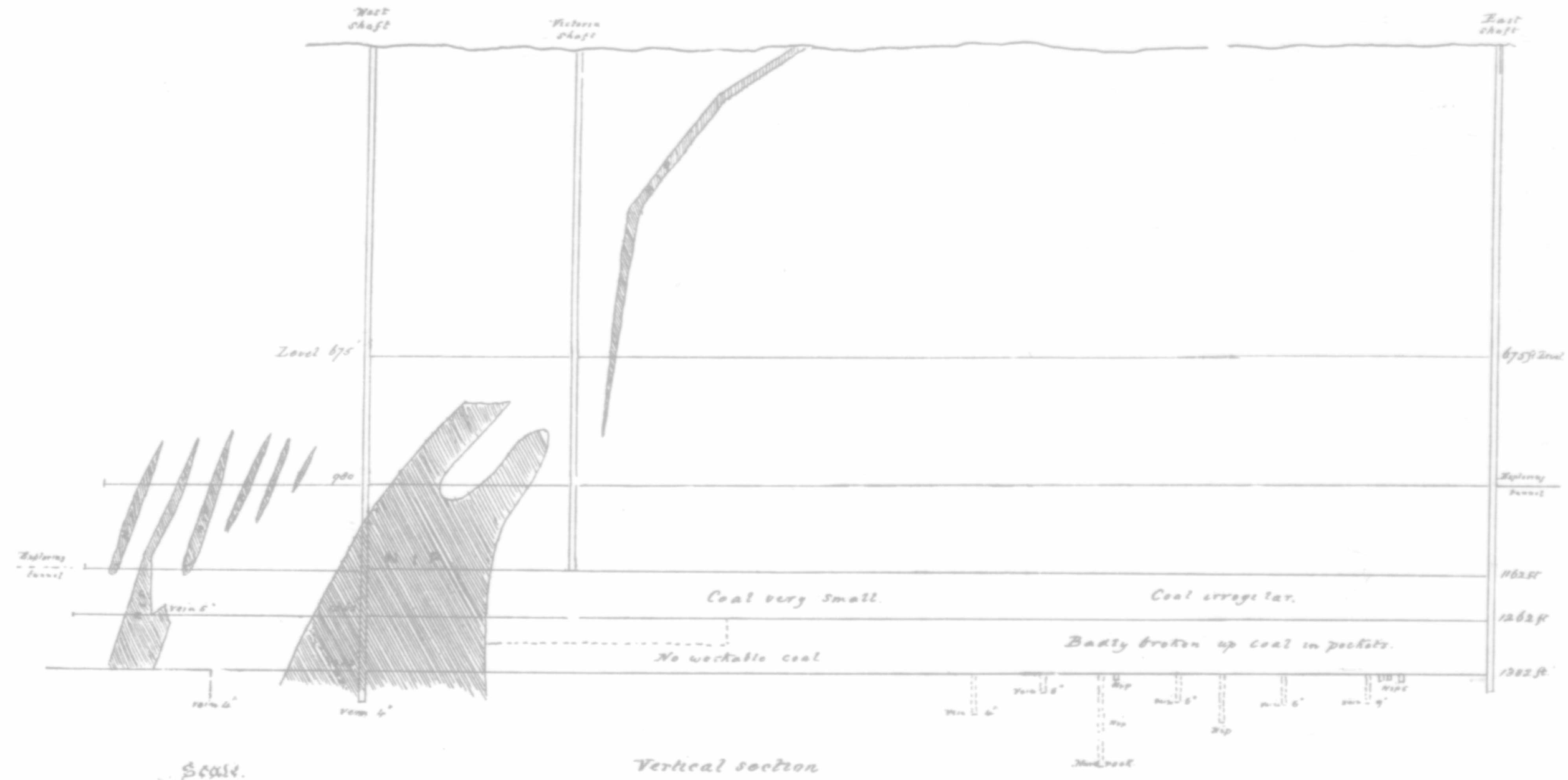

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200 Feet = 1 Inch.

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depth worked increased, until, in the lowest level, 1,382 feet from the surface, in a distance of 2,954 feet, two-thirds of that length was occupied by nips and the yield of coal fell to 58½ tons per foot in height. It seemed evident, therefore, that the coal was being exhausted, and in order to test this apprehension several openings were made below the 1,382 feet level at the east end of the mine. These explorations were openings large enough to allow a man to work in, and were sunk to various depths over a distance of 1,200 feet in a westerly direction from the east shaft; the result was as follows: In these holes the coal was either cut off entirely or so reduced in size as to be unworkable. The depth sunk varied from 5 to 210 feet. In one hole the thickness of the vein was reduced to 9 inches, in another to 6 inches, in another to 4 inches, and in the deepest—210 feet—a thickness of coal of 2 feet in the level fell, with variable thickness, to 12 inches and then to a mere leader, which terminated in totally barren rock. This variation in the thickness of the vein, which was so general, is exemplified in the 210 feet hole. The thickness in the level, as stated, was 24 inches; at 36 feet down it was 42 inches, at 53 feet it averaged only 9 inches, at a depth of 97 feet it increased to 24 inches, and at 113 feet it was reduced and terminated as stated. These explorations were therefore considered confirmatory of the exhaustion of the vein.

The indications at each extremity of the workings still further strengthened this opinion. At the west shaft a drift was driven to the north, from the vein in the 1,162 feet level, 700 feet. This was entirely in hard shale and no coal was found. Westward from the end of workable coal, in the same level, a drift was driven 400 feet, terminating in soft shale and sandstone. At the east end an exploratory drift was driven eastward 600 feet from the shaft, and cross drifts to the north and south out of it, covering a space between the extremities of over 700 feet. These also were in shale and sandstone, and equally unsuccessful in finding any coal. The accompanying plans will, it is hoped, aid in realizing not only the position of the vein in the shales superficially, but also the peculiar interruptions of which mention has been made. Attention may be drawn in the first instance to the sketch map No. 1, which shows the oblique course of the vein in relation to the strike of the shales and the axis of their anticlinal position.

In plan No. 2 the section is given from the surface in order to show at what an early stage in the operations the nips were met with; one of about 50 feet in thickness was found to extend to a vertical depth of 800 feet. In connection with these nips attention may also be drawn to the parallelism of direction that prevails. Whether their course has its starting point from the lower end of the deposit, as regarded in a vertical position, or if it be assumed that some had their origination at the upper end, it is evident their bent has been imparted by some operating force on the west side, derived in all probability from the mass of metamorphic rocks at the west end of the shales and against which they abut. A brief description of the mode of working this peculiar mineral, in all respects, will be of interest. The method pursued in opening at an additional depth was to sink a hole from the working level—say 100 feet; out of this hole, midway between the upper and lower levels, drifts were turned away and driven a short distance east and west, the hole and the drifts being well timbered. A chain was then suspended in the hole from top to bottom, and the hole was then filled with coal. This part of the work was generally done before the shaft was sunk to the depth at which the level was to be driven. When the shaft level reached the hole, the chain was worked up and down by a lever to loosen the coal, which, when taken out, left the hole free for an air-way and for working the mid drifts.

It may be noteworthy to add to this record of so interesting a mineral, that 54 cubic feet produced a ton of 2,240 lbs.; that it yielded 15,000 cubic feet of 64-candle gas to the ton, and that the price obtained during the course of years the mine was in operation, ran from $10 to $15 and $21 per ton—$18 being steadily maintained for some time.

Before closing this memoir it will not, it is hoped, be considered irrelevant to refer again to the very unique character of the albertite deposit. So far as the writer has information no similar deposit is known; if there be any such it would be intensely interesting to know all the circumstances of geological position for comparison with those of the albertite. These in that locality may be summarized as consisting of the position of the mineral in a considerable deposit of shales

highly impregnated with bitumen, with overlving micaceous and bituminous oil-bearing sandstones, an anticlinal form of the strata of local intensity, with corresponding but still greater general disturbance indicative of violent upward as well as lateral pressure; of the further peculiarity of the shales, that of their finely laminated and perfect stratification, and the abundance of fossil fishes they contain. The fineness of deposition exhibited in the shales would certainly imply a somewhat quiescent state during its accumulation, and it may be further inferred that such a condition was adapted to the mode of life of the fishes found in such abundance, and that by an elevation of the strata they were suddenly shut off from exit to the main body of water, and thus entombed as the successive depositions gathered over them.

That there must have been some local difference that tended to the production of the peculiar deposit, albertite, in that detached portion of the Albert shales may be fairly inferred in view of the striking similarity and geological condition of the shales which are found at Belliveau and Memramcook, the localities before referred to, and the absence therein of any deposit of albertite of a workable size.

It remains to refer to the question of origin of the albertite, and the diversity of opinion that was, and perhaps is still, held regarding it As intimated in the beginning of this paper, the particulars of position in the mine and other circumstances, it was hoped, might be of service in this respect. Plan No. 2 is a vertical section of the vein from the surface to the lowest level and the exploration openings. Looked at in a horizontal point of view, the question may be asked, has it any resemblance to a similar representation of an ordinary seam of coal? Then, in a geological point of view, as shown on plan No. 1, are the usual characteristics of conformity of deposition with the enclosing strata present, and the general underclay of a coal floor?

To these questions the writer thinks a negative answer must be given. The interruptions in the regularity of the vein, their peculiar shape both in the massive and the fissure form, and the variable thickness of the vein, apart from a still greater diversity in the relationship with an ordinary coal seam, seems to indicate too great a dissimilarity to permit of the deposit being classified with it. The other diversity

referred to may be given in the words of the able manager of the mine, Mr. Byers, who in a letter to the writer says: "From my observations during twenty-five years' experience at the Albert mines, I think there is no doubt about the albertite having been injected into an open fissure in a very fluid state. Every crack and opening in the shales for some distance from the main fissure has been filled with the fluid. I have worked the albertite from eighteen (18) feet in thickness to a few inches, and in all cases found it pure albertite, without any strings of impure matter like other coal, except where a piece of loose rock had fallen into the fluid mass, and in these cases the rock was covered with albertite, like a piece of rock thrown into boiling pitch." This is surely a strong corroboration by a thoroughly practical man of the geological deduction arrived at by Professor Bailey and Dr. Ells.

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On the Strange Singularity of Colour in some Forms of Asbestos.

By Robert H. Jones, F.S.A., London, Eng.

When we consider the many forms of asbestos which are known to exist in various parts of the world, we cannot fail to be struck with the very small proportion of these which, up to the present time, are found to be available for use, not only in the arts and manufactures, but for innumerable purposes connected with industrial and every-day life. Such as we have been able to utilize are found to be of the greatest value; others, for which no special use could at first be discovered have, in the course of time, proved to be valuable for certain specific purposes, but still by far the greater number remain, for which no definite use can yet be found. These at present are regarded chiefly as mineralogical curiosities only by those scientifically acquainted with them, while, so far as the trade is concerned, they are left severely alone and treated as waste.

These forms of asbestos are by no means the only things which, because they are deemed to be profitless to us, are generally treated as waste; though, on reflection one cannot fail to see that the term is an absolute misnomer, for the longer we live and the more knowledge we acquire, the more certain we become that there is absolutely no single thing in the inorganic, any more than in the organic, world, which can rightfully be regarded as waste. The frequent use of this word only shows the feebleness of our poor imaginings, which result from our imperfect understanding. There is no form of matter on, in, or under the earth, which has not been specially designed for some definite or specific use; and if we could only once understand the purpose for which it was created, we should see that every created thing has some certain use, and that there is nothing in the world which can rightfully be termed waste.

To take only an ordinary instance; when travelling over the world, how often does it happen that we meet with some district of so

uninviting a character, so boulderstrewn, or encumbered with large rock masses, so wanting in verdure, so ruggedly mountainous, so wildly precipitous as to be generally inaccessible, so much so that even the most unreflecting of human beings will at once see that the Almighty could never have intended it to form an agricultural or pastoral land. Supposing any such person to be especially looking for this last, in his bitter disappointment, he may well be disposed to cry out that it is all barren, hideously barren, hopeless and altogether waste, while in the blindness of his ignorance, he altogether fails to realize that it is to entirely different qualifications he must look in such a land as this, than to pastoral beauty and agricultural capabilities. Beneath such lands often lie the great storehouses of Nature's mineral wealth, which she dispenses, with no niggard hand, according to the requirements of the world, though only too often as the fruit of untiring and unremitting toil. As perhaps an altogether too familiar instance of this, we have only for a moment to look to that uninviting region towards which the hearts of men seem now to turn almost with one accord, as to a land of hope, according as they may be more or less afflicted with that eternal and incurable disease, *auri sacra fames*, Alaska and the Klondike.

And it may be here parenthetically mentioned, that far richer goldfields than these await us, it may be in the near future, in Central Siberia; in the neighborhood of Tomsk, Irkutsk and Krasnovitsk. But, unhappily, these lie in that heart-breaking region to which the pitiless laws of Russia condemn so many thousands of political prisoners to wear out their lives in hopeless misery. This particular part of the country is, in fact, so rich, far beyond that of the Klondike, that no man cares to waste his time in collecting the alluvial gold or washing for dust, when he can easily gather a fortune by picking up the nuggets which lie ready to his hand. In many respects, the land resembles the Klondike. In winter many parts of it are altogether inaccessible, and are even in summer terribly hopeless; while it is, at all times, cursed with the awe-inspiring and terrible complications of the Russian mining laws, one hideous example of which came under my personal cognizance while engaged in some extensive iron works

there, and this I may perhaps be excused for recounting, notwithstanding its irrelevance, on account of its national interest.

Our manager was a fine, commanding, athletic, John Bull Englishman, as the Russians themselves make the worst of managers. He was much liked by the English employés, and much in favor with the authorities; but it happened that, one spring, about the time of the melting of the snows, such torrents of water came pouring down from the hills, and with such violence, that they carried away part of a reservoir embankment, swept away several houses and caused the loss of several lives in one of the company's villages. The manager personally was in no way to blame, but did everything in his power to relieve and compensate the sufferers and the survivors; yet then only he became cognizant of the fact, that under one of those diabolical laws, which drive so many people in pure self-defense into nihilism, every manager of an industrial works is held to be personally responsible for every accident which may occur in them, and in the case of loss of life is visited with condign punishment. And his informant, one of the Secret Police to whom he had been of assistance, also informed him that this matter had already been considered at St. Petersburg, and he himself, as the responsible manager, had been sentenced to five years in Siberia. Hardly crediting this, he was able by the connivance of many friends to reach the frontier before the arrival of the warrant for his arrest. He managed to pass the barriers and get out of the country, leaving of course, every thing behind him. It would avail nothing to tell how, penniless and in rags, and in hopeless misery, he contrived in time to cross Europe. Suffice it to say, that when at last he reached his home, the sufferings and privations he had undergone were found to have hopelessly affected his brain and soon afterwards he died by his own act.

Leaving this digression we will now continue. It is by no means gold alone that has so often to be looked for in such desolate and uninviting regions as those mentioned. Asbestos especially is not seldom to be looked for in the most dismal and frequently untrodden parts of the country, and asbestos prospectors are only too familiar with such places, a sample of which anyone can see for himself as he approaches

the hungry-looking and inhospitable mountains of Coleraine and Black Lake.

It has been particularly requested that in this paper I should give some information as to the colored varieties of asbestos and especially the blue variety which comes from the Cape of Good Hope, and is known as the Cape blue. What may be said to be the normal color of asbestos, which at any rate is that with which we are the most familiar, is a snowy white when fibreized, such as is found more especially in Thetford and Danville. Even a more beautiful fibre than this, is that found in the Laurentian formation, such as was formerly worked by Mr. Circkel at Templeton, and notwithstanding the fact that it is remarkably pure, on account of its entire freedom from any taint of metallic oxide, which only too frequently so deleteriously affects, by discoloring, the fibre, it is a very remarkable fact that in the course of the operations at Templeton, Mr. Circkel uncovered a curious vein of a blue-black color, nearly two inches in width in the thickest portion of it. This extraordinary vein was found at a depth of sixty feet below the surface in serpentinous limestone of a dark bottle-green color, but how it came about that the metallic oxide should have become concentrated in this one particular spot and developed in the fibre such an unusual color, no one can tell.

Then if we turn to some of the more pronounced colors exhibited by the foreign fibres, we shall note that some shade of blue is by far the most predominant, consequently we will commence with the dark-blue fibres of Africa. The most important of these, which is technically called Crocidolite, a name derived from a Greek word signifying a woof, in allusion to its fibrous structure, is found, with slight differences of texture or color, in several parts of the world and in the text books is generally described by authors following Dana, as being of a "lavender-blue or leek-green color" and a silky lustre. With this description I entirely disagree. If you will look at the sample I have sent to your secretary and which I brought from the company's office, I think you will agree with me that the color might be better described as a Prussian blue; and the description silky I also take to be erroneous, the fibre having no approach to the silkiness of Thetford or

Danville but being much more like wool, that stocking wool, in fact, which mountain women seem to be always engaged in knitting. This peculiar fibre seems to occur in practically inexhaustible deposits in a desolate mountain region bordering on the Great Orange River, in Grigualand West, South Africa.

And this crocidolite fibre, when in the crude rocky state shewn in the photo, has one remarkable peculiarity which I have never observed in any other form of asbestos. If the ragged fibres be taken off, which can be easily done, and the lump of crude then taken into the palm of the hand, so that the thumb can be rubbed up and down, the hard lump will take a fine polish, the polished surface, at the same time, acquiring a much deeper tint than heretofore. This looks as if the fibrous lump is more compact than usual, though the fibres are just as easily separable when required for carding or spinning, which is a peculiarity found in this Cape blue fibre alone. In places also a a brownish tint is observable, shewing much like that brown fibrous quartz which in the States is called on account of its tawny brilliancy, by the name of Tiger Eye. This is found also in in the same place in large quantity. It is a beautiful ornamental stone, capable of taking a very high polish and can be cut or engraved as clearly and finely as a precious stone, and when polished the fibres of the asbestos are distinctly observable.

I perfectly well remember when this blue fibre was first brought from the Cape to England by a gentleman named Harris, who at once came to consult me about it and to ask my assistance in the working or disposal of it. I was then struck with its enormous comparative tensile strength, quite as much as by its singularity of color and its peculiar texture; but, knowing that, at that time, little could be done in England with any asbestiform fibre but the purest white, and knowing also that its color, which was so evidently derived from the protoxide of iron, would cause it to be totally disregarded by English manufacturers, whatever intrinsic value it might be otherwise found to possess, I was ultimately obliged to decline to deal with it. Mr. Harris having tried elsewhere, found, as I had predicted, that English manufacturers were too conservative to touch it, consequently,

he returned to the Cape and laid the matter before some of the members of the De Beers Company, who quickly took it in hand and furnished him with all the capital he required for working it. He then once more returned to England, registered his company and set to work to commence operations, which are still carried on with, as I am assured, a very fair amount of success. Three of the directors of the De Beers Company joined his board, the others being also well known men. Most of the shares also were taken up by ship owners and others, who were able to influence business, so that practically they were perfectly independent of the English market, and the company were soon able to announce that they had succeeded in obtaining very important contracts for boiler and steam pipe coverings in the dockyards of the French and Italian navies and for the protection of a large number of the steamers owned by the *Navigazione Generale Italiana.*

Let us now consider the peculiar nature of the fibre as shewn by its chemical analysis, which is given as

Silica	51.1
Protoxide of iron	35.8
Soda	6.9
Magnesia	2.3
Water	3.9

from which it is perfectly evident that very little reliance can be placed on it as a fire resistant. It is claimed, however, to be a remarkable non-conductor, and much stress is laid upon the fact that this famous blue fibre can be so well opened and carded as to produce "wool of half the specific gravity of the finest (so called) wool obtainable from other asbestos."

One specialty of the company consists in the manufacture of a kind of asbestos cushion, or, as they term it, a mattress, which is used as a boiler covering, and this they claim to be superior to the cement system, for the following special reasons:—That it can be fitted to boilers before leaving the works, so that a perfect fit can be assured; that it can be so fitted around the boiler as to prevent breakage; that it proves also to be a valuable protection to the tank tops in double bottomed vessels which, owing to the heat from the bottom of the boiler, invariably give trouble by so quickly rusting away; and more-

over, that it can be fitted to a cold surface, and thus avoid the necessity of getting up steam, as well as the mess, dirt and consequent inconvenience incidental to the application of ordinary cement.

In the preparation of these jackets or mattresses, the company claims that their pure, well-carded asbestos fibre is packed dry in asbestos cloth, which is sown around it and stitched through it at frequent intervals, in order to keep the material from shifting; whereby it forms a mattress or jacket which can be made to any size or shape to fit the object to be covered, and to which it is secured by bands of hoop iron, or some similar means, in such a way that it can be removed and replaced with the greatest ease. The outside, when painted or tarred, has a surface which will resist any amount of friction. It can be walked upon without injury and requires no protective casing. They also weave a hollow rope, which, when filled with their pure carded asbestos fibre, is said to be the best heat insulator extant, as also the simplest, lightest, cheapest and most durable boiler or pipe covering made.

Nor must we omit to mention their "Blue Cape asbestos bedding." This they declare to be fire-proof, as well as insect and germ-proof, rot-proof and hygeinic. It is formed of three separate layers of material, two of these being formed of the blue fibre, with the third of the finest hair sandwiched between the other two; in which state this bedding is formed into exquisitely soft, springy mattresses, pillows, etc. Numerous other articles of a useful and ornamental character are made out of this fibre, but it is to be feared that its first cost will in some measure militate against its extensive use. The works of the company are at Turin, where they have a large plant and machinery.

Besides the Cape, there are several other blue fibres, one of which, if asbestos as asserted, is of a most wonderful character. This was some time ago sent on from the South American Republic of Bolivia. Its special peculiarity lay in the fact that instead of having anything like a woolly or silky appearance, it has considerable resemblance to hair, and therefore is more like halotrichite* than any form of asbestos. The fibre is of a long, clear and very beautiful texture, is of consider-

*An iron alum.

able textile strength and of a deliciously blue, translucent color. It is also capable of being easily carded, spun and woven; but unfortunately from the time of its first introduction to this day, nothing more has been heard about it. It can only be surmised that the whole thing has been lost sight of in some of those political troubles which are so frequent in these South American Republics.

Then, quite recently, another of these hair-like, translucent blue fibres was discovered and brought over to England. This was not of quite so fine a texture as that last mentioned, but was very beautiful. It was brought from a place called Alilonci, in the sub-district of Sankimert, in the Austrian province of Bosnia, at a distance of about twenty miles from the Novi station The mine lay, as usual, in a wild, mountainous part of the country, somewhat difficult of access. Its product is in every way remarkable and the reports of its origin not only surprising, but in many respects startling, if not incredible. It was reported on and the fibre described by one of the professors of the Imperial and Royal School of Mines at Vienna. The report was altogether of a marvellous character and the analysis, made by the director of the same institute, at the chief office there for experiments, was even more surprising still. This analysis reads as follows:—

Scilicic acid	54.10
Argillaceous earth	....
Oxide of iron	15.76
Protoxide of iron	7.33
Magnesia	12.60
Lime	1.44
Natron	5.40
Kali	0.45
Carbonic acid	0.09
Water	.....
Loss by burning after deducting carbonic acid	2.81
	99.98

From the chemical constituents here given, it would almost appear as if this so-called asbestos was no form of asbestos at all. On more careful and fuller investigation it will, in all probability, prove to be

some other asbestiform mineral like glaucophane.* At any rate, it would seem that nothing at all like it has ever been shewn before.

At present, it has only been found in indurated muddy clay, which is described as being a secondary deposit, washed up as the German geologists tell us out of the primary deposits by aqueous agency; no indication of what the nature of this primary source is has ever yet been discovered. There is nowhere any indication of pyroxene, tremolite, hornblende, or serpentine, such as one might naturally look for, although the owner tells us that on one occasion, in the course of the excavation, he came across a big stone (some kind of conglomerate, I should imagine, from his description), to which, he says, some wonderfully long fibres, worth any money, were attached. But inasmuch as he did not preserve this wonderful stone, nor show it to any one, I think we can safely regard the story as altogether apochryphal. The soil all around is composed, say the local geologists, of strata of the trias formation, consisting, in the first place, of Werfen strata (the oldest strata combination of the triassic system in which sandstone forms the principal part, but in addition to which there are also found alternate beds of slate and lime), in the second place of black limes, the so-called Geehenstein limes, which form the next oldest component part, and in the third place of dolomites which follow in immediate succession to the Geehenstein limes. Over the whole ground there is spread out a mighty mass of diluvial mud, and it is of this that the fibre is said to be a product; in which case it would appear that the mud or clay itself was the primary source. This clay, as it hardens in drying, when thrown up, forms great indurated masses, and if one of these be taken from the heap, it has the precise appearance of dry plastic clay, and when broken in the hands there is revealed in its interior a glorified bunch of bluish, translucent fibre, which (if we ignore the color) can be likened to nothing but a tress of some lovely woman's hair. The texture of this is good, the tensile strength considerable, and its spinning and weaving qualities admirable. Then, also, a London dealer tells us he can sell any quantity of it, and an experienced manufacturer assures us that it would sell for £13 sterling per ton in the London market.

* A blue soda hornblende, usually found with black mica,

There are many other forms, both of chrysotile and crocidolite, of a blue and blueish color found in Norway, Moldavia and other parts of the world, but none of them are as yet of any importance. There are also many green fibres, notably one of the curious eucalyptus green found in Australia, so characteristic of the verdure of that country. The only sample of this I am acquainted with is of a hard, fibrous texture like the Cape blue, but the fibres are, like that, easily separable and I should think as readily capable of being spun and woven. Australia is a fine asbestos country, several good white varieties being found there and used in the different manufactories. Great quantities of the Laurentian fibre also occur there, some of the veins being much larger than any to be found in the Ottawa district of Canada, and some portions of these are slightly stained with oxide in such a way as almost to make the nacreous veins look as though bruised. Some other of the Australian fibres are of a pure white and applicable to all kinds of merchantable purposes, but a sample of brown fibre was recently sent me from the gold district of Coolgardie, which could only be used for grinding purposes, and this has the precise look of a stick of cinnamon, such as we may see in any grocer's shop window.

Many of the foreign brown and rusty-colored fibres are very objectionable. One of these, of which a large quantity was recently sent from Servia and Hungary, is stiff and harsh and irritating to the skin on handling. Directly a piece is taken in hand for the purpose of examination, its filaments penetrate the skin and irritate the flesh like the stinging of a nettle. They are also very troublesome to eradicate, as every movement of the hand will work them further and further in. Something similar to this occurs in Wyoming, and many coarse, ropy-looking fibres occur in the States, and these are also very generally of rusty-looking color.

Many of the Russian fibres are of a similar color and texture to the Servian, but none of them are of the same troublesome nature to handle. Recently we have had some much better fibres from that country than formerly, and now we have specimens of a remarkably good quality, one that will probably meet with a ready sale in England, provided it can be sent over at a reasonable price.

The Chemistry of Foundry Practice.

By Ernst A. Sjostedt, M.E., Montreal.

Compared with the chemistry of the blast furnace process (in which the ores are deprived of their oxygen, and the reduced metal combines with such elements as carbon, silicon, manganese, etc.,) and the different processes of iron and steel making (whereby the said foreign ingredients are oxidized and eliminated to a more or less complete degree), the chemical changes taking place in the cupola, where the metal is merely remelted, are quite simple. Nevertheless, these changes, small though they be, are sometimes of great practical importance, and as the physical qualities of the castings, such as strength, hardness, elasticity, etc., are very largely dependent on the chemical composition of the metal, it is evident that the adoption of chemical researches in connection with the foundry practice are well deserving of a most careful attention. The importance and necessity to the blast furnace manager and the steel maker of applying chemistry in their daily practice has long been recognized, but it is quite recently that the services of the chemist have been called upon to help solving the many puzzling problems which the foundryman constantly encounters. However, his legitimate place and position is already well established at the larger foundries in the United States and in Europe, besides at such works where a specialty is aimed at, such as car wheels and malleable castings; and the smaller foundries are slowly following their example.

In the hopes of arousing some interest in this important subject in this country, and especially among the members of this Association, the following notes and facts are hereby presented as a nucleus for discussion—founded as they are on the best authorities, and in all essential parts having been found correct and a most valuable help to the writer, in connection with his labors and investigations as chemist at different iron and steel works. Even at the risk of appearing pedantic the writer has aimed at making this treatise as elementary as

possible, in order to interest those least familiar with the subject, and must therefore ask of the well informed members their kind forbearance.

As we all know, absolutely pure iron does not exist as a commercial product, for what we are working and dealing with is not a single substance, but an alloy, composed of a number of elements in different proportions, the total sum of which, however, seldom exceeds five to ten per cent. Among these elements, carbon is an essential constituent and one that plays a most important role in determining the physical character of the iron. In fact its influence on the iron is so great that its presence in smaller or greater amounts is responsible for the three well known classes, with so distinctly different characteristics, in which iron has been divided, namely wrought iron, steel, and pig iron—pig iron containing about 2.5 to 5.0 per cent. of carbon, steel from .4 to 2.5 per cent., and wrought iron from about .03 to .35 per cent.; and their characteristics are so familiar to us all that it is here only necessary to recall their different melting points, which for pig iron is from 1,800° F to 2,200° F, steel about 2,650° F, and wrought iron about 2,880° F. Again, we must carefully keep in mind that carbon, in pig iron, occurs in two conditions which are distinct in their physical and chemical relations, namely as graphite and as combined carbon. If present as graphite (*i. e.* simply mechanically mixed with the iron) the pig has a gray, soft fracture, but when it is in chemical union with the iron the fracture is white and hard, with metallic luster. In molten pig iron all the carbon is present in its combined form, and it all depends on the time and conditions allowed during cooling which state—graphitic or combined—it will assume in the casting. The slower the cooling is taking place the better opportunity the carbon will have to crystallize forming graphite) and the grayer the iron becomes, whereas if made to cool suddenly (as when poured against a chill block) the carbon is not given this opportunity, and consequently it remains in its combined state, and the iron becomes hard and white—always provided no other strong agent is present that will break this rule, and of which we will speak presently. The carbon, *per se*, as long as it remains combined in the pig iron, increases the absolute tensile strength of the iron, but

when separating as graphite it makes the iron weaker; it also increases the hardness, but decreases the elasticity and the melting point of the iron (*i. e.* white pig iron is somewhat easier to melt than gray). The following analyses of combined and graphitic carbon in a certain coke iron will give a clear idea of the influence which the different modifications of the carbon exert on the fracture of the pig:—

No. 1 Foundry pig.....3.80 p.c. graphite, and..... .10 p.c. combined carbon
No. 2 Foundry pig.....3.78 p.c. graphite, and..... .25 p.c. combined carbon
No. 3 Foundry pig.....3.60 p.c. graphite, and..... .39 p.c. combined carbon
Gray forge.....3.00 p.c. graphite, and..... .70 p.c. combined carbon
Mottled.....1.50 p.c. graphite, and.....1.70 p.c. combined carbon
White..... .10 p.c. graphite, and.....3.10 p.c. combined carbon

Among the other elements usually present in the pig iron, and the one next to carbon in importance, as regards its effect on the iron, we must place the silicon. Silicon, namely, exerts a controlling influence on the chilling properties of the iron, owing to its tendency of separating the carbon as graphite. Its percentage in the pig iron is generally in proportion to the temperature at which it has been manufactured—thus a coke iron is higher in silicon than a charcoal pig—and varies from a few tenths of one per cent. (as in Swedish charcoal pig) to 1.5 and 2.0 per cent. (in iron usually suited for machine castings,) and runs as high as 2.5 to 3.5 per cent. in good soft coke iron, and the "silvery iron" contains about 4.0 to 5.0 per cent. Silicon alloys with iron in greater proportions than carbon (ferro-silicon containing 30 to 50 per cent.) and decreases the absorption of carbon—hence coke iron is generally lower in total carbon than charcoal pig, and iron with 2 per cent. silicon and no manganese has seldom more than 3.8 per cent. carbon. It increases the fluidity and fusibility of the iron and lowers its melting point, retaining its heat for a longer time, and thus lessening the formation of blowholes, and decreases the shrinkage (in proportion to the amount of graphite that has separated). Added to "pure cast iron" it has been found to improve the strength of the iron up to 2.5 per cent, above which amount, however, it makes the iron weaker. From the above properties of the silicon it is easy to see why it is that pig iron which contains a high percentage of silicon acts and is used as a "softener," and that by melting various portions of such iron with hard iron all the different grades can be

obtained, from close to very open grained soft iron—in remelting, pig iron loses about .25 per cent. of silicon, which should not be lost sight of.

Another disturber of the equilibrium in a pig iron is sulphur. Contrary to silicon, sulphur present prevents the formation of graphite, and consequently it has a tendency of producing a white hard casting; it also makes the iron sluggish and full of blowholes, causes red shortness and increases the shrinkage. Besides, being generally irregularly distributed in the iron, sulphur tends to make an uneven, unreliable casting. For these several reasons sulphur has well been called "the foundryman's bane," and (owing also to the hindrance it offers to annealing) it should especially be avoided in malleable castings, also in iron intended for car wheels. Sulphur has a great affinity for iron, combining with it at a low temperature and in any proportion up to about 53 per cent.; and as its evil effects are perceptible already at a fractional part of one per cent., it must be a matter of great importance for the foundryman to keep track of this element. As a general thing it it is rarely found in a soft open foundry pig—for its presence to any high degree would make the iron more or less close grained or white—and this great enemy therefore is not always shunned as much as it deserves; but its presence in the coke, and sometimes also in the limestone, is certain to bring it in the iron, and thus it happens that a good iron often has been condemned when the fuel and the flux alone were to blame. Good Connelsville coke contains seldom over .6 per cent. sulphur, but at many a foundry 1. per cent. of sulphur in the coke is not unusual; and if a basic flux and a high temperature be not resorted to in the cupola the iron, in remelting, will increase .2 to .5 per cent. in sulphur, which is sufficient to spoil it for most most purposes,—if the silicon be not present in sufficient quantity to neutralize its effect.

The powerful influence of sulphur in changing the character and fracture of the pig iron has more than once been forcibly brought to the personal experience of the writer, and an extreme case was met with several years ago at Kathadin Iron Works, Maine, with iron made from a bog ore that contained from 1. to 3. per cent. of sulphur and which at the time was only imperfectly roasted. Analyses of

several samples of all grades of this pig iron—from open gray to white and spongy—revealed the presence of sufficient silicon which under ordinary circumstances would have made them all gray and soft, but the varying amounts of high sulphur present were here the determining agent, as we see from the following table :—

	No. 1.	o. 2.	No. 2.	No. 3.	No. 3.	No. 4.	No. 4.	No. 5.	No. 5.	No. 6.	No. 6.	No. 6.	No. 6.
Silicon.....	3.09	3.10	2.35	3.55	2.00	2.74	2.70	2.22	1.30	3.89	3.05	2.73	1.26
Sulphur.....	.03	.13	.18	.39	.10	.20	.34	.62	.18	.60	.46	.65	.43

Here, thus, we have a white iron with nearly 4. per cent. silicon, which but for the .6 per cent. sulphur present would have shown an open soft gray fracture.

An element we often hear about, and which when present even in the smallest quantity in steel is much dreaded, is phosphorous. In foundry pig, however, a certain small amount is not only permissable but highly desirable, as it lowers the melting point of the iron and makes it fluid, thus causing it to retain its heat longer and making it suitable for producing small castings of a delicate pattern. Pig iron with less than .2 per cent. phosphorous is apt to shrink.

But when it is present to over .75 per cent. the iron becomes brittle—this in proportion to an increased percentage of carbon present,—and strong castings should not contain over .5 per cent. of phosphorous. It unites readily with iron to about 26 per cent., but practically the pig iron in the market contains from a trace to 1.5 per cent. Phosphorous in not eliminated in the cupola smelting, and its presence should therefore be kept run of.

Manganese is also an element to be taken in consideration in foundry practice, for so many iron ores contain this metal, and a certain amount enters the iron during the blast furnace process, while part combines with the lime and the sulphur and is removed with the slag. Its most striking property is to make the iron "chill," *i.e.* prevents formation of graphitic carbon. But this chill does not make a

durable wearing surface, as it is more crystalline than hard, and readily crumbles under the impact of rapid shocks (to which *e. g.* a car wheel is subjected). Its presence up to 1 per cent. however is not considered detrimental, but a high percentage of manganese makes the casting brittle and white—provided the silicon is not exceptionally high, in which case (as in some Scotch foundry pig of good repute, which carry 2 to 3 per cent. of manganese), the graphite is separated, and a gray iron obtained. Iron alloys with manganese in all proportions, and when the amount of manganese runs between 20 and 80 per cent. the producf is called ferro-manganese, and when containing from 5 to 20 per cent. it is termed "spiegel" iron. Manganese raises the point of saturation for carbon, *i. e.* permits of a high total carbon. Iron without any manganese rarely contains over 4.5 per cent., but ferro-manganese often from 5 to 7 per cent. of carbon (nearly all of which is in the combined state). Owing to its affinity to sulphur it acts as a "purifier," even more so than lime, in the cupola, removing oxides of iron and silicon from the molten iron, and thus helps to prevent blowholes.

A metal which during the last decade has come in great favor as an admixture to iron and steel is aluminum.

The credit of first calling attention to the influence of aluminum on iron castings belongs to a Swedish inventor who introduced the so-called "mitis" castings—a mixture of wrought iron and aluminum. The principal effect this metal has upon cast iron is that it lowers the melting point of the alloy, consequently increases its fluidity and makes it run quick and sharp, besides giving the gases an opportunity of escaping from the molten iron—hence its reputed quality of preventing blowholes. Like silicon, aluminum tends to make a gray iron, and lessens the tendency to chill (*i. e.* favors the formation of graphite), and if allowed to take the place of silicon it will make a stronger and softer casting than if silicon were the agent; but added to an iron already high in silicon it makes it weaker. An addition of aluminum, therefore, is beneficial only to a low silicon pig. If added in sufficient quantities (2 per cent. and more) aluminum, for the same reason as silicon, prevents shrinkage.

Other elements, such as titanium, arsenic, copper, nickel, chromium, etc., also exert their influence on the character of the iron, but they rarely occur in sufficient quantities to require looking for.

From what already has been said, it follows that carbon is a necessary but passive component in the pig iron, made to change in amount and in form by the presence of other elements. Thus sulphur and aluminum, and to a lesser degree silicon, cause it to release, while manganese enables it to hold more carbon in solution; silicon and aluminum tend to change the carbon into graphite, while sulphur, manganese and phosphorous do not cause carbon to leave its combined state. Sulphur, manganese and combined carbon increase the tendency to shrinkage, while silicon and phosphorous help to counteract this evil,—and the more of the effective element the iron contains the more is its action facilitated or retarded, as the case may be.

According to the state in which the carbon is present in the pig iron its grading is determined; but as we have also seen how largely the proportional amounts of graphite and combined carbon are dependent on the many foreign elements present, and to a great extent also on the conditions under which the metal has been allowed to cool, it will at once be evident how uncertain and unsatisfactory it must be to try to judge the quality of the iron simply from the fracture it presents. On the other hand it is not claimed that the physical properties of an iron are wholly dependent on a certain chemical composition—for there are several possible and proper compositions for an iron intended for any certain purpose,—each of which depends for its physical success on the manner of working the iron, as the fuel, blast, temperature, etc., and on the relative proportions of one element to another, as well as on the actual amount of each present—but before we institute chemical investigations we do not gain a true knowledge of what causes these different physical qualities in the iron, nor is it otherwise possible to ascertain the true composition of the pig iron or the cupola charge. In trying to remedy any evil, the first step to be taken, after all, is just in this direction of discovering its cause, after which a restorative generally can be found. For in forming his deductions, the chemist's mode of procedure is singularly simple, reason-

able and practical: as a result of years of scientific experience, theory and actual practice, it is known that certain impurities in the material produce certain characteristic effects on its physical behavior; and these impurities may be eliminated, retained or forced into combinations with others, according to fixed laws and conditions to which they are subject. "There are foundries that can get along without chemical service, but they are very few who could not obtain practical benefit from a use of the knowledge now obtainable upon this question."

Some Modern Forms of Milling Machinery.

FREDERICK T. SNYDER, Keewatin, Ont.

The time has happily gone by when directors of mining companies order a mill "ready made" like a suit of clothes, and it is not unusual to have a mill designed to fit the ore it is to treat, as carefully as the development aims to explore the lead. The machinery, whose description follows, is a case where designing to meet specific conditions has been carried somewhat further than is customary.

The problem was to plan a custom plant to handle the gold ores of the Lake of the Woods, many of which are low in grade, but contain streaks of high values. The absence of copper or lead in addition to the low tenor, put smelting out of the question. A site was selected at Keewatin, having ample water power with the lake for a mill pond. The ore is brought in from the mines to the plant in barges, carrying thirty tons. It was decided to build the mill, to unload this ore, crush it, and sample into storage, then run over amalgamated plates and vanners; all the ore handling to be automatic. It will be seen in the following description that nothing radical was introduced, and that the principal features worth noting were improvements in the detail of existing methods.

The ore is unloaded from the barges by means of a Locke-Miller cableway of four hundred and fifty feet span. This hoists the ore in skips to an elevation of seventy feet and carries it across the main line of the Canadian Pacific Railway into the sampler building. The skip is automatically dumped into a two hundred ton bin, by means of a spring hook. The bottom of this bin is shaped like the letter W, having a gate at each point, so that each side may be used as an independent bin. Both discharge into a crusher feed hopper in the form of an iron cone, thirty inches in diameter at the bottom, placed with the open end thirty inches from the crusher feed floor. The gates being open the ore forms a cone on the floor around the bottom of the hopper, and automatically works down as it is fed into the crusher.

This crusher is of the "Invincible" type. Tension strains are carried by wrought iron, and all compression strains by cast metal. The movement of the jaw is parallel, the top and bottom moving equal distances; and not, as in the Blake, where the bottom moves more than the top; or, as in the Dodge type of crusher, where the top has the greater throw. The usual arrangement is reversed and the outside jaw made moveable, with the result that the common massive frame is done away with. This brings the weight of a ten inch by eighteen inch machine, which is the size used in this plant, down to nine thousand pounds, while the customary weight of the cast iron frame machine of the Dodge or Blake type is from twelve thousand pounds to eighteen thousand pounds. Each portion of the jaw moves over an elliptical path, the long axis of which is so inclined that during the moment of crushing the hanging jaw plate moves directly towards the stationary plate, and only at the end of the stroke moves down and back to feed the material through. The result is a minimum amount of cutting of the plates by the ore, there being no sliding movement at the time of greatest pressure. The tension strains are taken by four wrought rods which run through the frame of the machine to the rear and end in nuts. By tightening independently the rods holding the top and bottom of the hanging jaw, the inclination of the moving plate with reference to the fixed one can be altered. It is profitable to have the opening of the crusher as large as possible that sledging may be avoided, while the angle between the jaws must be so sharp that the rock will not jump up when the jaws come together. These independent adjustments allow the angle between the jaws to be the largest practicable for any particular ore, and once placed, does not change during the operation of the crusher. In the design of this machine the parts which require attention have been concentrated at the back, so that the jaw end can be built into the feed floor, placing the jaw opening where most accessible, and at the same time bringing together within easy reach and out of the dirt and dust from the ore all oil cups and adjustments requiring attention. The enertia effects in this machine were planned to make it as free as possible from longitudinal shake, and in this plant, where it is set twenty feet or more from the ground, produce little or no vibration of the building.

The ore from this crusher is carried by bucket elevator to a screen, which deserves especial notice, its use removing the list of troubles attendant on handling crushed quartz dry through a revolving trommel. It is an ordinary gravel screen, set up at an angle of forty-five degrees, and furnished with a cover. But it is this cover that makes the difference, as it prevents the ore from taking long jumps, and thus permits the use of a screen of almost double the mesh of the product desired. That is, to get half inch mesh ore use a one inch screen, the ore particle striking the screen at so small an angle as not to fall through if more than two-thirds the size of the opening. Particles of ore which get wedged in an ordinary screen do not get into the openings of this screen at all, but jump down over it to be further crushed. The screen surface used in this plant is five feet long and ten inches wide, and readily handles six tons of ore per hour.

What fails to pass the screen goes to a pair of rolls, in which the best results of the experience of a number of mining machinery designers have been utilized. These rolls having shells thirty-six inches in diameter and ten inch face, weigh twenty-six thousand pounds, and when taking rock from a three inch screen and crushing to half inch mesh, run smooothly without jar. The frame is cast in one piece, extended below to form a hopper. The moving roll is of the sliding yoke type. The bearings are nine inches in diameter by twenty inches long, and are patterned after the journals of a railroad axle, which seems to be the best type for heavy service under repeated strain. They have a solid shell and are babbited on the side supporting the strain. The other half is chambered out to form a recess to hold waste, soaked with oil. In addition, back of the babbit is cored out a water jacket, which, in the event of heating, can be connected by hose with the water supply, and the operation of the rolls continued. The shell on the outside is but partially formed in the shape of a ball and socket box. It allows the box to adjust itself to any horizontal angularity of the shaft, such as is produced when one side of the roll is fed and the other side is empty, but prevents the shell from tipping out of a horizontal plane so that the babbit in one end of the bearing cannot wear out without wearing out the other end at the same time.

These bearing shells are supported in yokes, which, in the case of the moveable roll form the sliding part, and in the fixed roll are cast in the frame. By removing the caps of the yokes a roll, together with its bearings, can be lifted out at any time for repairs without disturbing the tension of the springs. One bearing of each shaft is furnished with collars on both ends, each of which, in the case of the ten inch by thirty-six inch roll used in this plant, has a bearing surface of two hundred and sixteen square inches. Between these collars and the ends of the box are loose brass rings, making the total thrust bearing surface in each direction, on each shaft, four hundred and thirty-two square inches. These collars are threaded upon the shaft and by screwing them in or out, the shaft is adjusted endways to keep the rolls in alignment. The housing above is a prolongation of the frame furnished with openings covered with canvas curtains, making all dust tight. The shaft of the moving roll passes through sliding plates, which are held against the housing by springs. All the principal nuts on the machine are split and provided with clamp nuts, so that they can be securely held in adjustment, yet readily be loosened for movement. In operation, the rolls are set apart by means of cast iron plates, against which the sliding box is screwed up solid. When running it does not jump. Each yoke of the sliding boxes has a bearing surface under it twenty inches wide by thirty-eight inches long, in the form of a steel plate two inches thick, removeable when worn. To provide against the accidental introduction of a piece of steel too large to go through the rolls safety springs are provided which, however, do not yield until the pressure per lineal face of roll exceeds four thousand pounds, giving a spring pressure for this size of roll of forty thousand pounds, which will flatten out a wrought iron nut, but will allow a cold chisel to go through. The feeder for these rolls has no moving parts, but consists of a series of four inclined steps facing in opposite directions, from one to the other of which the ore slides, and is so spread evenly over the width of the roll shells. One of these steps is hinged, and by means of a short lever can be thrown up against the step above it to shut off the ore supply in case of trouble with the rolls or with the spouting above.

That portion of the ore passing through the screen goes to an automatic time sampler, which was designed for this plant. It consists of a casting about the size and shape of a miner's gold pan which is mounted to revolve on the end of a horizontal shaft. The ore to be sampled is allowed to fall on the inside of the sloping flange, and slides off into a receiving bin. At one point of the sloping flange is a narrow slot, which, as the sampler revolves, passes under the spout and allows a portion of the ore stream to pass through to the back of the sampler into a second bin, where it forms a sample of the lot. This sampler was designed to avoid the mechanical complication of the Bridgeman sampler, which was recognized as doing theoretically correct work. An attempt was also made to reduce the head room necessarily occupied by a sampler, with the result that the seven feet required for a Bridgeman sampler of the same capacity, has been reduced in this machine to twelve inches. It is probable that this machine, while making but one cut on the material, does theoretically the same work as the Bridgeman, which makes three. Referring to the accompanying diagram, figures one, two and three, represent successive cuts that are made by a Bridgeman sampler on an ore lot, the shaded portions being the parts successively removed. Figure four represents the portion which is reserved as a sample. Figure five shows how the same result is arrived at with this machine, the entire reject being cut out in one operation, the result, shewn in figure six, being the same.

From this sampler the ore drops into one of two, three ton hopper scales, where it is weighed and delivered by flat belt conveyor to one of the two hundred ton storage bins. When required for reduction it is drawn off from the bottom and carried by another belt conveyor two hundred feet into the stamp mill. These are flat belts, twenty inches wide, eight ply rubber, running at a speed of three hundred feet per minute, and have proved entirely satisfactory, The surface wears but little, the ore being given the same forward velocity as the belt, before it is allowed to drop upon it. This belt has carried over sixty tons of ore per hour on a space not over eight inches wide in its centre. The belt goes uphill and delivers the ore into the ore bins above the stamps.

From these it is fed by automatic feeders of the suspended "Challenge" type, which are without the usual frame and hopper, the disc with its rotating mechanism being hung on two iron bars at the back of the mortar. A light iron spout connects it with the ore bin gate, and the ore bin proper forms the hopper, thus giving free access both to the back of the mortars and to the mechanism of the feeder.

These deliver the ore into the mortars, which were designed solely as crushing machines intended to give a maximum output when fed with ore which has passed a half inch screen. They are double discharge, provided back and front with splash boards. The discharge from the back screen is carried through a channel cored out in the base of the mortar so as to issue, together with the discharge from the front screen, through a short spout on the front of the mortar. These mortars weigh six thousand pounds apiece, the base being ten inches thick. They are furnished with steel liners on the sides and ends, and the wear of the shoes compensated for by false bottoms of steel. The screens stands at an angle of seventeen degrees from the vertical, and are twelve inches by fifty-two inches giving a total discharge area of twelve hundred square inches. The stamps dropping in these mortars weigh nine hundred and fifty pounds each, and drop eight inches one hundred times per minute.

The pulp passes from the mortars to the distributing box of a gyrating copper plate, four feet long and six feet wide. These are silver plated, coated with amalgam, and by a simple mechanical arrangement, each point in the surface of the plate is caused to gyrate around a circle about three-quarters of an inch in diameter. This causes each particle of ore, in place of running over a straight path of amalgamated copper six feet long, to go over a spiral path about thirty-four feet long, before it reaches the bottom of the plate. The gyrating shake enabling the table to be operated at about one half the incline necessary without it.

From these plates the tailings pass to vanners with four feet plain belts. These vanners in place of the customary side shake of the "Frue" are given the same gyrating shake as the plates, that is, each point in the belt moves over a circular path about three-quarters of an

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The production of the whole Slocan district may be roughly stated at 100 tons per day, of which 60% is of high grade, over 65% lead, and 25% at least, carries fully 15% zinc.

The question of flux is an important one in considering the treatment of these ores. Lime is very abundant, of good quality and cheap, but iron oxide of fair purity does not occur, and metallic iron as scrap is procurable in but limited quantity at the rate of $15.00 per ton. The ores of Rossland district have been spoken of as suitable for fluxing lead ores, but that is a very questionable point. An average Rossland ore will carry excess silica and no little arsenic, and they strike me as an expensive flux when the cost of roasting is considered. Also the difficulty of making a good roast cuts some figure in the cost of treatment. A complete roast on a mixture of galena and pyrites, enables one to charge a certain proportion of raw galena ore, a manifest saving.

Until recently, I was firmly convinced that a blast furnace matting plant would handle the ores of Rossland camp very economically and to great advantage. I still believe so, though I consider the difficulties are not few.

I have no definite information regarding the treatment of Le Roi ore at the Trail smelter. Would like to be able to state, to what degree of concentration they attain, and what proportion of calcined ore they use on the charge. Having analyzed samples from many of the mines, I am of the opinion that, given an assortment of ores from different mines, matte smelting can be successfully and economically carried on. The consumption of fuel and flux should be kept very low, and as these two items form by far the major portion of the cost of first concentration, it is of importance to determine whether 10 or 15% is necessary. A year ago I was told that they were using but 10% of coke, and I analyzed a piece of slag produced without extraneous flux, finding :—

Silica	49.2 p.c.	Gold .045 ozs. per ton.
Ferrous oxide	23.2 p.c.	
Alumina	14.9 p.c.	
Lime	5.7 p.c.	
Magnesia	5.4 p.c.	

It would be very interesting and instructive to see pyritic smelting thoroughly tested on these ores, with a well adapted plant. It may be said that pyritic smelting has never yet proven a success, but it has

limestone crops out southward 2 miles south of Hirtuda Point. On the opposite side of the channel is Texada Island, which is the most prominent mining district on the coast at present. The most important is the Van Anda mine, which with the Raven and others occurs along the line of contact between granite and limestone. The ore from this averages $40 per ton. On the other side of the island is the Texada iron mine, which was formerly worked for iron, but now is beginning to produce copper. According to Dr. G. M. Dawson, this is a contact deposit peoduced at the junction of the granite and limestone, and intrusive felspathic rocks occur there. The ore lies in irregular bodies or chimneys and penetrates the granite and volcanic rocks as well as the limestone. In Jervis Inlet at Treasure Mountain lie several bodies of chalcopyrite. The country rock is quartzite, slate and granite, which are traversed by intrusive igneous dikes. These bodies of ore appear from the work so far done to be likely to be of considerable economic importance. In Howe Sound zinc blende occurs on Gambia and Bowyer Islands in considerable quantity. Chalcopyrite occurs north of Vancouver eight miles and also on the North Arm, but very little work has yet been done. The district as a whole has as yet been very little developed, and hardly prospected away from the shore, but is likely to rival the more developed sections of this Province eventually. For much of the information relating to the district, especially as to the southern part of it, I am indebted to Mr. A. J. Colquhoun, M.E.

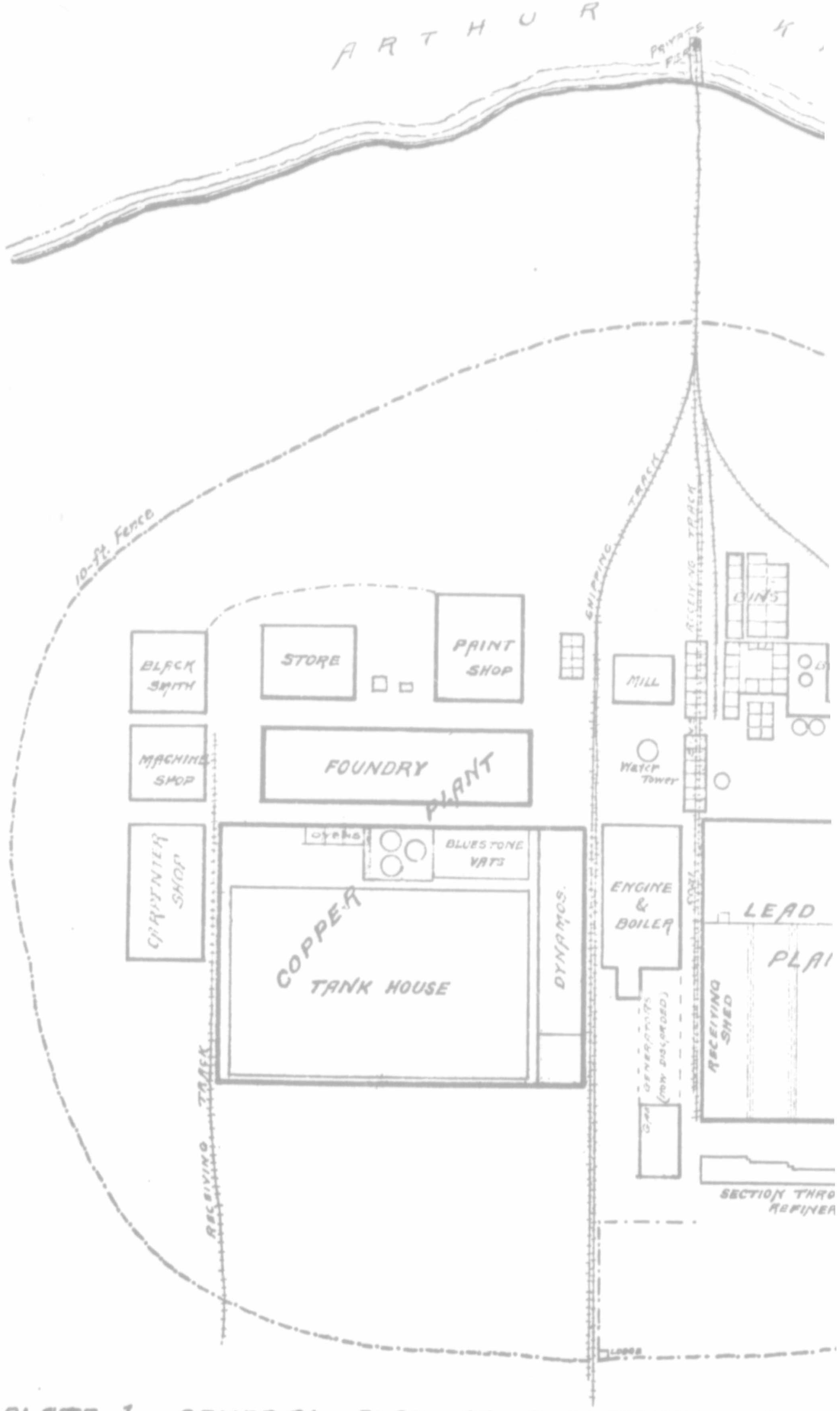
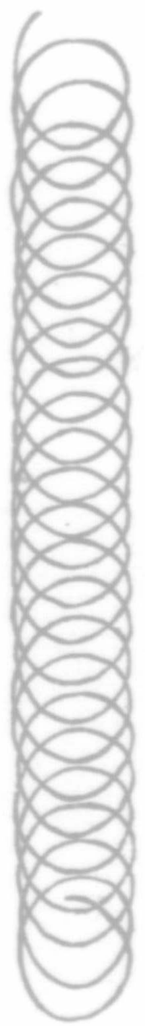


PLATE 1. GENERAL PLAN OF GUGGENHEIM SMEL
LOCATED AT PERTH AMBOY, N. J.



GYRATING —
— VANNER

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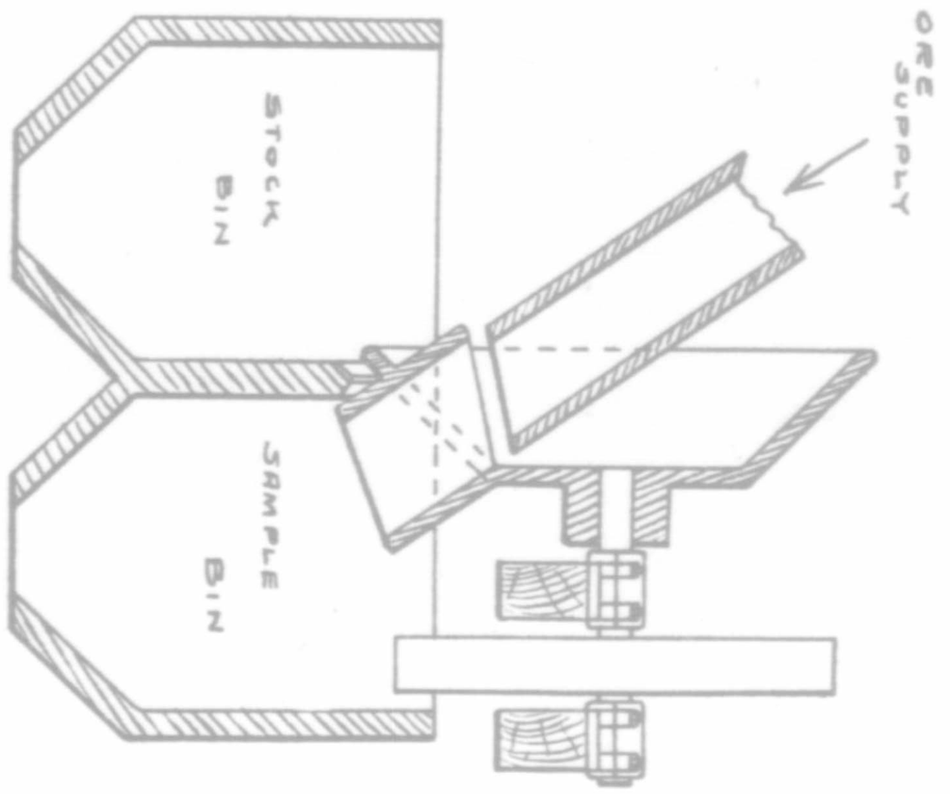
FULL SIZED DIAGRAMS TRACED BY
STATIONARY PENCIL ON MOVING BELT

AUTOMATIC
TIME SAMPLER



The electrolyte, which is a beautiful blue colored solution, contains between 6.0 p. c. and 7.0 p. c. H_2SO_4 and is supplied to the tanks from a central distributing reservoir placed overhead, to which the solution, after being heated, is pumped from the storage tank. This solution is tested daily and more or less acid and bluestone are added to maintain it at uniform strength; in course of time the electrolyte becomes charged with impurities taken up from the dissolved anodes and has to be renewed, the foul solution being diverted into large lead-lined vats, where either the bluestone is crystallized out on strips of lead hung in the solution or else the copper is precipitated by scrap iron, the remaining solution in each case being thrown away.

The electric current which goes through in 'multiple' circuit varies between 2,200 and 2,400 ampères, delivered at about 250 volts, the current and fall of potential being registered by large ammeters and voltmeters, which, placed in the dynamo room are read every hour and noted, together with the number of tanks in circuit. In order to lessen the resistance the connecting rods and plates are cleaned daily with emery cloth, and to prevent in any of the tanks short-circuiting, detected by means of a portable voltmeter, the cathodes are lifted out and the irregular lumps or growths of copper are removed.

By the compound action of the acid and electricity the anodes become disintegrated, the copper being precipitated on the cathodes, while the precious metals fall with the impurities to the bottom of the tank in the form of slime, and have to be replaced The cathode sheets remain in the solution for about 16 days, those from eight double tanks being replaced daily; the anodes last from four to five weeks, depending on the strength of the electrolyte. Every day 10 tanks are cleaned, and the slime, containing gold, silver, copper and impurities, such as arsenic, etc., is taken from the bottom and the copper leached out; it is then washed, dried in small ovens and shipped in paper bags to the cupel furnaces of the lead refinery.

Above each row of tanks there is an overhead crawl running on a double track and having a snatch block and fall on its under side by means of which the tanks can more easily be loaded and unloaded.

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The cathodes, as they are removed from the tanks, are taken to the foundry, where they are melted and cast into ingots weighing 18 lbs., and wire-bars weighing 175 lbs., ready for shipment.

In order to prevent the copper from oxidizing and to secure a smooth surface to the castings, the molten copper is 'poled' just before being ladled — the eye-taught only by experience — being able to judge the necessary amount of this poling.

In front of the refining furnace are situated several water boshes, on the sides of which are fixed the moulds, as shown in Plate 4; as soon as the ingots have solidified the moulds are dumped into the water, and by this means the casting is colored a deep rose-red, the shade most liked for the market. The moulds do not last long and have soon to be replaced by new ones, which are made of copper in the refinery by means of a stamp.

The Lead Plant.— The lead plant consists of a huge structure built, as most modern smelters now are, in terrace-form, in order to facilitate the handling of the furnace products.

The base bullion which is desilverized and refined by what is known as the Parke's Process, is received at one side of the building, and after passing through the various furnaces arrives at the other side ready for shipment. The bars of base bullion are sampled on the car by driving a cylindrical punch having a hole ¼ in. square in the end, half way through the bars. The position of the punch in each bar is changed both as to length and width of the bars; the bars are then turned upside down and punched again in a similar way so that one sample chip is obtained from the top and one from the bottom of each bar.

They are then charged into the softening furnaces in 60 ton lots. The operation of charging is performed by two men, one of whom lifts the bars on to the blade of a long-handled paddle which the other manipulates, using the bottom of the furnace door as a fulcrum.

The softening furnaces, or 'softeners,' as they are called, are large water-jacketted reverberatory furnaces. They serve to get rid of most of the arsenic and antimony which rise to the surface of the molten bullion and are removed by means of a perforated scoop and sent

P.BUTLER (del.)

LONGITUDINAL SECTION OF MOULD

In order to get at the margin on treating a ton of ore, let us assume certain values, and figure the cost by shipping matte, and also converting to copper, and shipping for electrolytic treatment, assume :

4 p.c. copper, at 10c.....	$ 8.00	
4 dwts. gold, at $1.00.....	4.00	
4 ozs. silver, at 50c.....	2.00	
		$14.00

Shipping matte : 40 p.c. copper, conc. 10 into 1.

Freight to New York.....	$18.00	
Deduction : 3½c. per lb copper.....	28.00	
5 p.c. of silver.....	1.00	
	$47.00	
Representing 10 tons of ore, or per ton....	$ 4.70	
Blast furnace treatment, per ton.....	2.75	
Losses, say 7½ p.c. (excessive).....	1.00	$ 8.50
Leaving a margin to miner on $14.00 ore...		$5 50

Or converting 40 p.c. matte to metallic copper.

Roasting and reverberatory furnace work, per ton of copper.....	$30.00	
Marketing one ton of copper.....	40.00	
	$70.00	
Representing 25 tons of ore, per ton.....	$ 2.80	
Blast furnace treatment.....	2 75	
Losses on treatment, say 10 p.c. (excessive)	1.40	
	$ 6.95	
Leaving a profit to miner on $14.00 ore....		$ 7.05

You will observe that for the purpose of facilitating these calculations, I have taken my copper value at 10c. per pound. It is customary to figure at $1.00 per unit, or 5c. per pound in ores, which would make this a ten dollar ore.

That there is every indication that such grade of ore will be developed in enormous quantity, I am sure most mining men familiar with the country will agree.

With East Kootenay I am not familiar, but I believe that the range between Kootenay Lake and Fort Steele will produce ores that

So far gold-bearing quartz has only been found in Huronian rock, although considerable quartz is found in the Laurentian gneiss near the contact of the two formations.

By far the greatest number of the locations are in the vicinity of Wawa Lake, six to ten miles north-east of Superior. The Dickenson, or MacKay claim, the first discovered, consists of four fairly parallel veins running to the north-east and dipping about 35° to 45° to the north-west. Two other veins cut these on the angle. The rock is a somewhat massive hornblende schist, containing a little pyrite. The veins vary in width from one to four feet. Specks of free gold are easily found in pieces chipped off with a hammer. Eleven essays ran from $13 to $145 in gold.

Many of the veins of the region occur in quartz porphyry. The Johnston-Lawlor vein is an example. It has been traced over a mile, and free gold taken from it at a number of points. On Lawlor's claim three assays yielded $285, $324 and $693 respectively.

Besides Wawa Lake, locations have been made on Dog Lake, near the Canadian Pacific, and on Manitowick Lake, twelve miles to the south-west.

No development work had been done up to the time I left the district, so there is little on which to base an estimate of the possibilities of the region. There is certainly quartz in abuudance. On the side of precipitous hills a wall of quartz is frequently found. Numerous veins 10 to 15 feet wide have been reported. Many, probably the majority, of these are of the bedded variety. Others are true fissure veins.

As to the contents of the quartz one has only the assays to guide him, and these are notoriously misleading. I have already mentioned some of the best. Many of the samples I took myself from other properties have yielded only traces of gold or nothing.

In the kind of rocks, in the mode of occurrence of the quartz, in the minerals in the latter this region very closely resembles the Lake of the Woods and the Sudbury districts. One may fairly expect that a similar development will take place here, and that with the increased interest taken in mining, that the development will be much more

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varieties, anhydrite, blue gypsum, bird's-eye plaster, alabaster, and crystalized selenite, the latter sometimes in large, clear sheets. Fluorite in blue crystals occurs in the limestone of Plaister Cove, Strait of Canso. The plaster beds also contain besides petroleum, elsewhere mentioned; the salts—holite and mirabilite.

The Borates.—"Howlite," named after Professor How, of King's College, Windsor, N. S.; "ulixite," "winkworthite," and "cryptomorphite," appear occasionalty spotted through the gypsum and anhydrite.

Baryta.—Well crystalized forms as well as amorphous bodies of barite occur in the limonite veins at Bridgeville, and with calcite and copper pyrites at Five Islands.

Saline Waters occur in the gypsum beds and in some of the deeper coal workings. They have not been noticed at a less depth than 1,000 feet in the land-locked coal basin of Pictou, and they give rise to the suggestion that they may be in such a place preserved samples of sea-water current in carboniferous times. Analyses of the waters from the gypsum and other places have been published, but the following by Mr. Mason, of Halifax, is new. It is from the McGregor seam at Stellarton:—

	Parts per 1,000.
Sodium chloride	6.5545
Magnesium chloride	1.8405
Calcium chloride	0.9992
Calcium oxide	0.1176
Carbonic oxide	0.3294
Silica, Alumina, Sulphuric oxide	traces
Total solids in solution	9.7053

kept on circulating for a number of hours. This proved quite effective and was found that the use of steam for two hours a day was ample. And at a time when the boilers are not otherwise in use the method is to be commended as probably the most satisfactory, whereas in this mine the need of artifical ventilation is so occasional as not to justify the installation of a regular ventilating plant. In order to see just what change took place in the air it was necessary to make a series of analysis and tests of the air from different parts of the mine during the month in which the ventilation began to be very unsatisfactory knowing that there was no especially poisonous gas, and that the trouble was due to a lack of oxygen and a corresponding excess of carbonic acid gas the testing apparatus here figured was employed. Its construction will be readily understood from the drawing and the following description of its use:

It consists essentially of a measuring burette graduated in cubic centimeters, which has at the upper end a heavy capillary glass tube through which the sample of air is brought. At the end of this tube there is a three-way tap and between this and the burette are placed three "U" tubes, each controlled by a tap in the main tube. To the lower end of the measuring tube there is connected, by means of rubber tubing, a bottle containing water which is used for driving all the air out of the measuring burette and capellany tube before the experiment and for keeping the sample under a definite pressure during measurement, as explained hereafter. The determination for carbonic acid is effected as follows: The bottle of water *A* is placed as represented in the figure and the three way tap *D* is turned so that the air in the measuring burette passes out through the bottom of the tap and is replaced by water. The tap *D* is then closed, the bottle *A* lowered, and the tap *D* turned so as to connect the sample of air to be tested with the apparatus. Exactly 100 c. c of the sample is admitted to the burette, the tap *D* closed and the bottle *A* raised to its former position. The tap *E* is then opened, admitting the sample to the bulb *F* which is filled with a solution of pure caustic soda of 1.115 to 1 16 Sp. Gr. which rises in the other limb of the U tube as the sample enters. The caustic soda is repeatedly lowered and raised in *F* by

No systematic observations have yet been made of the directions in which the stalactites of limonite incline, so that the evidence of movement which they might furnish is not yet available.

Lead.—Occupying the same relation to the carboniferous limestone in contact with older formations as do the hydrous oxides of iron and the manganese ores elsewhere mentioned,* galena is found disseminated throughout the limestone at several places, as Smithfield, Gay's River, Arichat, etc., but nowhere is it worked at the present moment.

Isolated crystals have been found in the coal measures at the Joggins, Cumberland County, and at Port Hood, Cape Breton.

Zinc.—Twin crystals of "sphalerite" occasionally appear with pyrite in the cracks of strata between the coal seams of Pictou County.

Sulphides.—Pyrite is commonly disseminated and amorphous in the coal seams, sometimes preserving plant tissue, at others crystallized in veins and cleat planes, or as filamentous radiations in the coal strata. Pyrite often appears as part of the lenticular masses of coaly clay ironstone, occuring in some seams which masses have been noticed as large as 8 feet in diameter by 10 inches through the centre.

Occasionally the pyrite takes the form of "marcasite," cockscomb pyrites, notably in the strata of the Spring Hill mines. Calcite is a common associate with pyrite on the cleat faces; in that position it may be more or less converted into brown spar, which rusts on exposure to the air. The plates are generally thin, though they do occur up to 3-16ths of an inch in thickness.

Where decomposed from exposure in old workings "melanterite" is formed as an efflorescence or as stalactites. There also appears as a product of decomposition in the pits at Port Morian the mineral "almogen."

Lime and Magnesia.—The lower carboniferous series supply limestones in quantity suitable for blast furnace uses, and plaster in quarries of great extent. They are extensively worked* and furnish several

* See also Mr. Fletcher's Reports in the Geol. Surv. Reports of Progress.
* How's Mineralogy, 1868. Mineral Statistics: Geol. Surv. Annual.

Having a general knowledge of what has been done towards the establishment of a Canadian iron industry, and the efforts to encourage this by governmental or provincial assistance, some applications of the foregoing conclusions to the future of the Dominion may be expected at this time. The suggestions offered are not based upon detailed knowledge of local conditions superior to that possessed by many present, for I realize how much better equipped others are to discuss this subject locally. But it may be possible for one whose professional work has included numerous investigations of the adaptibility of various locations for the establishment of iron and steel industries, and whose examinations have embraced some of the ore deposits of the Dominion, to present new phases concerning pig iron production as exemplified in the records of progress in the United States, which may be applied to Canadian development.

If this paper should in a small way contribute to the advancement of a country whose borders co-incide with those of my native land, for a distance equal to one-sixth of the circumference of the globe; a country with which we have many ties; a country whose advancement must be of assistance to my own. If any words of mine can add to the future progress of Canada, I shall be more than pleased.

Canada is well supplied with iron ores; many of them of excellent quality; some of them have withstood heavy cost of transportation and paid duty for consumption in blast furnaces in the United States, several hundred miles from where they were mined; others lie unattacked where nature placed them, waiting to be transformed into articles of usefulness by the hand of man.

If future investigation demonstrates that electro-metallurgy will supplant our present smelting processes, the numerous excellent water-powers for which Canada is famed, offer great possibilities for generating electricity cheaply and liberally, and if the utilization of the power of falling water does not extend to the primary process of reducing and smelting ores, these great reserves of power may prove serviceable in supplementary treatment of the metal produced.

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gress has been largely due to the possibility of producing non-Bessemer pig iron cheaply, to be manufactured elsewhere.

With the exception of a few charcoal blast furnaces in the New England States, the iron producing industry there is dormant, and although Eastern New York and New Jersey have abundant ores, the distance from a cheap fuel supply restricts their out-put of metal.

East Pennsylvania fares somewhat better because of a local development of the iron and steel industry, but is not advancing its production, nor is this to be expected unless the export trade demands greater activity on the part of its industries.

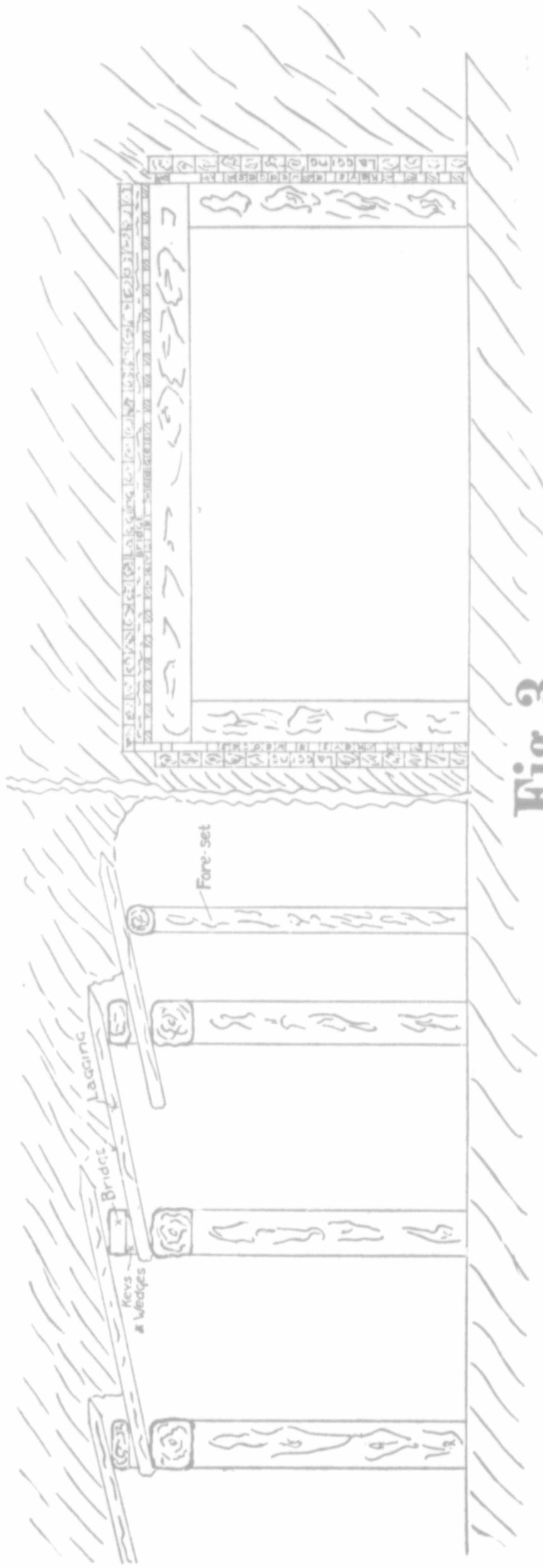
The bulk of later advances has been in the districts tributary to the great lakes, or which can be conveniently reached by the excellent ores of Lake Superior.

A brief summary of the development of the iron industry of the United States may be given in a statement of the rapidly increasing out-put of pig iron, this being the basis of the entire industry.

The statement is given by decades and for the years when the product exceed even millions of tons.

GROWTH OF THE PIG IRON INDUSTRY OF THE UNITED STATES.

Year.	*Gross Tons of Pig Iron Made.*	*Remarks Concerning Out-put.*
1810	53,908	
1830	165,000	Trebled in 20 years.
1840	286,903	Nearly doubled in 10 years.
1850	563,755	Doubled in 10 years.
1860	821,223	Increased nearly 50 p.c. in 10 years.
1864	1,014,282	First year when an out-put of 1,000,000 tons is recorded.
1870	1,665,179	Doubled in 10 years.
1872	2,548,713	First year when an out-put of 2,000,000 tons is recorded.
1880	3,835,191	Increased two and one-third times in 10 years, also first record of 3,000,000 tons.
1881	4,144,254	First record of production of 4,000,000 tons.
1886	5,683,329	First record of production of 5,000,000 tons.
1887	6,417,148	First record of 6,000,000 tons.
1889	7,603,642	First record of 7,000,000 tons.
1890	9,203,703	Increased two and one-third times in 10 years, and first record of 9,000,000 tons.
1897	9,652,680	Maximum annual product.



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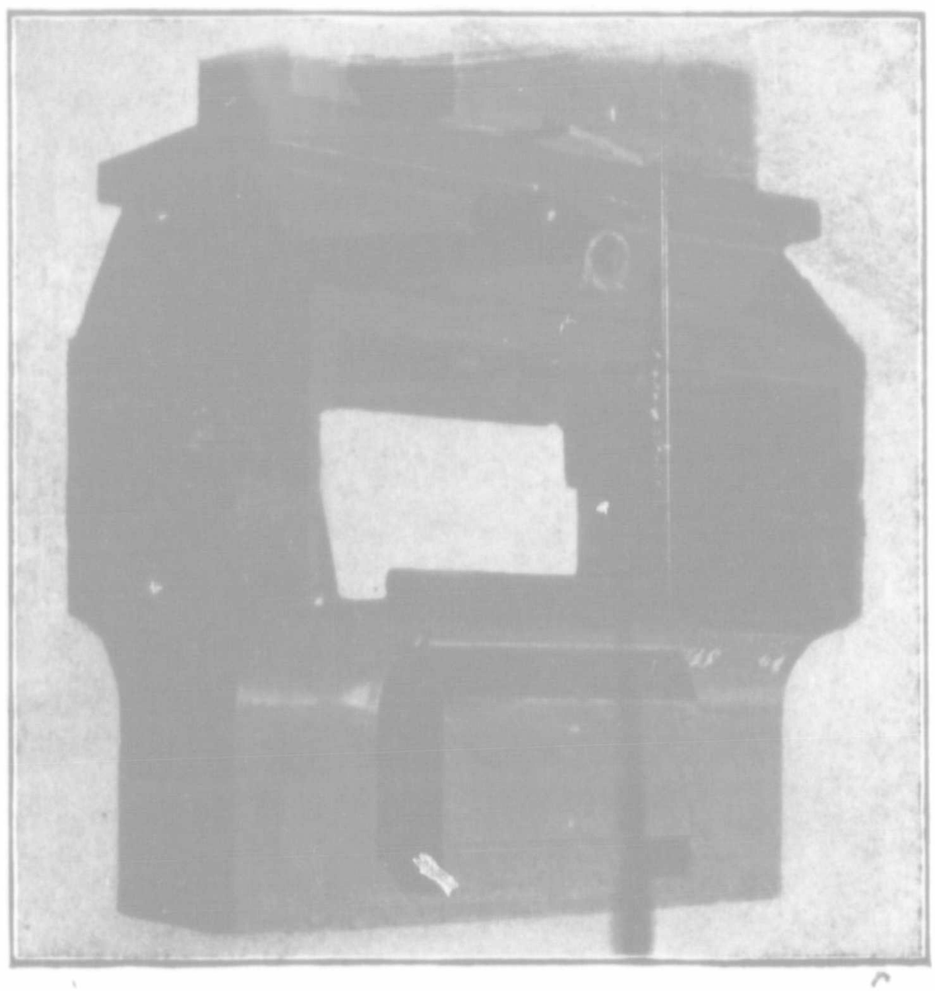


Ottawa Mortar, Feed Side,

Gold-Bearing Reefs and Placers of Northern British Columbia.

By William Hamilton Merritt, F.G.S., Assoc. R. M. S.

Placers.—Even before the rich discovery in the Klondyke district, in the North West Territories, renewed attention for the past few years had already been given to the placers and quartz reefs of Northern British Columbia, particularly in the Cariboo district, but also to some extent in the Lillooet district. Some notes on their general character, both from personal investigation and from results obtained by others, may not be without interest at the present time. Of the placers it is my intention to treat more particularly of types of "deep-diggings."

The placer producing areas of both of these districts are similar. The country is very mountainous. The country rock is schists, for the most part, in varying degrees of metamorphosis, from soft talc, schists to schistose-gneisses. These schists are interbedded with innumerable quartz veins and bunches, running chiefly along the line of strike of the schists and in the joint structure of the formation. Some well defined strong veins can be followed for considerable distances, but the quartz generally occurs most irregularly, having more the character of segregations of quartz in the buckles and joints of the distorted formation.

Sometimes the irregular quartz masses seem to follow along the line of shear zones and are met, one after the other, with abrupt terminations and commencements. In these cases fault lines are rarely discernible, the occurrence indicating formation of the qnartz after distortion rather than that the irregularity is due to direct faulting disturbance. Faults, however, can occasioually be seen through the veins or the quartz bodies.

The above remarks are more particularly applicable to the Cariboo district, but a cursory investigation of the Lillooet district seemed to show similarity. The Gold Commissioner of the latter district describes the conditions as follows: "I have referred to the

and effectiveness of their machinery was admirable for economical working at shallow depths.

Such an arrangement for hoisting is shown by the attached sketches (Fig. No. 1 and 2), illustrating a deep diggings placer still operated in the Cariboo district, on the old day model. Everything about the plant is made of wood, which is very abundant in these districts, there being no iron used in its construction.

The gravel, and two feet of bed-rock is dumped into the "dump-pit" along-side the shaft head. This dump pit is 12 feet long with grade of one inch to the foot. The bottom is 12 inches wide, and the sides, which are from four to five feet high, slope outwards and are four feet wide at the top. This box should hold the gravel taken out between two sets of timber, viz: some 1,750 cubic feet.

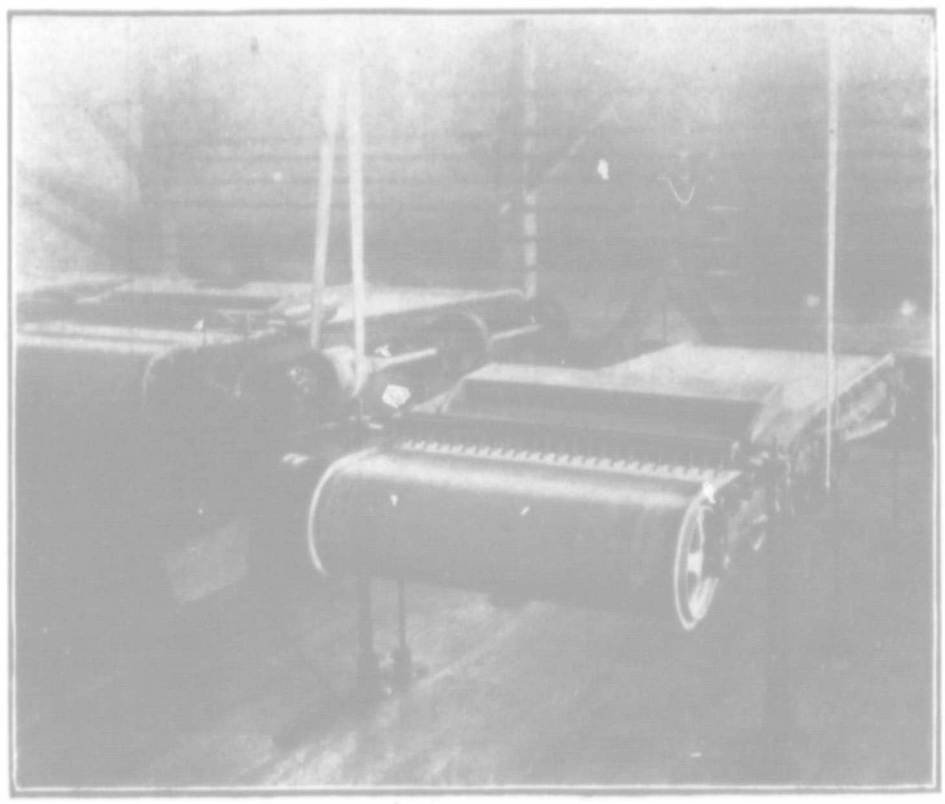
The advantage of a dump-pit is that water can be kept running on the gravel and bed-rock, and it gets time to slack, and the gold to settle, before the clean up.

Below the dump-pit, the "dump-box" is situated. This may be 12 ft. to 18 ft. long with 1 in. grade to the foot, and its width 3 ft. with a depth of 20 in. to 2 ft. Below the dump-box the sluices, 12 ft. long, 12 in. wide and 12 in. high, run with about a grade of ½ in. to the ft., when there is ample water. The placer shafts are generally small, in this instance 3 ft. x 5 ft.

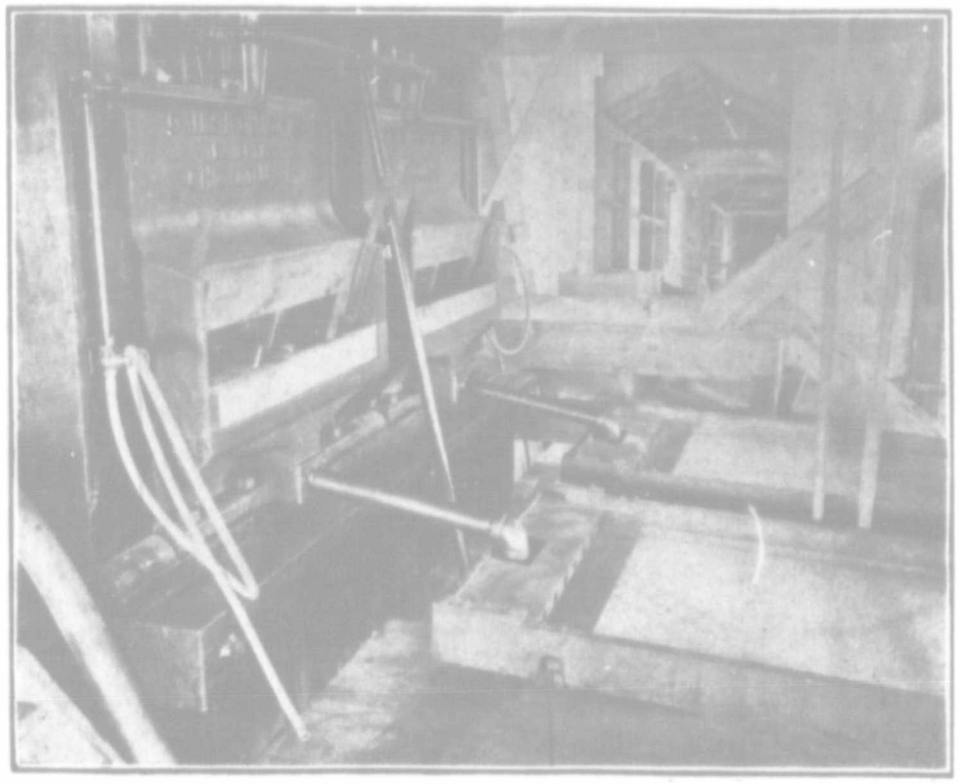
The work at the face of the gravel on the bed-rock is interesting, being the well known method of "spilling." (Fig. No. 3).

The width of the working face is 10 ft. The operation of putting in a new set is as follows:

A "bridge" is driven in under the ends of the lagging resting on the advance set of timbers, three "keys," or wedges, are driven in to raise up the bridge, then "lagging" for the new set is started in between the keys and driven as far as it will go. Meantime gravel is being removed and some 2 ft. of the bed-rock is picked up. The coarsest gold as a rule being found in cracks in the bed rock. Some 18 inches beyond the set of timber a "fore-set" is put in to catch the lagging. This fore-set is lighter than the ordinary sets and is merely temporary. The lagging, which is cut in lengths of 4 ft., is then



Gyrating Vanner. Drive side. Frue Vanner in background.



Front of Battery showing connection between Battery and Gyrating Plates.

Back

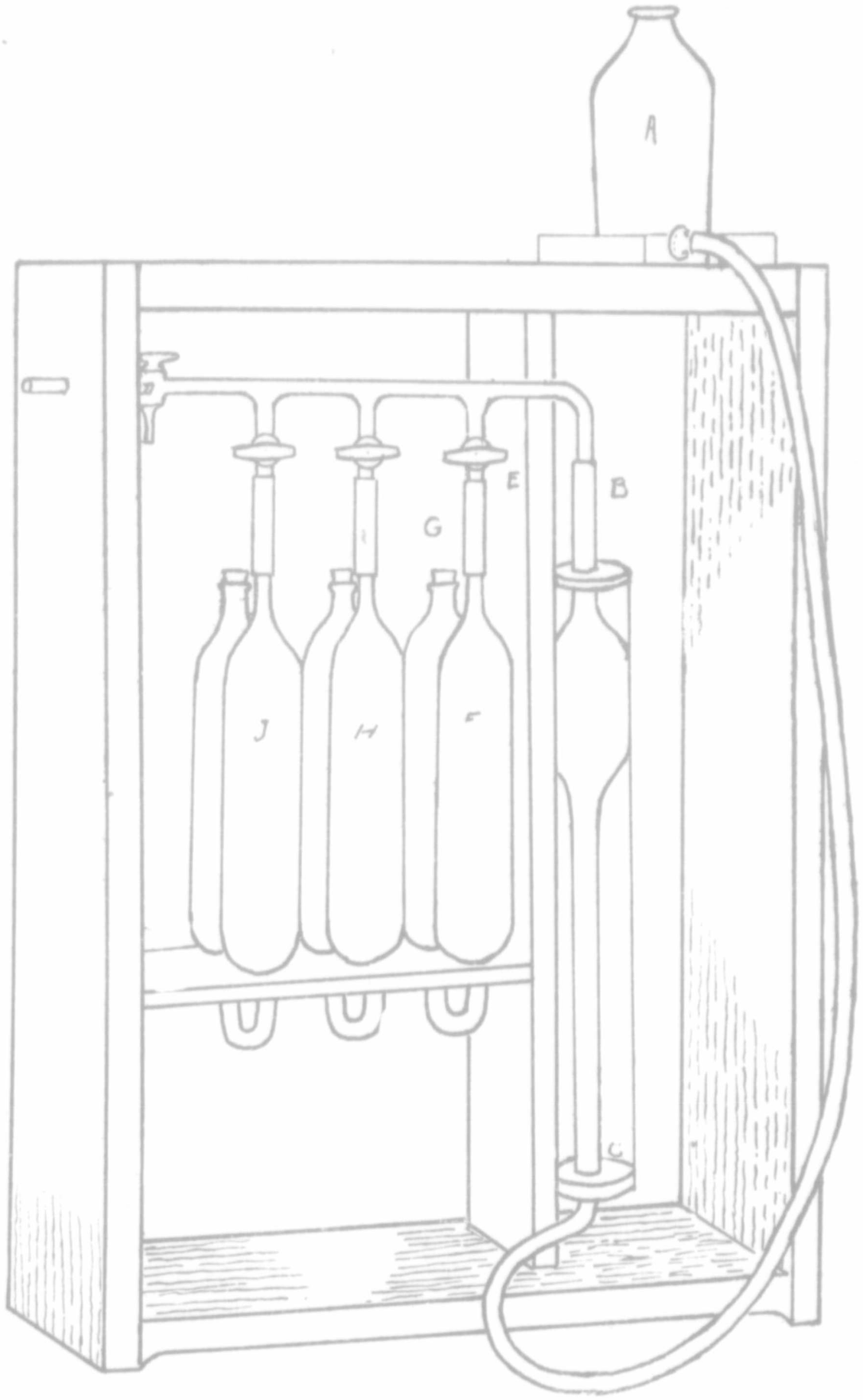


PLATE II—Gas Testing Apparatus, illustrating Mr. John Preston's Paper "The Ventilation of Deep Metal Mine as Affected by Seasonal Temperature."

boniferous the spathic is less abundant and is only known as an occasional accompaniment of limonite with the carboniferous limestone.

"Clay ironstone" appears as nodules and bands in the coal measures, and as long ago as 1829 diligent search was made by trenching across the outcrops in the Albion mines district, and some of the ore got was used in the trial furnace then erected.

"Black-band ironstone" is reported in both the Sydney and Pictou coal seams, and in a very limited way only was that of the latter tried as an ore.

"Limonite," of which important deposits are associated with the carboniferous limestone, occurs in veins about the contact of that division with older formations, * often appearing as though it replaced an original deposition of spathic ores. Limonite occurs fibrous, columnar and stalactitic, sometimes coated with the less hydrous varieties, "turgite," "gothite" and "przibramite."

These ores of iron are associated with, or replaced, in the veins by the ores of the allied metal—manganese; either as mixtures, earthy compounds or as distinctly crystallized minerals, in the compositions of "pyrolusite," and "manganite" and "psilonulane," with possibly "polianite."

The non-metallic vein associates are calcite and barite, with an occasional small crystal of white "mica." Both the former furnish crystals of interesting forms.

It is interesting to note the relation of these minerals to one another. Limonite seems the foundation on which all have been deposited. "Turgite" and "gothite" always appear as superficial deposits in the former; while barite and pyrolusite seem to be still later, often acting as cements to displaced fragments of all the ores of iron and to have been contemporaneously deposited in distinct crystals. Evidently series ot movement have passed through these limonite deposits, crushing parts into coarse fragments and disturbing the vein matter from its original position.

* Fed. Can. Mg. Instit., 1895, p. 221.

the surface through the stopes and inclined shafts. Most of the mining is done by machine drills, and as they use compressed air for power, the exhaust furnishes a very considerable supply of fresh air to the miners. Also the cars running up and down the shafts create an air current which is of especial benefit to the night trammers.

If now the ventilation due to natural causes be considered, we find that owing to the underground temperature being constant, in the summer the conditions causing the movements of air are quite different to those in winter.

Taking 70° as an average temperature of the air during the hot weather, the air would be much less dense on the surface than in the mine. Also in the above figure (1) the pressure at T is less than the pressure at C owing to the fact that the temperature of the shaft $S\,C$ is lower in the summer than the outside air, and the air in it would consequently be denser, and the extra pressure at C would be equal to the difference in weights between the column in the shaft $S\,C$ and a similar column outside. Considering the same thing in winter we find that the opposite would be true, for now the air in the shaft $S\,C$ would be very little cooler than in summer, while the corresponding column outside would probably be below freezing, this would cause a greater pressure at T and so cause the air to flow in the opposite direction.

The management noticed that the air was always good close to the steam pipes leading to the pumps and was led to try the well known expedient of steam jet ventilation. A 2 in. pipe was led from the boilers of the hoisting engines almost to the bottom of the mine and from the end of this a 1 in. pipe carried the steam to the bottom of each shaft. By pointing the ends of the pipes upwards and turning on the steam at considerable pressure, the air is forced by an injector-like action in the direction of the jet and as the steam and pipes as well heat the air considerably, this aids in helping it to rise. During the first fifteen minutes that the steam was led down, nothing but water escaped, and after that the steam came freely, and at the end of two hours the shafts and adjacent stopes were filled with steam for about one-third of the distance up. As soon as the steam was shut off it quickly condensed and fresh air took its place and the current once established

Some Concentrated Foods for Miners, Prospectors and Explorers.

By J. T. Donald, M.A., Montreal.

The exploration of a new territory, the development of a new mining camp or of an entire district, is often a question of food supply, as witness the present situation in the Klondike region. It is believed, therefore, that the subject of this paper is not out of place in the programme of a meeting of a mining institute.

Foods may be classified in various ways. For our purpose we may group them under five classes, viz.: Carbohydrates, fats, albuminoids, mineral or saline, and acidulous.

Carbohydrates are represented by starch and sugar, and fatty foods by butter and other fats; these are required to produce heat and force.

As examples of albuminoids or nitrogenous foods, we may take the lean of meat or the gluten of flour. These albuminoids are required to build up the muscular tissue of the body.

Then, next, the saline or mineral foods are required to supply the mineral matter found in various parts of the body, *e.g.*, phosphate and carbonate of lime, the principal ingredients in the bones, potash salts for blood and other fluids of the body, common salt for gastric juice.

The acidulous foods are found in fruits and vegetables. Whilst they may not contribute to any permanent tissue, they are indispensable, for without them we know that long continued health is not to be expected.

All five classes are required to keep the body in a healthy condition, although one or other of them may be omitted for a considerable time, and all five are required in certain proportions.

According to the report of Commissary General of Subsistence of the United States army for 1896, the desired amount of elementary food constituents for a man engaged in very hard work is as follows:

after concentration will materially assist smelting operations in the country. West again of Boundary Creek, in the Okanagan country, I have seen evidence of ores in veins of unusual size, that will yield handsomely.

The Coast too, if report be true, has its ores of character suitable for smelting, and exceptionally situated for economical treatment.

My figure on converting 40% matte to copper and marketing that, seems abnormally high, but it is based on roasting in the hearth furnace by expensive hand labour, and can be greatly reduced by automatic machinery.

The New York market being the best, necessitates a high freight, and if all values are paid for they must charge a good treatment rate

Notes on the Michipicoton Gold Field.

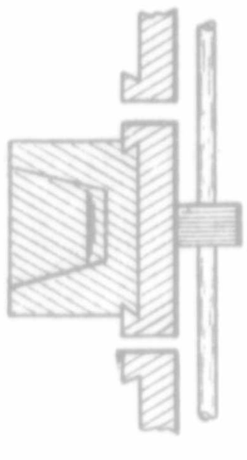
By A. B. WILLMOTT, M.A., B.Sc., Toronto.

During the summer of 1897 some fine samples of fine gold were obtained on the shore of Wawa Lake, a few miles north of Michipicoton on Lake Superior. Interested parties gave most glowing accounts to the local newspapers and these were widely copied. The marvellous accounts of the Yukon were fresh in the minds of all, and here was another Klondike close at hand. Prospectors flocked into the district from points as distant as New York and Minneapolis, and special correspondents were sent into the field by enterprising journals.

As the region was almost unknown, I was asked by Mr. Blue of the Bureau of Mines, to make a brief geological examination of it. A few facts gathered during this visit, I thought might be of interest to the Institute.

In volume VIII. of the Geological Survey Reports, the learned director states: "There can now be very little doubt that every square mile of the Huronian formation of Canada will sooner or later become an object of interest to the prospector, and that industries of considerable importance may yet be planted on this formation in districts far to the north, or for other reasons at present regarded as barren and useless." The first part of this prediction, made only two years ago, has already been fulfilled in the Michipicoton district. One hundred and eighty-six locations have already been taken up, and these mainly in the two months of September and October.

The Huronian area in this district is not yet well defined. In a map of "The basin of Moose River," published in 1883, Dr. Bell has laid down the geological boundaries as determined by traverses of the canoe routes. Much of the map is hypothetical, and my own explorations lead me to believe that the Michipicoton Huronian area is much smaller than represented on this map.



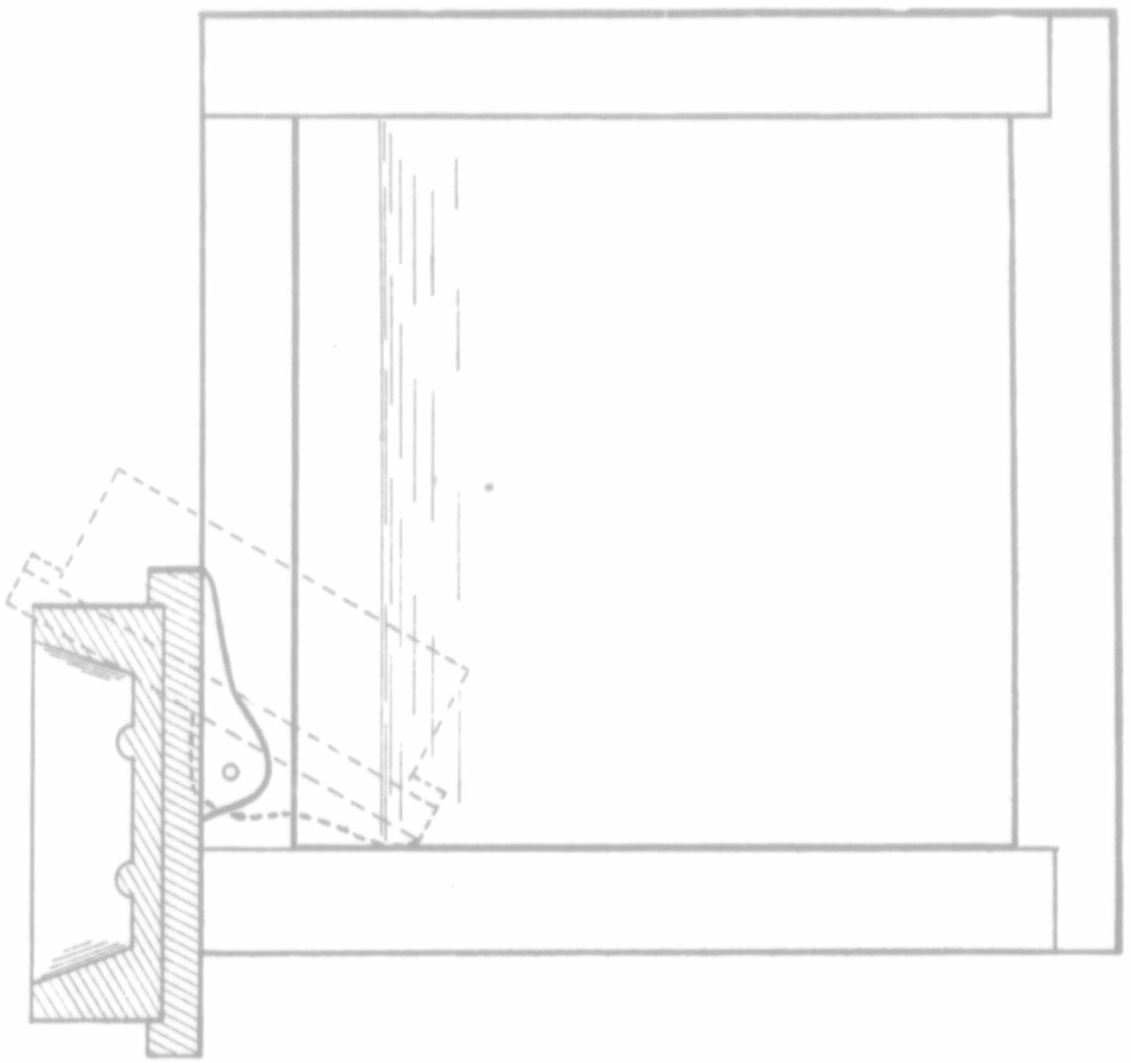
CROSS SECTION OF MOULD.

SIDE OF INGOT

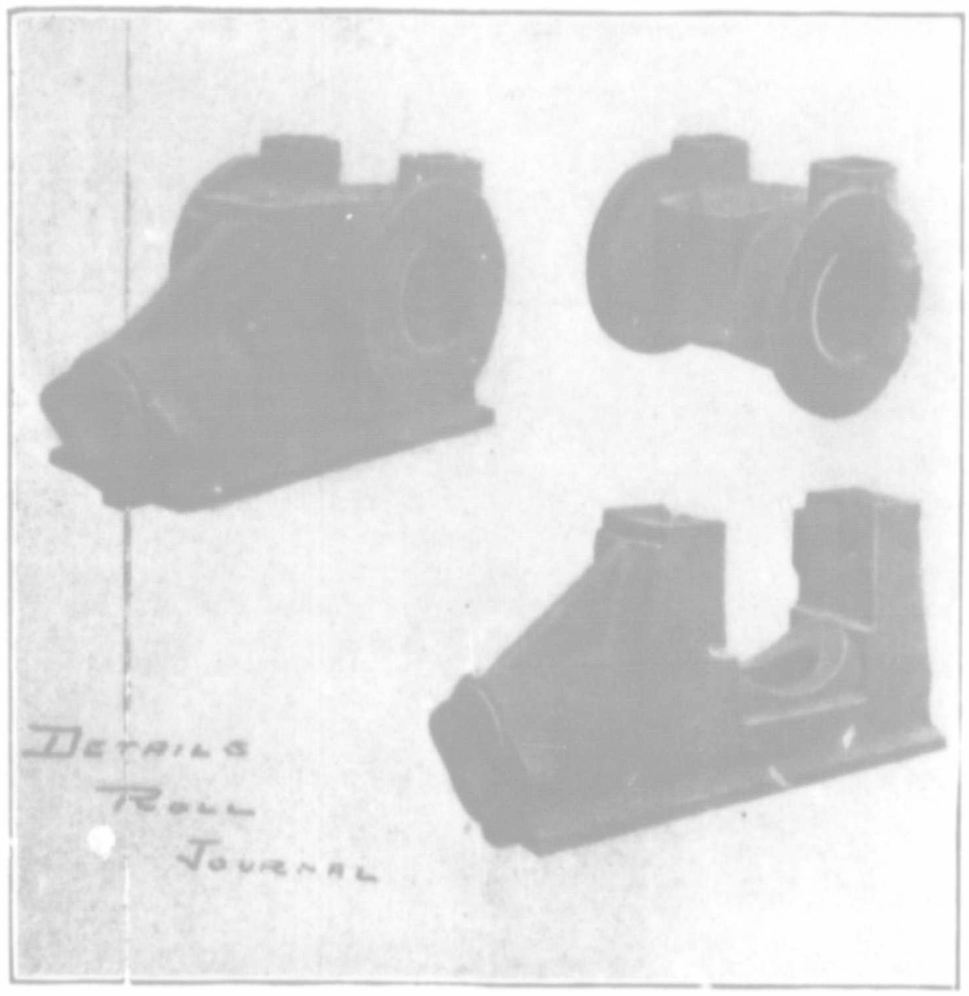
BOTTOM OF INGOT

PLATE 4.

P.BUTLER (Del.)



LONGITUDINAL SECTION OF MOULD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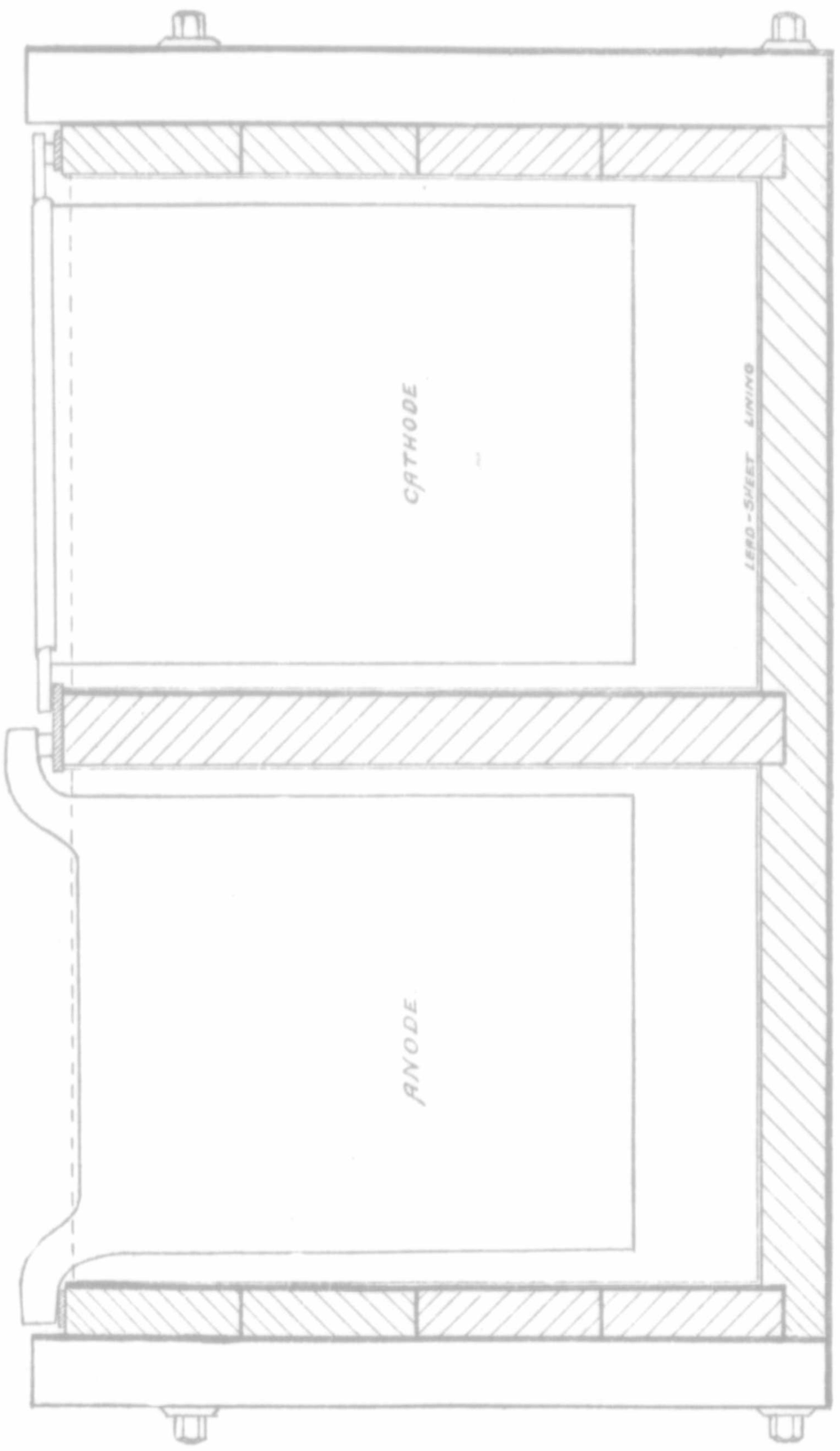


P BUTLER (ONT.)

PLATE 3. CROSS SECTION OF COPPER TANK SHOWING MANNER OF SUSPENDING ELECTRODES.

never yet had a fair trial In Newfoundland, it has been stated that purely pyritic smelting was successfully carried on, but the ore treated, if I understand aright, carried very little slag forming material, and, therefore, the concentration was low Professor James Douglas made a trip expressly to see that plant in operation.

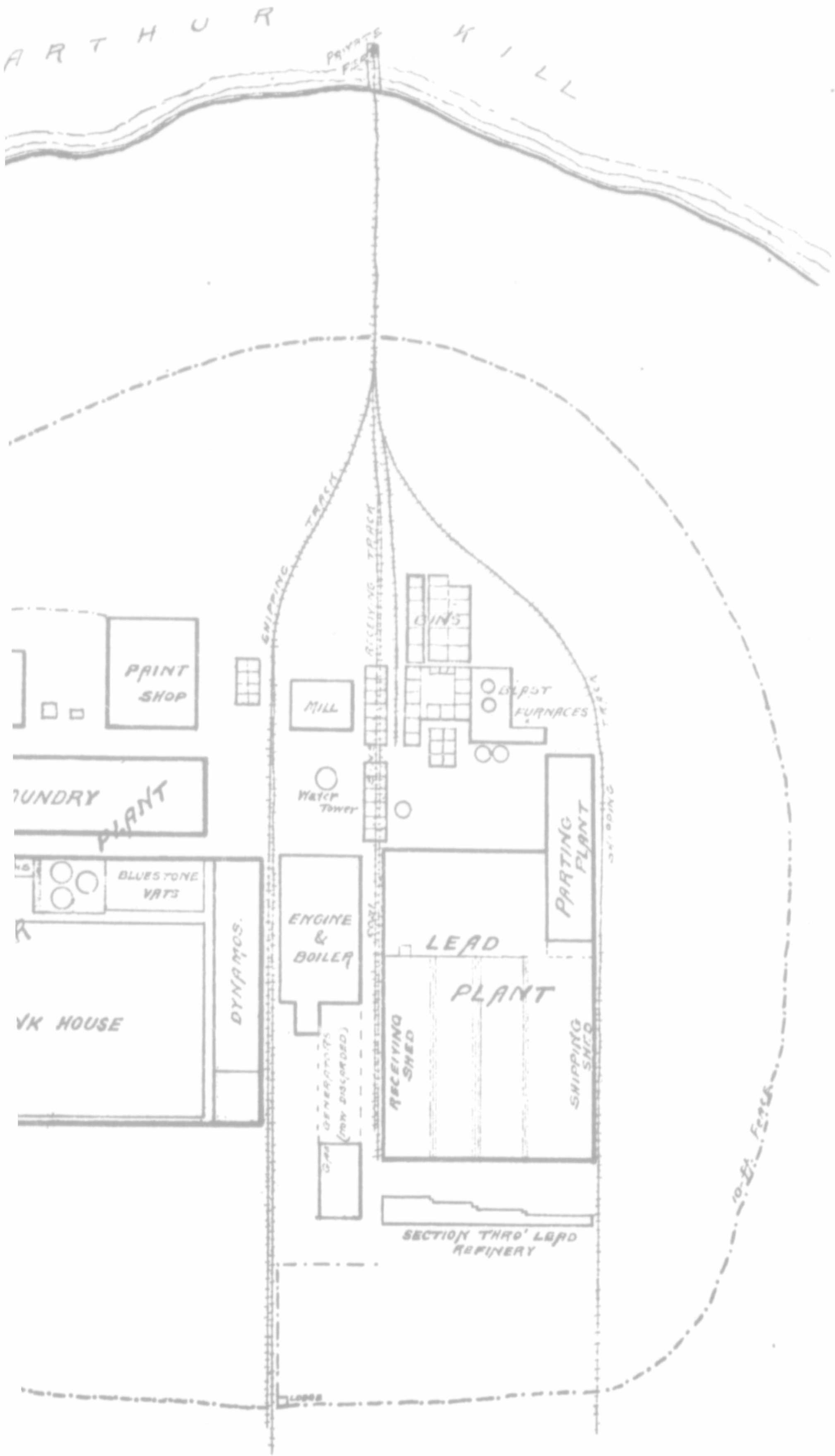
Mr Robert Sticht wrote at length on the subject, and described the operations of plants at Boulder, Kokomo, and Toston, stating that there were obvious reasons why they were not successful, either through faulty plant or ores unsuitable.

As yet we do not know what the Rossland mines are capable of producing. Wild statements have been made on this head, but I believe that a 500-ton plant, erected at such a point and run so economically, that it could make a smelting rate of $7.00 per ton f.o.b. Rossland, would soon have to increase its capacity. If these ores will smelt with a concentration of 10 to 1, using 12½% coke and 10% barren flux (limestone), that figure will leave a profit to the smelter.

Speaking of possibilities, however, I consider that they are far greater in the Boundary Creek district. There, the variety is greater, and a perfectly self-fluxing ore is obtainable. I do not pretend to say that there is an abundance of ore of such grade as to maintain a large plant, but I do say that there is every indication that such will prove to be the case. Once transportation is had, development will be pushed and plants will follow. Ores will be treated, both by direct smelting for matte and by previous concentration. There are very clean ores of mixed pyrites, chiefly pyrite and chalcopyrite, that will carry 8 to 12% copper and low silica; others of low pyrites, and gangue, that will form an excellent slag.

Should the coal, on development, prove to be of good coking quality and in sufficient quantity, a plant with large capacity will treat ore as cheaply as anywhere on the continent. Even, bringing in coke, at a cost a $12.00 per ton laid down, I have no hesitation in stating that a 500-ton plant (two furnaces) using steam power, will smelt at a cost not to exceed $2.75 per ton of ore.

This of course will produce matte, the grade of which will depend on the degree of concentration and the percentage of copper in the ore.



PLAN OF GUGGENHEIM SMELTING WORKS
ED AT PERTH AMBOY . N. J.

P. BUTLER
(Del.)

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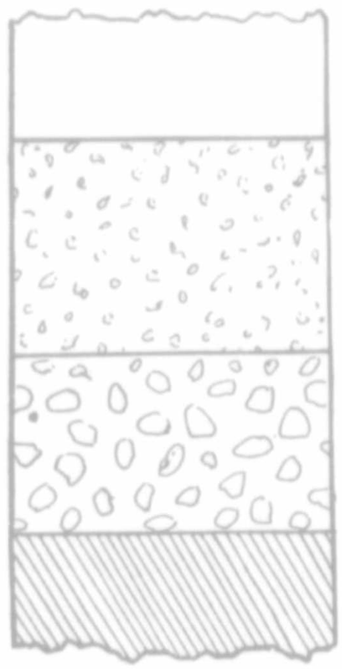
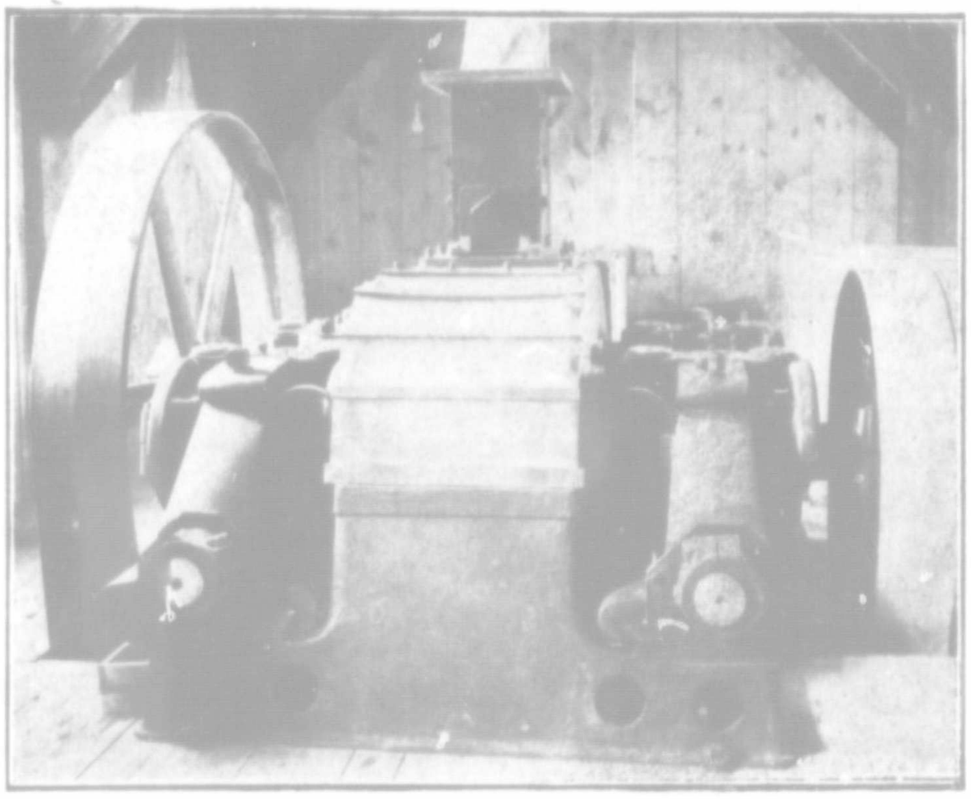
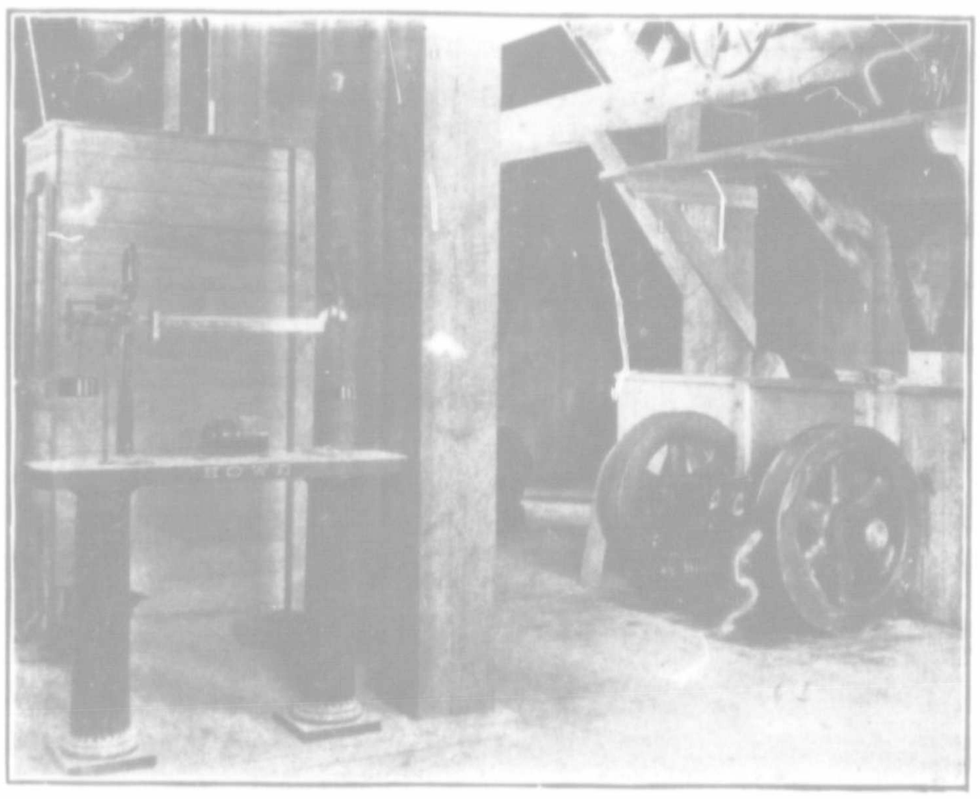
driven in and is caught by the "fore-set," which holds it up until it is driven in some 3½ ft., when another set of timbers, with posts and crown-tree 1 ft. square is put in, care being taken to leave room above for bridge and keys. Side lagging is also driven as well as the top lagging. All the lagging is tightened by wedges not to allow the ground to move or settle. It is very important to keep the ground solid above, if at all possible, for if a run once starts it is sometimes impossible to stop it. Two men should put in one set in each eight hours shift in ordinary ground. The same may be said also with regard to the speed of drifting in the gravel. An ordinary condition is to find "gravel" on the "bed-rock," above that "chicken-seed" or fine gravel, over the latter "slum" or fine running silt often occurs. If this latter gets started it is very difficult to stop. Often times workings had to be abandoned. The order varies somewhat, but gravel is always on the "bed-rock." Clay sometimes takes the place of slum and then acts as a cover.



It is a great advantage where a drainage tunnel can be driven, as is the case in the workings just described, for then pumping is unnecessary. Where pumping is necessary it is, in many instances, advisable to sink the main shaft in the solid rock, (a "bed-rock shaft") and drive from it into the old bed of the river, as is being done at present on Slough Creek and Willow River. In the former case the



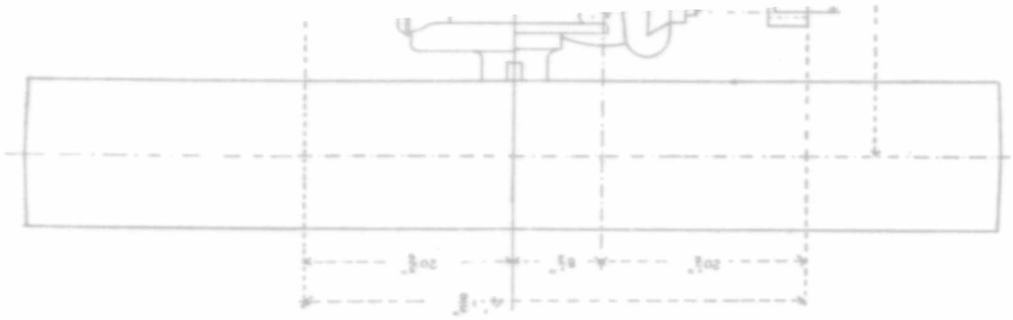
36″ x 10″ Crushing Rolls.



Sampler House, showing Sampler-Housing, Hopper Scales, Crusher and Hopper.

rapid. The country is easily accessable, wood and water are abundant and considerable water power is available.

The Michipicoton district has been declared a mining division and now comes under the provisions of Part III. of the Mines Act. By this Act all mineral rights are withdrawn from sale or lease. Annual miner's licenses are issued, and those holding them may stake out and work claims. A claim unworked for three months, except during the winter time, may be forfeited.



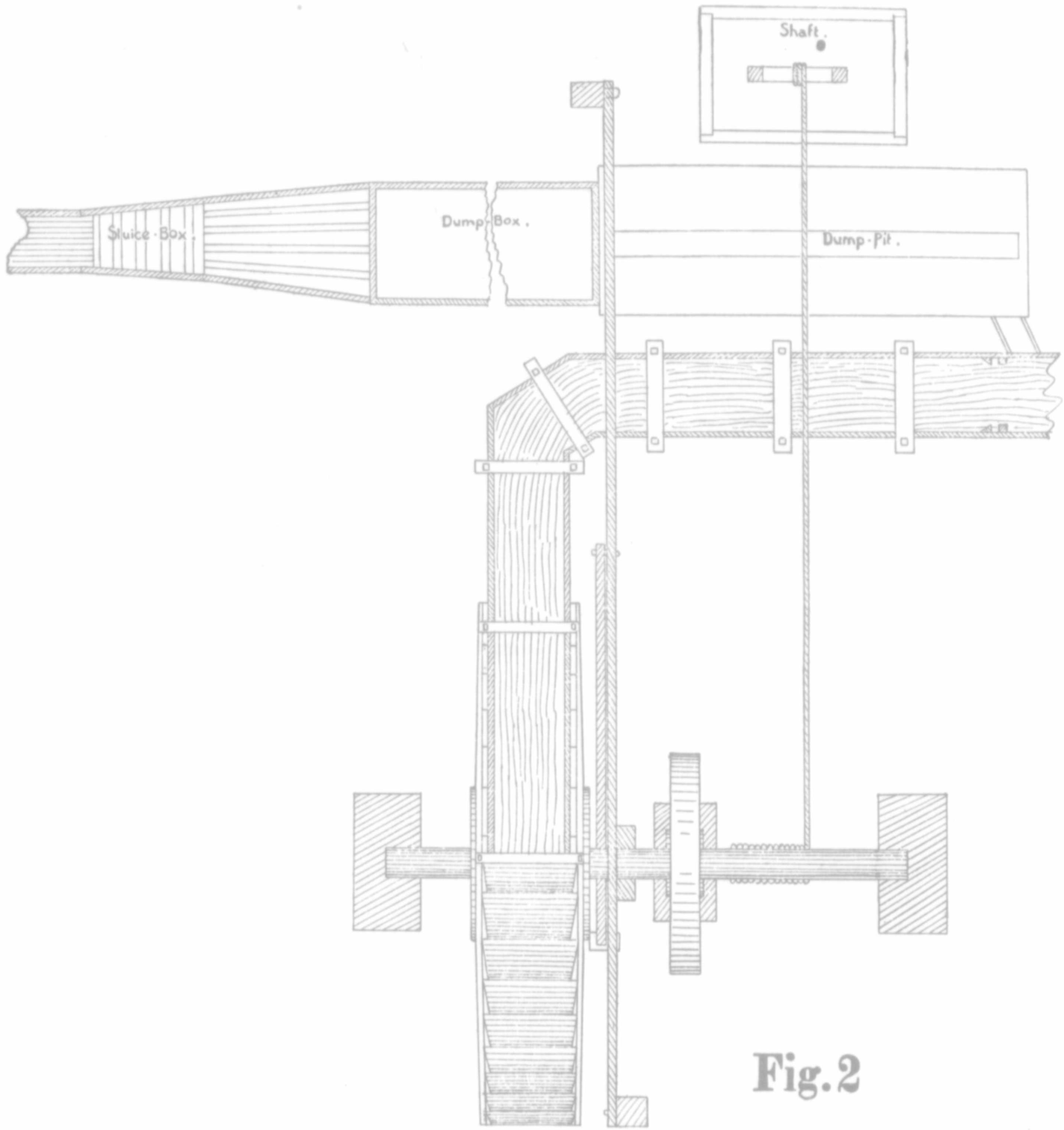
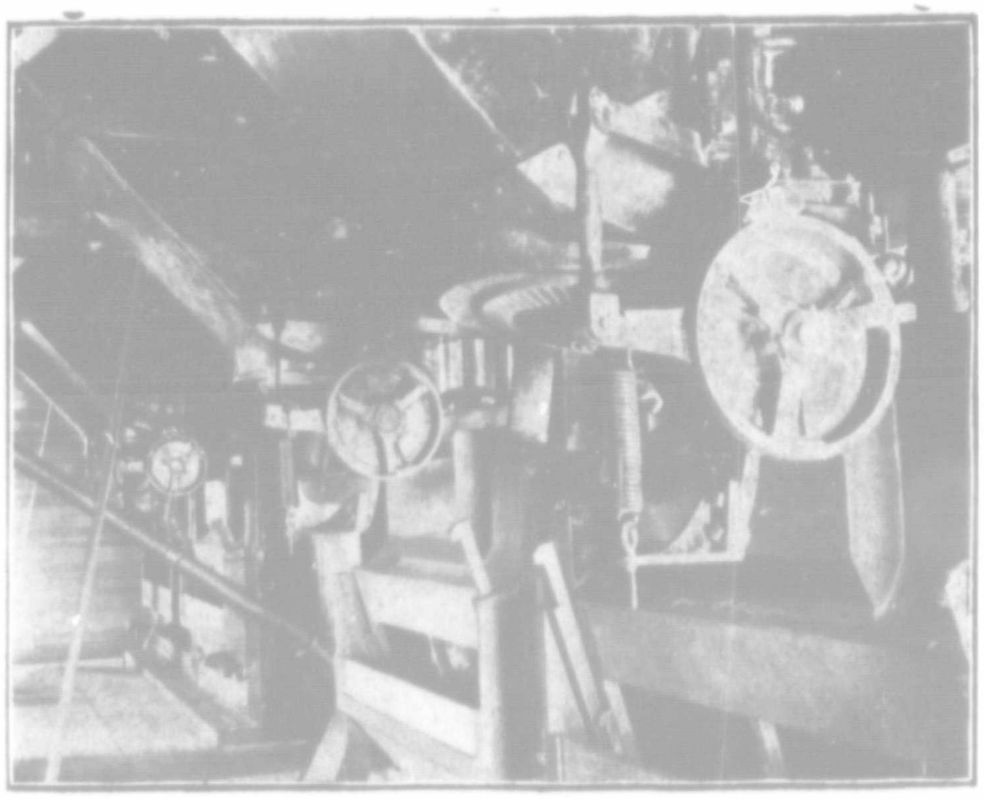
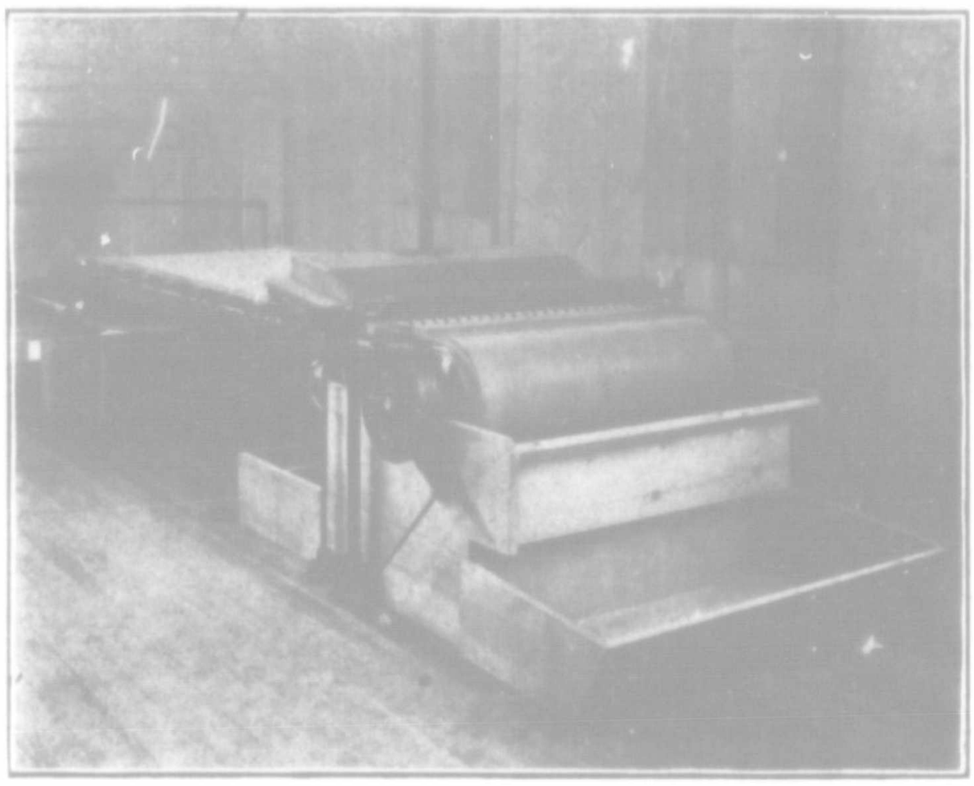


Fig. 2



Back of Battery, showing Back Screen and clear space left by Hanging Feeder.



Gyrating Vanner. Feed Side.

management or control, the question of ample capital to build, equip and operate works, adds another factor.

In good practice the amount of ores required to produce a ton of pig iron will exceed the quantity of fuel and flux necessary to smelt them, and in a general way it would appear better policy to convey the fuel and flux to the ore and smelt it. But transportation facilities, a market and ample cheap labor are necessary to insure success. Therefore, when ores, fuel and market are not all convenient, the question as to the location of a works will be influenced by relative conditions affecting each special feature.

Thus, in 1897 almost 12,500,000 tons of iron ore were shipped from the Lake Superior mines to furnaces, some of which are 1,500 miles distant, the average distance between the mines and furnaces using the ores being probably 800 miles. These ores have gone partly to meet the fuel, but the predominating attraction has been the market afforded for the distribution of the metal produced and the articles manufactured from it.

Chicago, Illinois, is dependent upon Michigan, Wisconsin and Minnesota, for iron ore, carried from 400 to 800 miles, and upon Pennsylvania and West Virginia for coke, transported 500 to 800 miles; the facilities for assembling these raw materials and distributing the finished products, added to a good home market, are responsible for the present advanced position of the Chicago district. Allegheny County, Pennsylvania, of which Pittsburg is the business centre, has the distiction of producing a larger amount of pig iron than any other district in the country. It has an excellent fuel supply close at hand, but the iron ores are brought an average distance of 900 miles from the Lake Superior region. The rail road facility for assembling raw material and taking away finished product; a near by market and intimate connection with the steel industry have combined to give Allegheny County pre-eminence.

The Birmingham district of Alabama is convenient to supplies of raw material, but distant from market demands, consequently its pro-

being installed to raise and wash the whole of the gravel down to the old channel.

There are several other notable enterprises of a modern character being developed in the Cariboo district. The operations of the Cariboo Hydraulic Co. on the south fork of the Quesnelle River is undoubtedly the most important of these.

The note of the Gold Commissioner in his report of 1890 on the discovery of the ground there worked, is interesting. He states: "The opinion has prevailed for many years among our most experienced miners from California and Australia, that, judging from the formation of the country, there exists, and ultimately would be found, in this district, immense obliterated river channels traversing the country upon a higher level than the present streams, which in crossing the former, in many instances, received therefrom their chief supply of precious metal. The first of such ancient river channels would now appear to have been discovered on the south side of the south fork of the Quesnelle River."

Examples of Placer Yields.—The two richest creeks in Cariboo were Williams' Creek and Lightning Creek. Some examples of yields may be of interest. According to the reports of the Gold Commissioner of the district, Williams' Creek and its tributaries yielded over nineteen millions of dollars, and Lightning Creek and its tributaries some ten millions of dollars. In the Lillooet district Cayoosh Creek was most productive and yielded nearly a million dollars.

On Williams' Creek the Aurora and Cameron claims each yielded some $800,000, a few other claims over half a million of dollars, and a number from $200,000 to $300,000, 108 claims yielding $17,355,000, being some $150,000 on an average per claim. On the Dillar claim on April 13th, 1863, three men washed up 104 lbs. (2,080 oz.) in the afternoon. The Gold Commissioner, Mr. Bowron, states he has seen 1,000 ounces washed up in the Aurora claim for three days, rim-drifting underground.

On Lightning Creek an approximate statement to November 1st, 1875, published in the report of the Minister of Mines of British

Leaving this attractive field for the investigation of others, the subject of iron production may be considered, in the light of present knowledge, which requires that to obtain metallic iron upon a commercial scale as to quantity and cost, iron ore must be fed to blast furnaces, together with suitable fuel and flux, and these three materials must be accessible and of desirable character.

The problem which seems to retard the central Canadian industry is the bringing together of satisfactory fuels for smelting, and ores of desirable character close to the point of distribution or consumption.

In determining the availability of a district, or individual location for the produciion or manufacture of iron or steel, the requirements are:

"*A.*" The facilities of obtaining raw materials of satisfactory character, viz: — iron ores, fuel and flux, their cost and the character of metal which they will produce advantageously.

"*B.*" The market which can be conveniently reached, or which can be developed, and the character of product most in demand.

"*C.*" The transportation facilities; both existing and prospective, and rates obtainable on raw material and finished products.

"*D.*" The supply and cost of labor, and the conditions which may cheapen or enhance the wage rate.

"*E.*" The relation which the location bears to other established works which make similar products, and the competition which must be met from these.

"*F.*" The character of works which can be constructed and their cost.

"*G.*" The cost to produce pig iron and to manufacture iron and steel of the forms most in demand.

"*H.*" The probability of other locations where no iron is made but possessing equal or in some cases superior advantages, engaging in iron production.

"*I.*" In countries like the United States and Canada the trend of increasing population demands consideration.

The problem, therefore, is by no means a simple one, and in the light of recent concentration of numerous plants under one general

Columbia, showed that up to that time 13 claims had yielded an average yield of $167,636 each—the Victoria, $451,642; Van Winkle, $363,983; the Vancouver, $274,190, etc.

It is commonly reported that the ultimate yield of these claims was much higher, and according to a report made on the spot by Mr. C. J. Seymour Baker, C. E., the following yields are given: Van Winkle, $2,000,000; Vancouver, $800,000; Lightning, $750,000; Spruce and Shallow Ground, $700,000; Point, $600,000; South Wales and Victoria, $500,000, etc.

On Lightning Creek the best weeks' wash-ups were:—In the Duncan claim, 400 odd ounces; in the Vancouver, 603 ounces; in the Victoria, 964 ounces; and higher up stream in the Van Winkle, $1,570 ounces, from 13 sets of timber, or 455 square feet, (viz., about 3½ ounces per square feet of bed-rock, or 120 ounces per set); and South Wales, 1,000 ounces, for the week ending October 9th, 1871.

The best month's yield in the Van Winkle claim gave:

Product for week ending 5th September, 1875..	858½ ounces	=	$15,169.69
" " " " 12th " "	1251 "	=	22,106.67
" " " " 19th " "	1570¼ "	=	27,749.87
" " " " 26th " "	893½ "	=	15,790.96
" to September 30th (4 days) "	495¼ "	=	754.64
Total for September, 1875.....			$ 89,571.83

These figures are from the original books of the Van Winkle Co., in the possession of the Gold Commissioner.

The best pan on record on the creek from favorable crevices was got by Harry Jones in the Van Winkle, 101 ouuces; other big pans on record are 72 ounces, and numbers of 30 ounces and upwards were obtained.

The largest nugget in Cariboo was from the Butcher Bench, on Lightning Creek, and it weighed 37 ounces. From the deep channel another nugget was taken on the same creek, weighing about 30 ozs.

A curious incident occurred in drifting a drainage tunnel on the Vancouver claim in the same creek. A 20 ounce nugget was found at some distance from the "lead," or old deep channel, and no "pay" whatever was found in the drift before or after.

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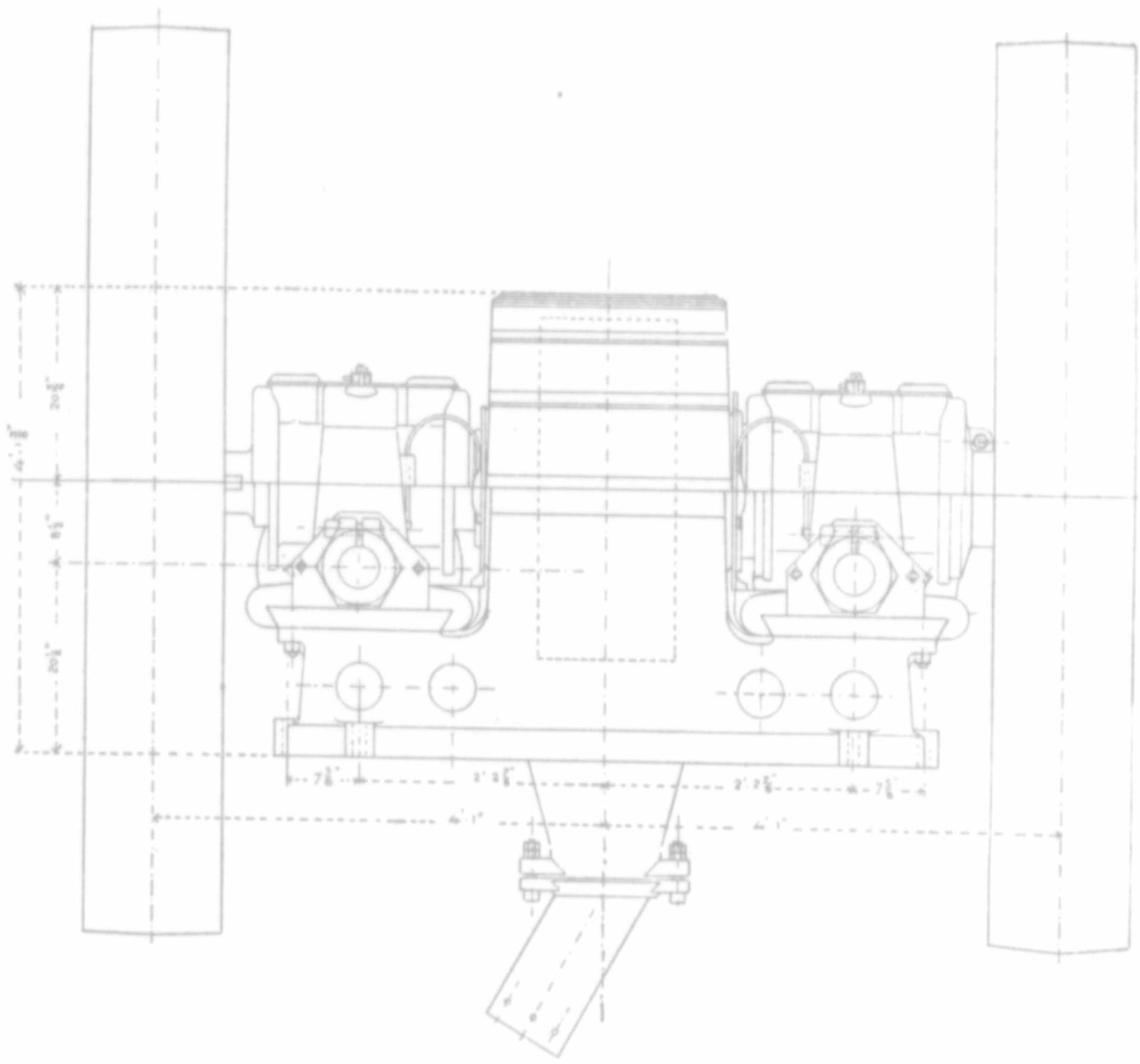


Crushing Rolls. End View.

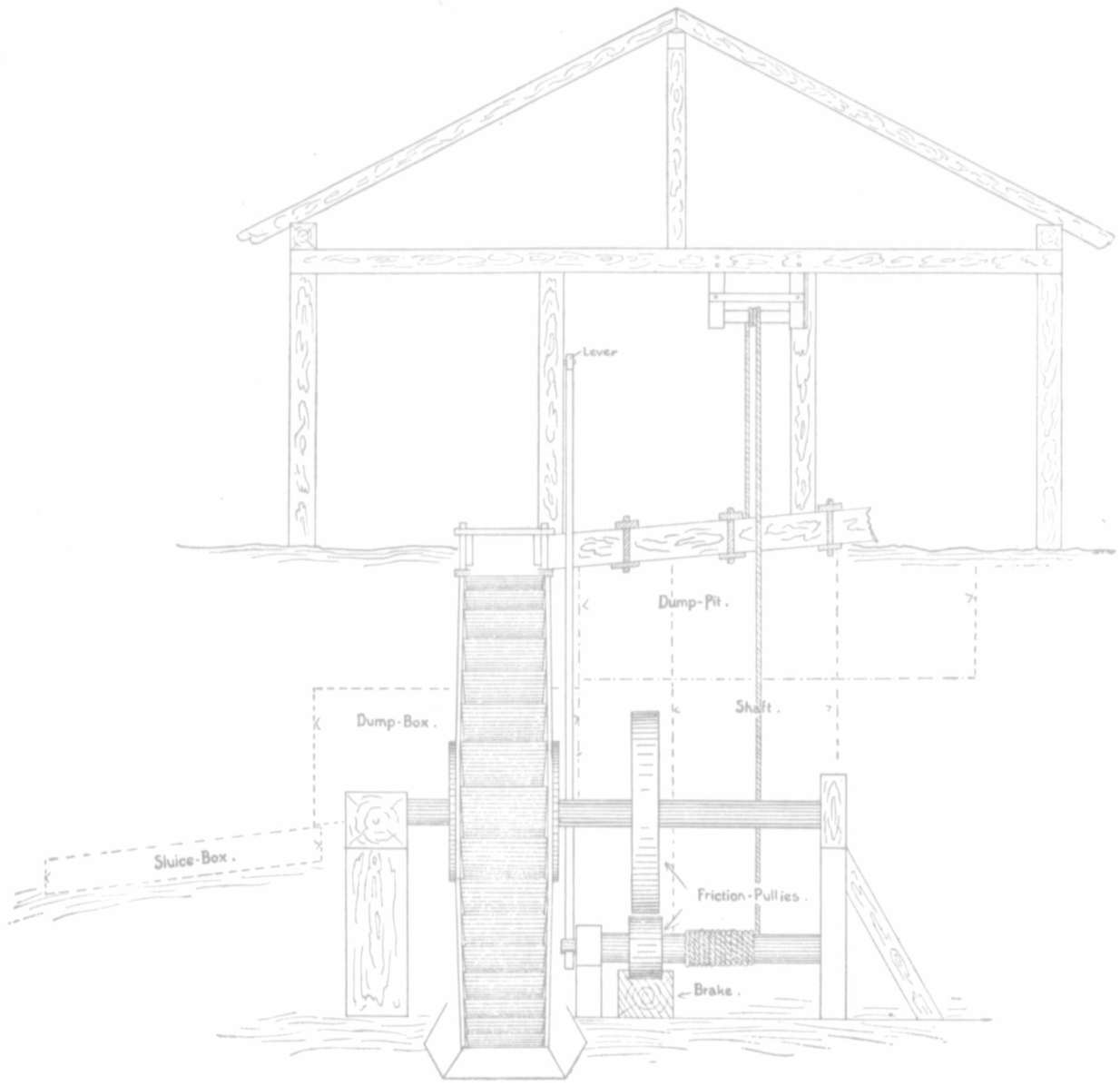
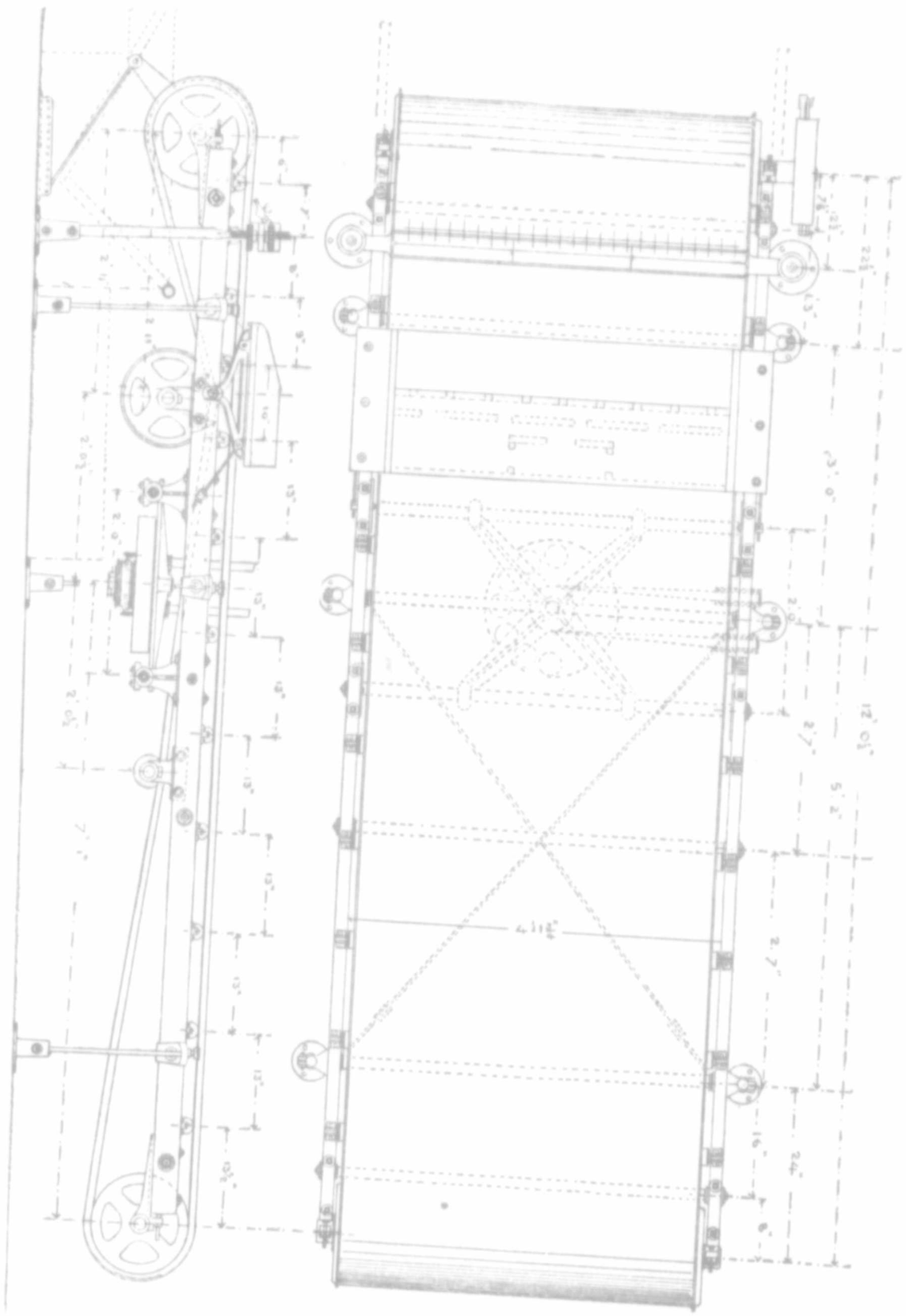
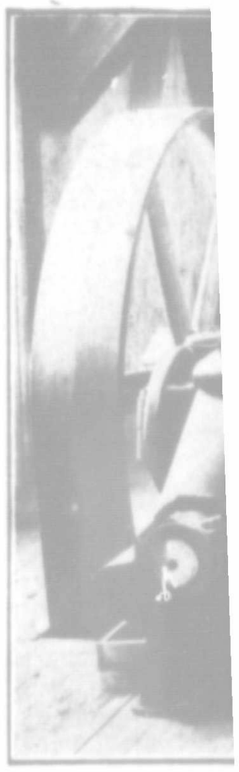
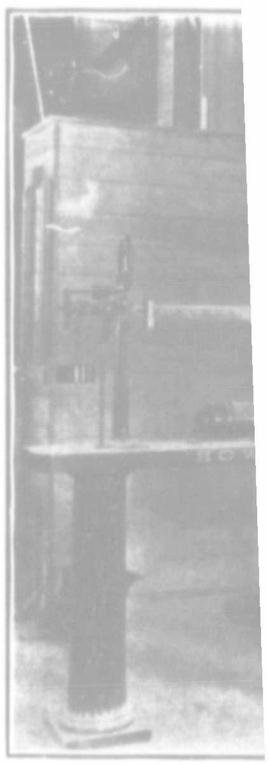

Lever
Dump-Pit.
Dump-Box.
Shaft.
Sluice-Box.
Friction-Pullies.
Brake.

Fig. 1



Gyrating Vanner.





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Notes on Mining on the Coast of B.C. and the Adjacent Islands.

By G. F. Moncton, F.G.S., Vancouver. B.C.

At the present time prospecting is being carried on along the whole line of the coast of the mainland, but it has hitherto been chiefly confined to that part which lies south of Smiths Sound, as this section was more readily accessible from the settled districts. The predominant feature of the district is the remarkable way in which the coast is penetrated by inlets, many of which extend for fifty miles, and branch out into numerous smaller inlets or arms. The mountains are very rugged and heavily timbered, rising in deep slopes and escarpments from the water, without any interval of low land which can be used for cultivation. Streams are abundant, and often of considerable size. Their course is marked by deep canons. The channels between the shores of the inlets and islands are very deep, it not being uncommon to find a depth of 50 fathoms a hundred feet from shore. Abundant traces of glacial action may be seen, and boulder clay occurs at many points. The climate is much milder than that of eastern Canada and it is rare for snow to lie for more than a few weeks below the elevation of 2,000 feet. The rocks composing the coast are granites, slates and limestones, with intrusive felspathic rocks, and some amygdaloid. There are also a few small patches of cretaceous rocks, notably at Point Rayner in the neighborhood of Cape Caution, where some work has been done on a seam of coal which is 2 feet thick and carries 74 per cent. carbon. These strata are associated with dikes and sheets of trap, together with some volcanic ash. The exploitations hitherto carried out seem to show that these coal-bearing strata were laid down in narrow inlets such as exist at the present day in the same district, and this has rendered it difficult to define their area, but they appear to underlie about four square miles of the present land surface, and may be found to extend to a considerable distance seawards. Auriferous veins have been found seven miles north of this at Yakush Harbor

ores of the out-crop may cause trouble, but, as far as development has proved to the present, it is astonishing what a short distance oxidation has penetrated into so friable and disturbed a formation.

Chlorination would treat most of the concentrated ores admirably, but as exploited so far, their usual grade is too low to allow profitable treatment by this method, and, if the extraction above alluded to can be relied on generally, the cyanide will be cheaper.

Mr. S. J. Marsh, M. E., of Barkerville, reports to the Gold Commissioner in the 1896 report of the Minister of Mines, regarding his results in testing 265 tons of ore with cyanide, to the effect that the results obtained were most satisfactory, but at the same time he points out that in certain cases he has not had conclusive results from some heavily mineralized ores, for which he favors part treatment by concentration and chlorination.

The government of the Province of British Columbia have been extremely liberal in their appropriations to assist the development of quartz mining. In the neighborhood of Barkerville they have assisted in the erection of a ten stamp mill, they built a chlorination plant and have latterly assisted in the erection of a cyanide testing plant. They also maintain an assay office at Barkerville, which is a great boon to those who are investigating quartz propositions.

With regard to the prospects of quartz mining in Cariboo, one can sympathize strongly with the expression of the Gold Commissioner who states in his official report: "If the mines of the Cariboo district were given a railway, which would mean cheaper supplies, machinery, etc., they would give lucrative employment to thousands, where at present but hundreds are employed."

Ultimately there can be no doubt about the successful development of quartz in northern British Columbia, but, as the Gold Commissioner points out, the railway question is of first-class importance in this connection. With that question settled immense quartz developments will arise, and by leaps and bounds British Columbia will forge to the front and take her place with the greatest producers of the precious metals in the world.

Commercial Progress as Influenced by the Development of the Pig Iron Industry.

By John Birkenbine, Philadelphia, Pa.

Omitting temporary disturbing causes of a national or international political character; comparisons of the present status of various nations, demonstrate that commercial prosperity is proportionate to the capacity of a country to produce what is required by its citizens or for other peoples; to it's financial ability to sustain these products, and to the facilities for distributing what it is able to supply.

This product may be of natural growth; as of cereals, fruits, lumber, etc.,— it may consist of minerals or of manufactured goods, and the nations which are best able to convert the natural product into useful forms, and to transport them cheaply to market, may claim pre-eminence.

A retrospect will bring to the notice of an observer numerous instances of local advancement in older districts which transformed crude into manufactured material, although the progress may have been limited owing to the area which could be reached by the transportation facilities applicable. As steam displaced animal, or wind powers, the market available was broadened, exchanges of commodities were made possible over larger territory, and the districts benefitted were increased in number and extent.

The same general conditions which influenced the advance of districts, counties, states or provinces, apply even more forcibly to nations; and we note the most marked improvement in those political divisions of the world which have developed their resources and supplied means for their distribution.

In the effort to secure such distribution many natural obstacles have been surmounted, and in the common parlance "distance has been annihilated" in many instances; so that in the state of transportation to-day, localities are only in part comparable by relative distances; the character of existing avenues of traffic, and the com-

Sometimes not a colour can be got within one foot of the "lead."

The varying values of the gold is interesting. Such creeks as Stevens', Wolff and Beggs (putting into Antler Creek), the value of the gold is about $14.50 to $15.00 per ounce; Williams' Creek, $16.00 per ounce, and Lightning Creek, $17.25 per ounce.

Tributary creeks to Lightning, such as Nelson, Chisholm and Anderson Creeks, $17.50 to $19.25 per ounce.

Mr. S. J. Marsh of Barkerville points out not only the well known fact that each creek has its characteristic gold, but that he has found different kinds of gold varying from $12 to $18 per ounce in the same creek, while again in Lowhee Creek he has found free gold in quartz in place corresponding exactly in fineness with the placer gold of that creek.

Quartz.—The natural inference is that it would be very desirable to get at the matrix which yields the rich placers.

Mr. Bowman, in his report above alluded to, states: "It would appear reasonable to assume the existence of rich quartz lodes, from which, by natural processes of waste, the alluvial deposits have been supplied. Consequently both in Cariboo and Lillooet there have been quartz excitement from time to time."

Prospecting is very difficult owing to the enormous amount of gravel, or debris, from the easily disintegrated schists, covering the mountain sides. Float from quartz veins is everywhere, but the veins are seldom seen on the mountain sides, but are constantly met with when drifting is done on or in the bed-rock. The veins on Burns' Mountain were discovered by a placer miner who started to drift in the snow!

The general geological features of the quartz veins have already been alluded to. Strong and apparently persistent quartz reefs can be seen, of which the attached small photograph may serve as illustration. The usual quartz occurrence is, however, accompanied by the greatest irregularity, as already indicated.

Instances will no doubt be found where it will be profitable to mine and treat the entire belts of quartz and schists, but the high

tonnage produced into the population of the United States in census years. This gives the following result:—

In 1860 the U.S. produced	1	ton of	pig iron for	32	inhabitants.
" 1870	"	1	"	21	"
" 1880	"	1	"	15	"
" 1890	"	1	"	7⅓	"

With the rapid increase in production there has been a marked decrease in the number of plants to supply the metal.

Twenty years ago (viz. 1877) the number of blast furnaces in the United States, considered as on the active list, was 716 In 1897, a similar list embraced 423 stacks, of which but about 200 contributed to produce the pig iron credited to that year.

While large furnaces have displaced small ones, the increase in size will not alone account for the result.

Improved equipment and technical knowledge applied to iron smelting has done more than anything else to secure the advancement indicated.

The most important factor in the development of the pig iron industry is the conversion of iron into steel. This is indicated by the figures which show that in the past ten years the quantity of pig iron, rated as Bessemer, has increased from 2,637,859 tons, or 40.65 per cent. of the total pig iron make of 1888, to 5,795,584, or 60 per cent. of the pig iron output of 1897.

The pig metal classed as Bessemer indicates the amount which was utilized to produce steel in converters; in addition, the open hearth furnaces required a considerable amount of pig iron.

The 5,500,000 long tons of steel ingots made in 1897 were transformed into rails, plates, sheets, nails, wire, etc., at works which were drawn to the vicinity of the blast furnaces supplying the pig iron.

It is not the furnaces alone, but the concentration of manufactories which gives value to blast furnaces as developers of a district.

Several years ago a town-site boom ran riot throughout the eastern portion of the United States, and prospective cities were laid out sufficient to require half of the population of the country to occupy their liberal areas. Most of these proposed cities were based upon the

old river bed was located at 287 ft. below the surface of the present Creek by boring through the gravel with an hydraulic jetting machine. A drain tunnel of 2,150 ft. was run to the old main working shaft to relieve it of water, and, from the last available information, this has been continued to the rim rock, in which a bed-rock shaft will be sunk to a point below the deep channel and then a cross-cut will be driven into the channel from the bottom of the shaft.

In the case of the Willow River lease a similar drainage tunnel, or adit, has been run to the rim rock and a three compartment shaft 6 x 12 ft. had been sunk 100 feet to the rim rock, and 112 ft. deeper in the bed-rock. Twelve feet of the bottom of the shaft is left as a sump, and a cross-cut 6 x 5 ft. was being driven to reach the old channel, according to latest available intelligence. An Ingersoll-Sergeant drill is used and a blasting battery, and about 100 ft. a month progress was being made. Mr. Fred C. Laird, the manager, reports that all the tunnel has to be timbered, and a great deal of extra work is caused by rock caving.

The machinery comprises a 50 h. p. boiler, a pair of 35 h. p. engines, an 18 in. Cornish pump, two 12 in. Cornish pumps, one horizontal steam pump, a 16 h. p. hoisting engine with upright boiler.

Careful boring, to locate the old channel, was also previously done in this case with an hydraulic jetting machine, commencing with a 6 in. hole and decreasing to 3 in. It is said that "prospects" of gold were raised by the drill.

These last two examples are types of modern operations to reach deep-diggings and work them. The first mentioned is now working, but is alluded to as a type of an old-time plant.

There is no important existing example where a tunnel drains the old deep channel while it is being worked in the usual manner. A condition exists, however, where this can be done in the lower, and yet unworked, ground on Lightning Creek, and a company is under course of formation to carry out this project.

On Willlams Creek a long drainage tunnel relieves the lower part of the old worked ground of its water, and an hydraulic lift is

vitiate it. The lights used are the ordinary paraffin candles and are one of the causes of the greatest loss of oxygen, as two candles consume as much oxygen as a man.

The explosive used in the mine is a 40 per cent. dynamite and the resultant gases are much lighter and thinner than those of ordinary powder smoke would be. They contain among other things carbon dioxide, but sulphurous and nitrous acids are not evolved. But the ore is a chalcopyrite containing in some cases over 50 per cent. sulphur, and it very often happens that when, in blasting, a heavy charge of explosive is used, that the ore is broken up into dust and fine fragments which are so highly heated by the explosion that they are "wasted," producing sulphurous anhydride in dangerous quantities.

It is not necessary here to enlarge upon the effect on the atmosphere of the respiration of the miners, except to say that as there are about 50 men employed underground, and as the air which is exhaled from the lungs of a man contains 4 p. c. of carbonic acid gas, in drifts and confined spaces not well ventilated, the air soon gets very impure and dangerous to breathe owing to the carbonic acid thus produced. Although the mine is remarkably dry, there is always a little water and moisture on the walls and in the shafts, and owing to its acidity it is constantly absorbing oxygen from the air, and, acting on the ore forms salts of copper. The mine is situated on a hill and the shaft is at the summit, as the outcrop of the vein is at that point. At a distance of 500 feet from the surface, measured in the dip, the shaft is cut by a horizontal tunnel, which opens in the hillside.

This adit is now altogether used in the working of the mine, the portion of the shaft above this level being used for ventilation and for carrying the smokestacks, as the hoisting engines and boilers are placed at the junction of the tunnel and shaft. As most of the miners walk to their different places, there is a stair and ladder-way which extends to the bottom. The course of the ladders is along one side of the mine for about one half of their depth. This portion is bratticed from foot-wall to hanging, leaving a gangway averaging 20 ft. wide, forming for this distance a ventilating shaft. The air for eight or nine months of the year enters the adit, follows down this air shaft and returns to

Albuminoids, 6.2-6.5 ozs.; fats, 4.5 ozs., and carbohydrates, 17 ozs., there being sufficient salts and acids associated with the classes named.

When we come to examine various foods with which we are familiar, we find that usually two or more of our classes are associated. The solid matter of the potato is almost entirely starch, but in flour we have starch, albuminoids and salts associated. In beef we have salts and albuminoids associated. In fruit, such as grapes, we have tartaric acid and sugar.

Let us look now at the approximate composition of some common articles of food, as set forth in the subjoined table:

Name of Food.	Water	Albuminoids.	Carbohydrates.	Fat.	Salts.	Acids.
Lean Beef	80.	19.	.....	.....	1.	
Potatoes	75.	2.	22.	2.5	.7	
Turnips	91.	1.2	7.2	.....	.6	
Apples	85.	.....	12.98	.....	.....	1.04
Milk	87.	3.	4.	3.5	.36	
Beans	12.5	30.	48.	2.	3.5	
Peas	14.	23.	53.	2.	2.65	
Flour.	15.	11.	70.	2.	1.7	
Oatmeal	15.	12.	64.	5.6	3.	

On glancing at this table we are at once struck with the large per centage of water in all except the cereals and the leguminous products, *i.e.*, flour, oats, peas and beans. These cereals and leguminous seeds represent, as it were, naturally concentrated foods, for whilst it is possible to drive off a portion of the water they contain, yet unless under very special conditions it is not possible to prevent the reabsorption of water from the air.

Of the foods named in this group, flour is generally recognized as the staff of life. One great difficulty in connection with flour, in so far as the prospector is concerned, is the skill required to make bread, oatmeal, peas and beans require much less culinary skill. It is greatly to be regretted that larger use is not made of peas and beans by prospectors and others who require a concentrated and nourishing food. It

Date.	Locality.	Per Cent. C. O.^{2}	Per Cent. Oxygen.
July 2	Johnston's Stope	0.6	17.9
3	Slide Drift	0.4	18.0
4	Moyle's Drift	0.6	18.0
7	Jones' Drift	0.9	17.8
8	Nelson's Drift	1.0	17.3
9	No. 3 Shaft	0.8	17.8
10	Near Turntable	0.9	17.9
13	Old Drift (not working)	1.6	17.3
14	Jones' Drift	1.6	17.4
16	Beattie's Drift	0.6	18.0
19	Dire Drift	1.8	17.0
20	Halfway down ladders	2.8	16.9
22	Harvey's Drift	0.9	17.1
23	Moyle's Drift	1.1	16.3
26	Jones' Drift	1.2	16.8
29	Billadeau Stope	1.6	16.9
29	Turntable	0.4	17.8

Temperature determinations were taken on June 7th and August 8th and were as follows:

	June 7th.	August, 2nd.
At the Landing	66.0	66.6
Bridge		57.8
Slide Drift	54.8	56.0
Dire Platt		57.0
Turntable	55.0	56.2
Junction	55.2	56.5

These were all taken in the air, not close to the walls. This shows that in two months the average temperature in the mine has risen about 0.2°, and that there has been a gradual increase in the amount of carbon dioxide and a decrease in the amount of oxygen in the underground air.

Just what chemical effect the steam has on the air is rather uncertain. We know that at ordinary temperature and pressure, water will combine with an equal volume of carbonic acid, and, although at higher temperatures this decreases, there was no doubt some absorption of carbonic acid by the steam.

case the material had the colour of rosin and the consistency of wax. In the form of inspissated drops associated with crystals of brown-spar and calcite, petroleum occurs at McKay's ford of the East River. Usually these round globules are hard and brittle, but a few have the elasticity of elaterite. Allied to this last form of deposit is the well known "Albertite" of Hillsborough, occurring in quantity in veins which have been apparently exhausted.

To the specimen collector the Hub seam supplies handsome specimens of peacock coal.

Gold.—The rocks of the carboniferous are not usually regarded as gold-bearing, but in the basal conglomerates resting on the Cambrian slates coarse gold has been worked at Gay's River, and in times past yielded some fair returns.

Copper.—The higher horizons of the carboniferous system according to the classification that has hitherto been current;* the strata that have the New England comglomerate at their base, while yielding no coals of workable thickness or shales of value, produce some copper and lead ores associated with plant remains. "Chalcocite," in nodules or grains, generally encrusted with "malachite" and occasionally associated with "covellite" and jet, is found disseminated through certain beds of sandstone at Cariboo River, New Annan, French River, etc. In search of these ores, spasmodic explorations have been conducted for the past 60 years,† but nowhere has the distribution been found uniform over a large area.

Occasionally in the limonite at Bridgeville fibrous malachite in small quantities has been detected.

Iron.—The ores of this metal occurring in sedimentary deposits are spathic, clay ironstone and black-band ironstone, not one of which is mined at the present time.

"Spathic," in the varieties "ankerite" and "sideroplecite," occurs in the veins at Londonderry in rocks of Devonian age, but in the car-

* The recent reports of officers of the Geolological Survey touching this district question the classification in vogue and seem disposed to place the strata affected still higher in the scale.—N.S. Instit. Nat. Sc., 1893: Poole, p. 228.

† Gesner, Jackson, and Alger.

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Then again, we have the well-known Bovril, fluid beef, etc., which are the virtues of beef in highly concentrated form.

Again, in compressed corn beef we find 52½ per cent. of water against 80 per cent. in the fresh beef.

The process of concentration by removal of water has recently been applied to potatoes, turnips, and other vegetables. From 100 lbs. of ordinary potatoes 15 lbs. of this concentrated article is obtained. In the case of turnips 8 to 10 lbs. represent 100 lbs. of ordinary turnips; the loss, peelings and water. In some other vegetables the results are higher, 15 or 16 lbs. to 100. It is thus evident that two or three pounds of these concentrated vegetables, which are imperishable whilst kept dry, represent a week's supply for a man.

But of late the idea of food concentration has been carried still further. Not only are various articles of food concentrated by the removal of water by methods that leave the flavour and nutritive value of the foods unimpaired, but various articles of food are blended into ideally perfect foods, the carbohydrates, fats and albuminoids being properly proportioned and put up in packages, each containing a day's rations. These combinations are packed in tins, hermetically sealed, so that the contained foods will keep indefinitely. As an example of the keeping qualities of these foods, I may state that I have seen a package that Nansen took with him on his celebrated voyage in the "Fram," and which on his return he handed over to the makers of the food, in as good condition as when it was first sent out.

I lay before you the so-called cartridges, each containing one day's rations for a man under hard work. These, as offered by a firm of food specialists in this city, are of two kinds, distinguished by their colours as blue and red. The blue contains nitrogenous matter in the form of beef, and as carbohydrates we have potatoes together with fat. The red cartridge contains beef and bacon, and instead of pototoes we have peas. It is recommended that these two be used alternately so as to produce variety.

The contents of these cartridges are almost entirely freed from water, and all that is required in the way of preparation is that they be heated for a short time with water, or indeed, in cases of emergency,

inch in diameter. The reason for this circular shake in place of the customary side shake of the Frue vanner will be apparent to anyone who has attempted to settle the contents of a gold pan; or in a hand screen, has tried to get the coarse material on top. The advantage of this shake is so apparent, that the question arises why it has not been used before, especially as it was patented some seventeen years ago in the United States. The difficulty has been to build a practical machine that would not shake itself to pieces under the varying strains brought about in producing this gyrating motion. Success was obtained in the vanners of this plant by stripping them of the customary heavy frame, supporting them on six round steel rods, one end of which was screwed to the floor, the vanner resting on the upper end free to float around in any direction. The belt is stretched over rollers in the usual arrangement and below it is supported, on a short vertical shaft, an unbalanced weight. When this weight is caused to revolve by a two inch belt the amount that it is out of balance causes the vanner to swing around in a circle, whose radius mutiplied by the weight of the table equals the radius of gyration of the unbalanced weight multiplied by the amount that it is out of balance. In practice it has been found desirable to use a gyration about three-quarters of an inch in diameter, and to run the table at a speed of about two hundred and twenty-five shakes per minute. Owing to the fact that the table is just balanced by the amount the gyrator is out of balance, no jar or shake is transmitted to the floor, and no racking strain is set up in the vanner itself. The feed of the belt is obtained from a Challenge feed clutch on the head roll. The tail of this clutch is attached by a flexible link to a point on the floor, the gyration of the table furnishing the necessary movement. By changing the point of attachment of the link to the floor the feed of the belt can be altered from nothing up to twenty-five feet per minute. The heavy frame of the Frue vanner, the side shaft with its three eccentrics, and the complicated "G" spring feed is avoided. From the vanners the tailings are divided over two more sets of gyrating copper plates, each four feet wide by six feet long supported in a similar manner on flexible steel rods, and gyrated by the revolution of an unbalanced weight supported below each.

New Reduction Works of the Ottawa Gold Milling and Mining Co., at Keewatin, Ontario, showing Locke-Miller Cableway, crossing railroad, for taking ore from lake barges to sampler.

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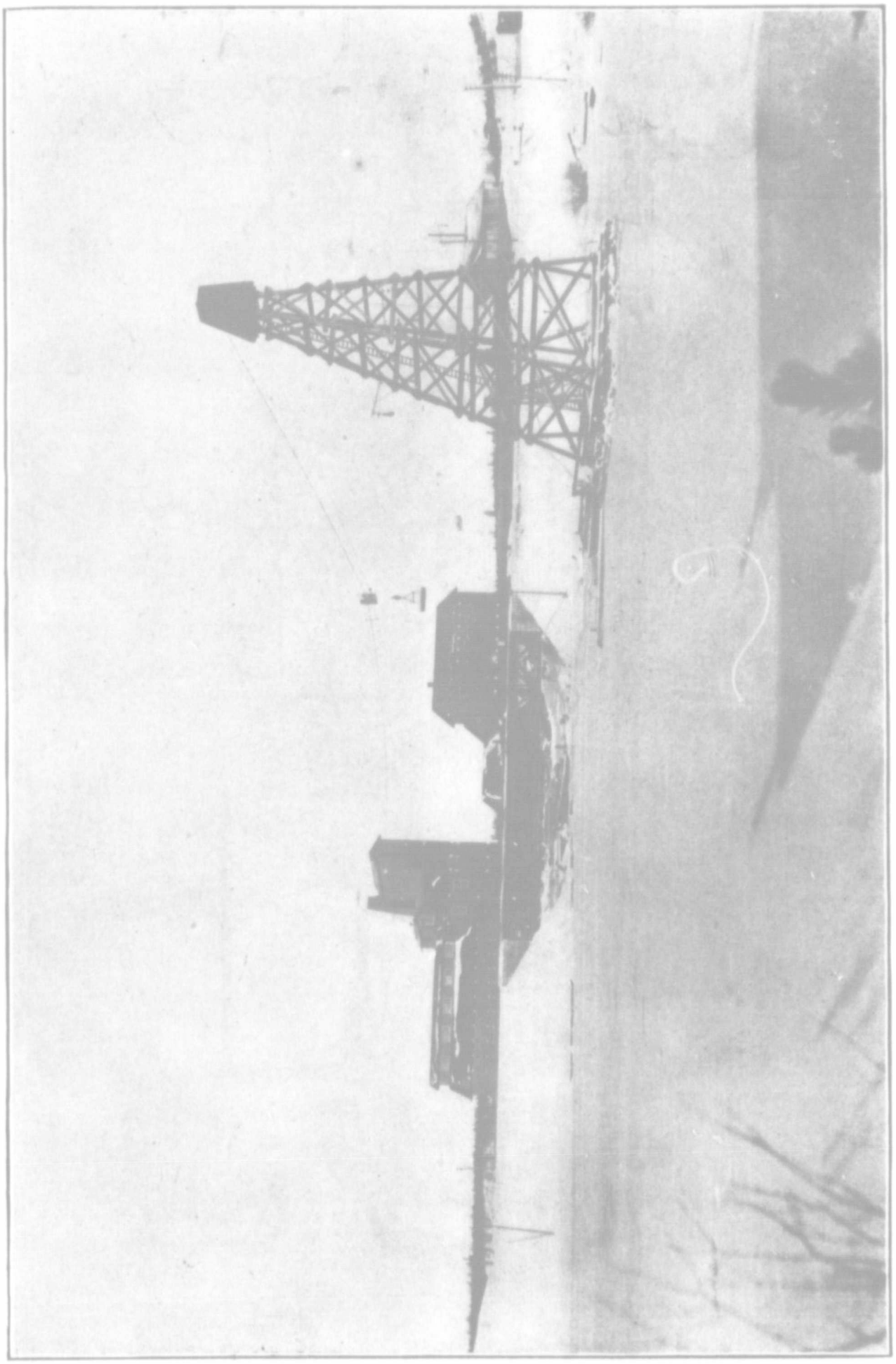

New Reduction Works of the Ottawa Gold Milling and Mining Co., at Keewatin, Ontario, showing Locke-Miller Cableway, crossing railroad, for taking ore from lake barges to sampler.

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and work is being carried on there. Locations have been made on many islands and on the shores of the inlets to the south, especially on Loughsborough Inlet and Cracroft Island, where copper ores occur, but the interest at present is centred chiefly on the district between Phillips Arm and Howe Sound. The first point at which any considerable amount of work was done was at the Alexandria mine, west of the entrance to Phillips Arm. At this point there is a band of slate with intercalated quartz veins, which has been proved by a drift along the best vein for a length of 150 feet and a cross cut 70 feet long. As shown in the cross-cut and on the shore, the strata consist of alternate layers of quartz and slate, varying from 3 to 15 feet thick. All the quartz carries some iron pyrites and yields a little gold, but the pay-streak was a seam of blue laminated quartz found near the hanging wall of the largest quartz vein, and carried the gold disseminated through very fine-grained arsenical pyrites. This was 4 inches wide near the mouth of the drift and yielded $68 per ton in gold. At 100 feet further in it was nearly 3 feet wide, but had a value of only $8. At this point it was faulted by a dike of quartz felsite and has not since been recovered. In this property it seemed that wherever the pyrites is coarse-grained the gold value is low. Further up the Arm, on the same side, are the mines grouped around Fanny Bay Of these the Coon was the first located. It has several veins in slate which carry gold associated with iron pyrites, one being 3 feet wide, but the most important is a small one cropping out on Hewet Point, which is an island at high tide. Smelter tests of this ore yielded $100 per ton. On the same claim occurs iron ore at the junction of the granite and limestone. On the west side of the bay lie the Dorothy Norton and other properties which are now being worked on the extension of the Alexandria vein. The limestones and slates lie in narrow synclinal basins between the masses of granite which form the high ridges. A good section of one of these is seen in Marble Creek. The slate and limestone seen on the bay cross the arm, and some work has been done on them there. They may also be traced, but not continuously, to the south side of Carden Channel, where they crop out for five miles continuously. Between the locations at that point and those of Fanny

The Copper Plant.— The copper plant consists of two large buildings known respectively as the Foundry and Tank House.

Foundry.— In the foundry there are three large brick reverberatory furnaces — one for concentrating the copper matte received from the blast furnace and converting it into black copper, one for making anodes of black copper and one for converting the cathode copper into marketable form. As the black copper arrives at the foundry in the form of pigs from Mexico and Colorado, they are first sampled by boring holes at intervals through each bar by means of an electric drill, and then cast into rectangular plates called anodes, which are taken by means of a narrow gage railway to the tank house, where they are electrolytically refined.

Tank House.— The tank house contains 180 double tanks, each divided longitudiually in the centre by a partition into two compartments about 12 ft. x 2¼ ft., and 3½ ft. deep. The tanks are made of wood strongly bolted together externally and lined inside with heavy sheet lead. (Plate 2). They are arranged in 12 rows separated by narrow aisles. The tanks in each row are terraced and connected by lead overflow-pipes controlled by faucets so that circulation of the electrolyte goes on through gravity. The last tank of each row empties into a lead-lined trough connected with the storage tank, by means of these arrangements the tanks can easily be emptied for the purpose of cleaning up slimes and re-standardizing the electrolyte.

Along the top on either side of the tank run copper connecting rods on which rests one terminal end of the electrodes; the other end rests on copper plates placed along the top of the dividing wall between the two compartments; the alternate ends of the electrodes being insulated by means of porcelain blocks (Plate 2).

Electrodes.— The electrodes in each compartment consists of 22 anodes and 22 cathodes suspended alternately about 1½ inches apart and wholly immersed in the blue-stone solution. The anodes (Plate 3) are about 2 ft. x 2¾ ft. and 2 in. thick and weigh approximately 200 lbs. The cathodes have the same surface area as the anodes, and are prepared in what is called the graphiting department by precipitating copper on thin sheets in tanks, 15 in number, set apart for that purpose.

The past three months' rate of production has been at the rate of 12,000,000 tons.

These figures show that while the production of 1860 was about one-twelfth that of last year (1897 when 9,652,680 tons were made), it was five times greater than in 1830. Taking the Census report for a half century, the data indicates that the *pig iron out-put of 1890 was over thirty-two times that of 1840.*

This indicates a rate of progress which has never been duplicated in any country in a similar interval of time, and it may never be again, for if the product of the blast furnaces of the United States increased in the same rate for fifty years subsequent, as it did for fifty years prior to 1890, this would reach the enormous total of 295,000,000 gross tons per annum, and require that in 1940 the country should produce in one year, two and one-half times the total out-put of all the United States furnaces for the fifty years, 1840-1890.

It may be of interest to note that until 1840 all of this iron was made with charcoal. The year 1855 was the first recorded in which the production of pig iron by the use of anthracite coal exceeded that made with charcoal, and in 1860 the relative proportions of iron made with the different fuels were practically twice as much charcoal pig iron as coke iron, and twice as much anthracite iron as charcoal iron.

In 1897 the quantities of pig iron made by the different fuels were:

Using coke and bituminous coal.....	8,464,692	gross tons
Using anthracite or anthracite and coke mixed..	932,777	"
Using charcoal.....	255,211	"
Total.....	9,652,680	"

The great advance in the use of coke may be further stimulated by experiments which indicate that bituminous coals not ordinarily classed as "coking" can be made into satisfactory metallurgical fuel, by carefully investigating them and treating these coals in improved ovens.

Mere figures of production do not show real progress, for the use of the metal is a better gauge; and this is indicated by dividing the

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Disclaiming any desire to minimize the important bearing upon national advancement which should be credited to other specialties, the iron industry may be given a leading position in securing commercial development. The term "iron industry" is intended to include all the steps from the mining of the ore to the production of the finished product in various forms of iron and steel. The winning of nature's crude materials from the earth, and (by the application of the mental and physical powers of man) the conversion of these into forms, which when properly applied add materially to our comforts, will improve any community and advance any nation.

This brief discussion will be confined practically to the production of pig iron, and the reliance of the more advanced stages of manufacture upon the crude metal, using the record made in the United States as illustrative.

Few articles which we manufacture have been so liberally discussed by political economists as pig-iron, and in legislation concerning custom duties, this product has assumed such a prominent position that we may infer that this particular industry is recognized as exerting a marked influence upon the progress of a country, and especially upon certain sections thereof. Facts sustain the inference, and probably no one industrial pursuit, except possibly coal mining, has done more to advance the United States than the production of pig iron, and by this product and subsequent manufactures, much assistance has been given to the development of the coal mining industry, which now contributes about 171,000,000 tons annually, or thirty per cent. of the world's out-put of coal.

In this connection attention may well be invited to the fact that much of the earlier advancement in iron production and manufacture was based upon the use of bog ores, which abound along the Atlantic sea-board, and which bear close relationship to the ores now smelted in the Province of Quebec in the production of metal of exceptional character.

prices of transportation, material and wages, makes the consideration of quartz mining a serious problem.

It would be thought that where rich placer ground was found free milling would be the characteristic of the ores. This has not so far proved to be the case. Examples of nuggets as large as 10 and 15 ounces are to be seen in the country, mined out of the irregular quartz stringers. The men who carry on this work in California are known as "pocket-miners," but it has not yet become an industry in Canada. It is found as a rule that the average ore of veins contiguous to such stringers is not free milling; only a small portion of its value can be extracted in the battery or on the plates of a stamp mill. Many quartz veins in this country are absolutely barren, so far as can be seen at or near the surface. The general characteristic of the veins, however, is that they carry a large proportion of iron pyrites, some also carry galena and a little zinc-blende. Iron pyrites is also generally found occurring abundantly in a crystalline form disseminated through the schists, and particularly near mineralized quartz veins.

Tests on a small scale have been carried on by myself on ores from various localities in Cariboo, and while some ores run as high as $30.00 to $40.00 in gold, only a very small proportion of it can be saved in the stamp mill, in the instances that came under my attention. As an example, an ore assaying about $30.00 a ton gave a varying extraction free milling of from nil to $5.00 per ton.

Cyanide extracted 85 p.c. of the values in 70 hours. By concentration the loss in slimes was considerable, and close concentration to get rid of the dolomite associated with the ore, with a view to chlorination tests, gave a 5 p.c. yield in concentrates, which assayed gold, 9 ozs., 10 dwt., 21 grs.; silver, 5 oz., 11 dwt., 18 grs.; lead, 10.08 p.c., and traces of lime and magnesia.

Other ores in the district give a yield as high as from 15 to 17 p.c. concentrates. An example of one of these gave an assay of from $8.00 to $12.00 in value, with a yield of some $2.75 in free gold and a loss of about $2.00 in the tailings. Cyanide extracted 85 p.c. in 72 hours, and most of the ores, where rich and constant enough to pay to mine, will probably be treated by this process. The oxidized

Notes on the Ventilation of a Deep Metal Mine as Affected by Seasonal Changes of Temperature.

JOHN E. PRESTON, McGill University, Montreal.

For a number of years past it has been noticed at the Eustis mine that the hot weather of summer always causes general disorder in the natural ventilation, which is generally sufficient. The first signs of this always came in the form of bad air shortly after a hot spell, if the latter lasts for more than three or four days- The miners working in drift using hand drills are the first to notice it, and it then soon spreads all over the workings. The effect is usually shown by a slight difficulty in breathing, and is particularly noticeable on the ladders, to men going up from work. As is always the case where candles are used under ground, they form an excellent index, and a slight change in the air is easily shown by the candle flame, for while generally one candle flame gives sufficient light to work with, two candles during the hot weather will hardly light one on his way down, even when walking very slowly, and while at work a man will need as many as six candles burning at once.

In the following paper the causes of this unsatisfactory ventilation will be considered, the means taken to better the condition described, and a series of analyses of the underground air will be appended.

First to be considered are the causes that tend to make these changes in the underground atmosphere.

We find that there are several operations going on in a metal mine which are constantly tending to render the air in it unfit for supporting life, viz.:

(1) The burning of candles;

(2) The explosions of powder, dynamite, etc.;

(3) The respiration of the workmen;

(4) A constant reduction of the air by the acid waters of the mine.

Of the above the first three increase the percentage of carbonic acid in the air, and all four decrease the percentage of oxygen and thus

establishment of blast furnaces, although some of the sites chosen had little to commend them as locations for pig iron production.

As a result there are now few indications of a number of these prospective cities, and even their memory is, in many cases, confined to those who invested in town lots laid out through cornfields, at prices equivalent to the cost of similar properties in actual municipalities.

Over 90 per cent. of the employees about a blast furnace plant are classed as ordinary navvy laborers, the number of specially skilled or educated specialists being small, hence the supplemental processes of converting the metal and especially its manufacture into articles of use do more to advance a town or city than the blast furnaces alone. In fact, so closely are these supplemental processes associated with pig iron production, that it is only at exceptional localities where it will be found desirable to establish new smelting plants, unless they are closely affiliated with steel works, rolling mills, etc.

While pig iron is a most potent factor in the development of a district, province or nation, its manufacture cannot be made successful without the use of good business management and technical knowledge. Even with these, failure may and probably will follow the location of plants without giving the site thorough, unbiased investigation.

In short, all of the factors above indicated must receive careful attention in determining the advisability of erecting blast furnaces if the pig iron industry is to exert a healthy influence upon commercial development.

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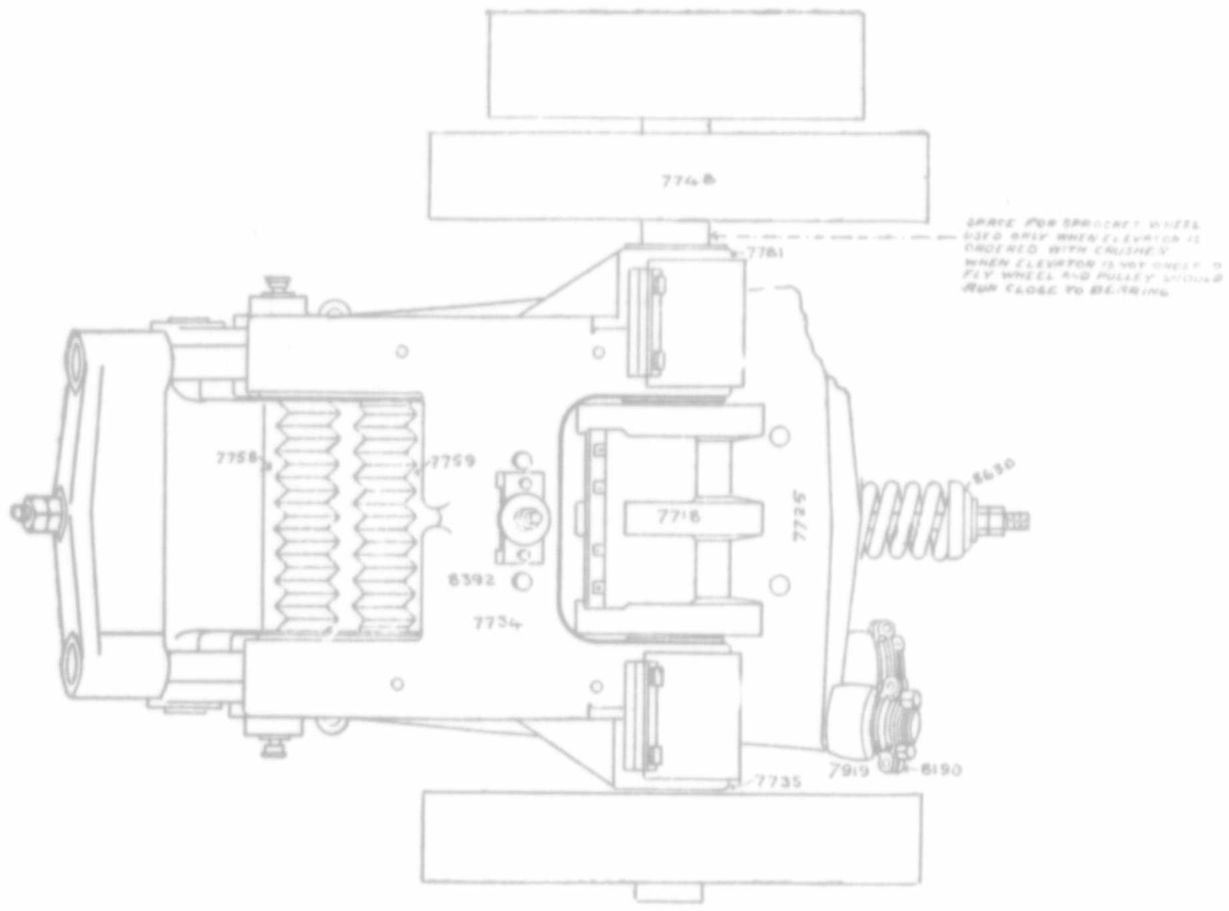
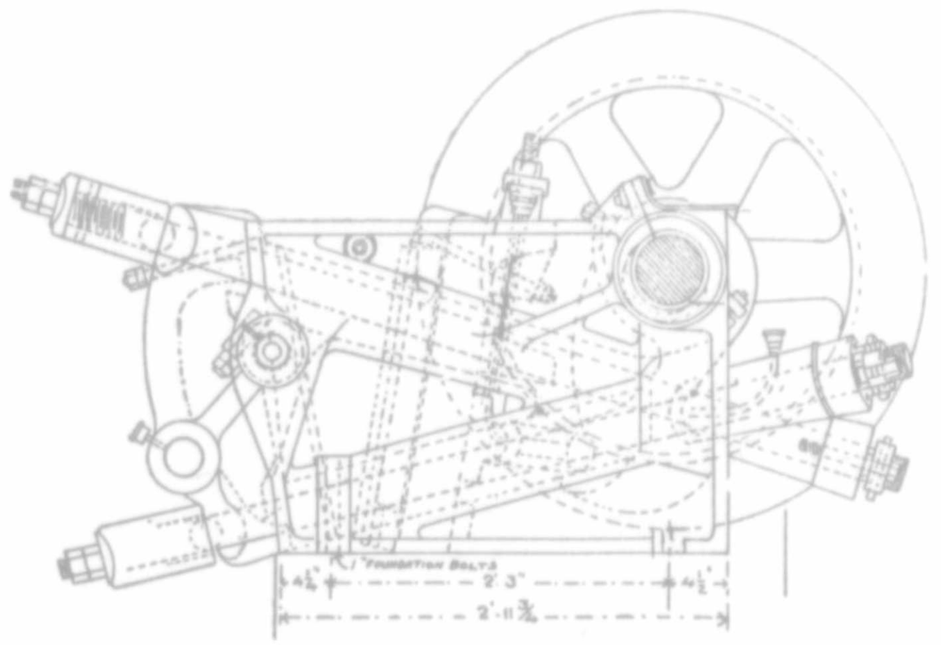




10″ x 18″ Invincible Jaw Crusher.

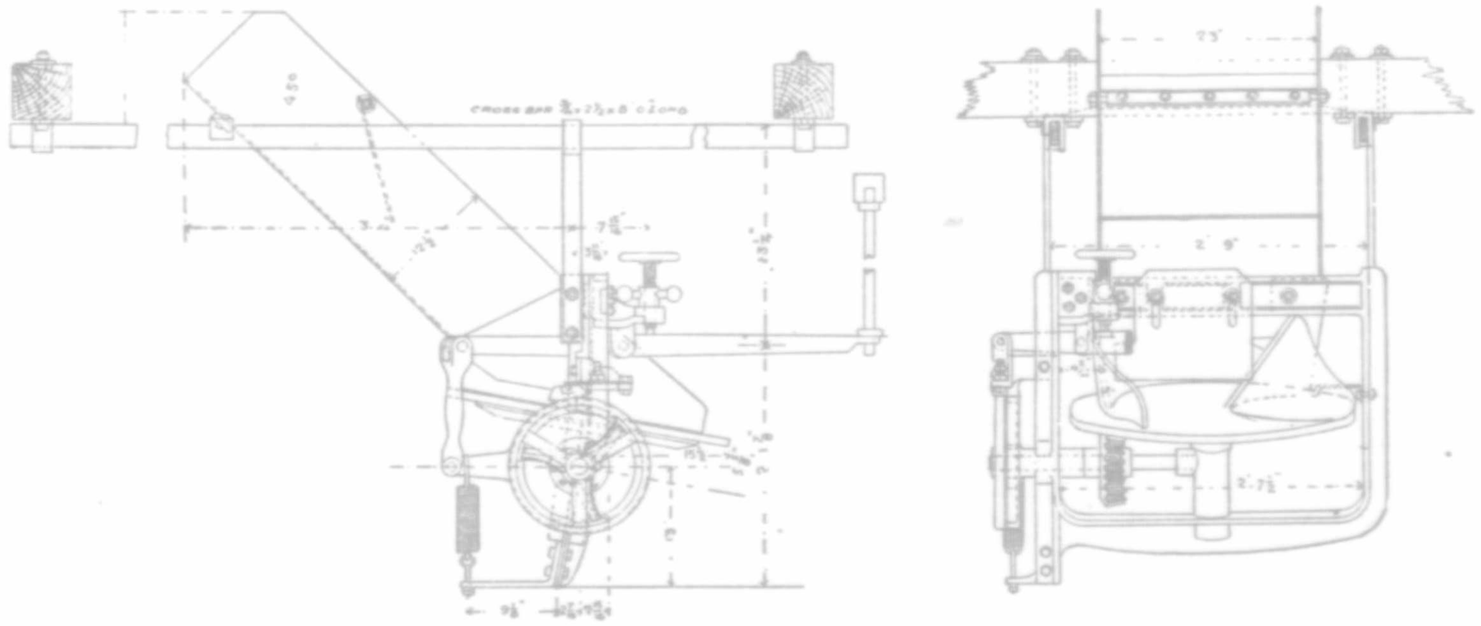
Geological disturbances that are in striking evidence everywhere on Cayoosh Creek. I would infer that quartz mining on this Creek will be beset with many difficulties, which will require careful thought and skilled management in dealing with and overcoming them. The blanket ledge will be in evidence, possibly rich, but suddenly vanishing or twisting out of shape and lost for a time. Wide areas of the numerous small quartz veins and auriferous schists may be worked profitably on the open face or quarry system, and in turn they will be blocked by intrusive dykes of worthless material." Instances have occurred in Cariboo of large pieces of free gold having been found in these small irregular veins or "pockets." Therefore it may be said in a general way of the localities above alluded to, given great areas of these mountain sides, tributary to a confined valley, ideal conditions exist for the disintegration of the soft schists and the concentration of the gold, when the great rush of snow water comes down in the early summer.

The general character of the ore will be dealt with further on in this paper.

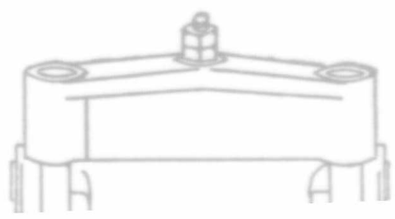
It is generally a well known fact that Cariboo district is commonly reported to have produced some fifty millions of dollars worth of gold from her placers, and Lillooet District some $1,200,000 (chiefly from Cayoosh Creek). Practically all the gold has been taken from deep diggings.

Mr. Amos Bowman, M.E., stated in his report on Cariboo, in the 1888 publication, of the Geological Survey of Canada: "Cariboo has not only been the mainstay of gold mining in British Columbia for many years, but has proved, for its area, one of the best placer mining camps in the world."

Nearly all the above mentioned out-put has been produced by groups of miners working as partners, or so-called companies. The same thing will undoubtedly be done in the same manner in the Klondyke district. In Klondyke, however, the disadvantage exists of having frozen gravel to work through, but in Cariboo the miners constructed large overshot wooden water-wheels, to give power for pumping and hoisting their gravel. The friction gear and general simplicity

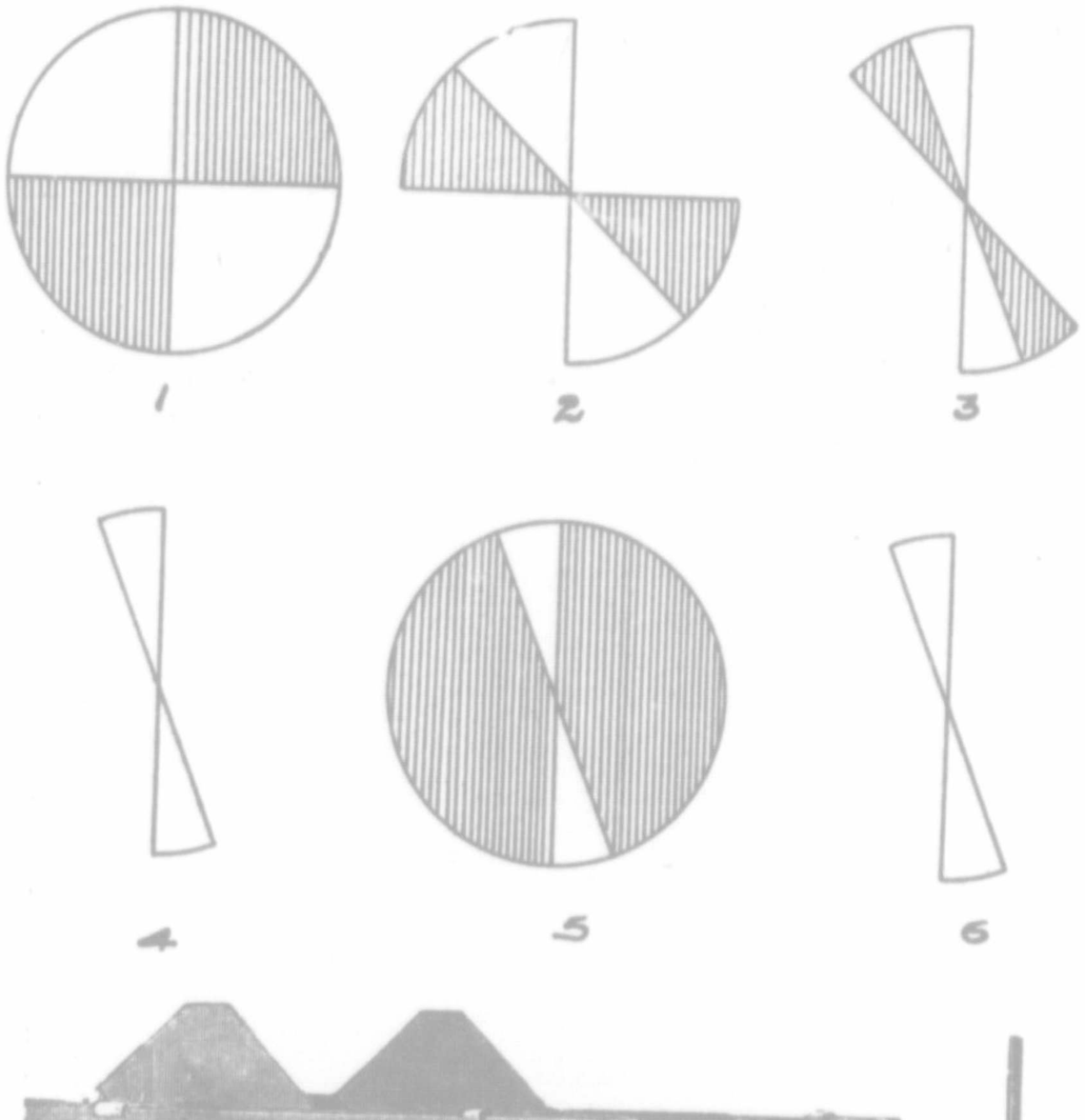


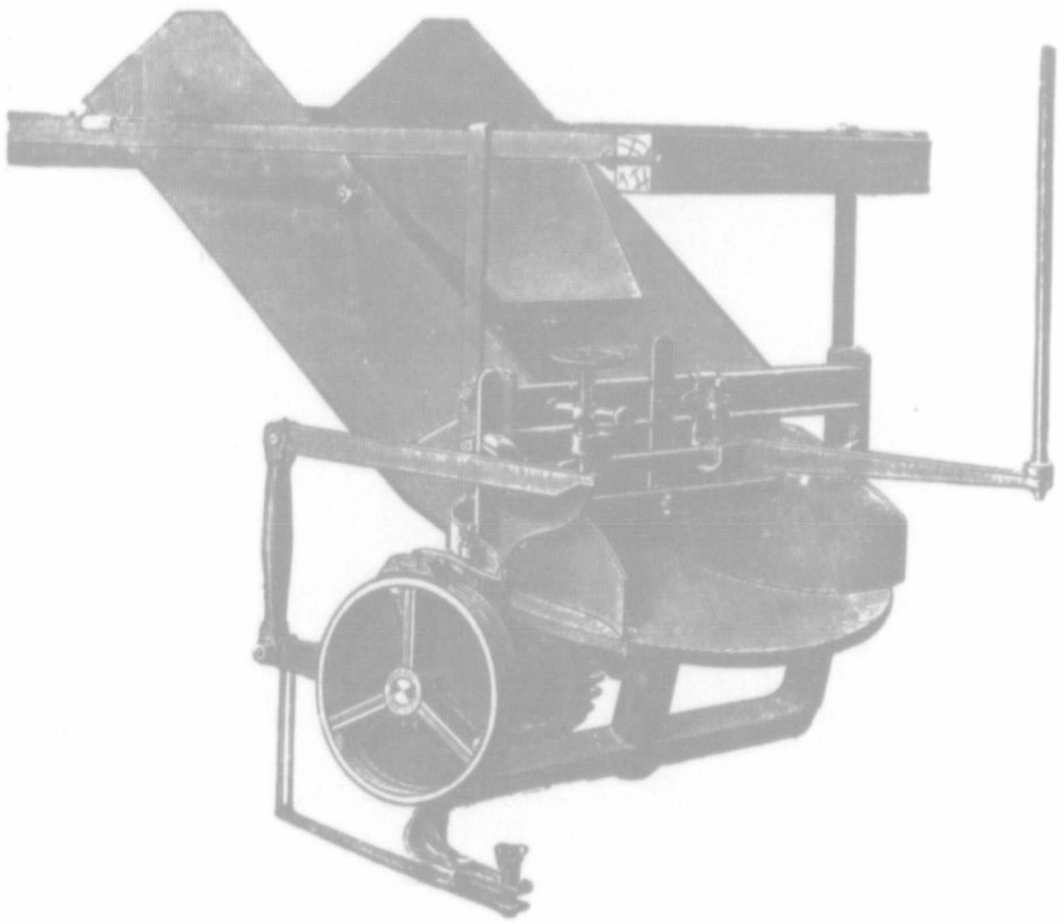
Suspended Challenge Feeder.



Diagram

Typical Samplers





Hanging Feeder
Disk Type

Full sized diagrams traced by pencil on moving belt
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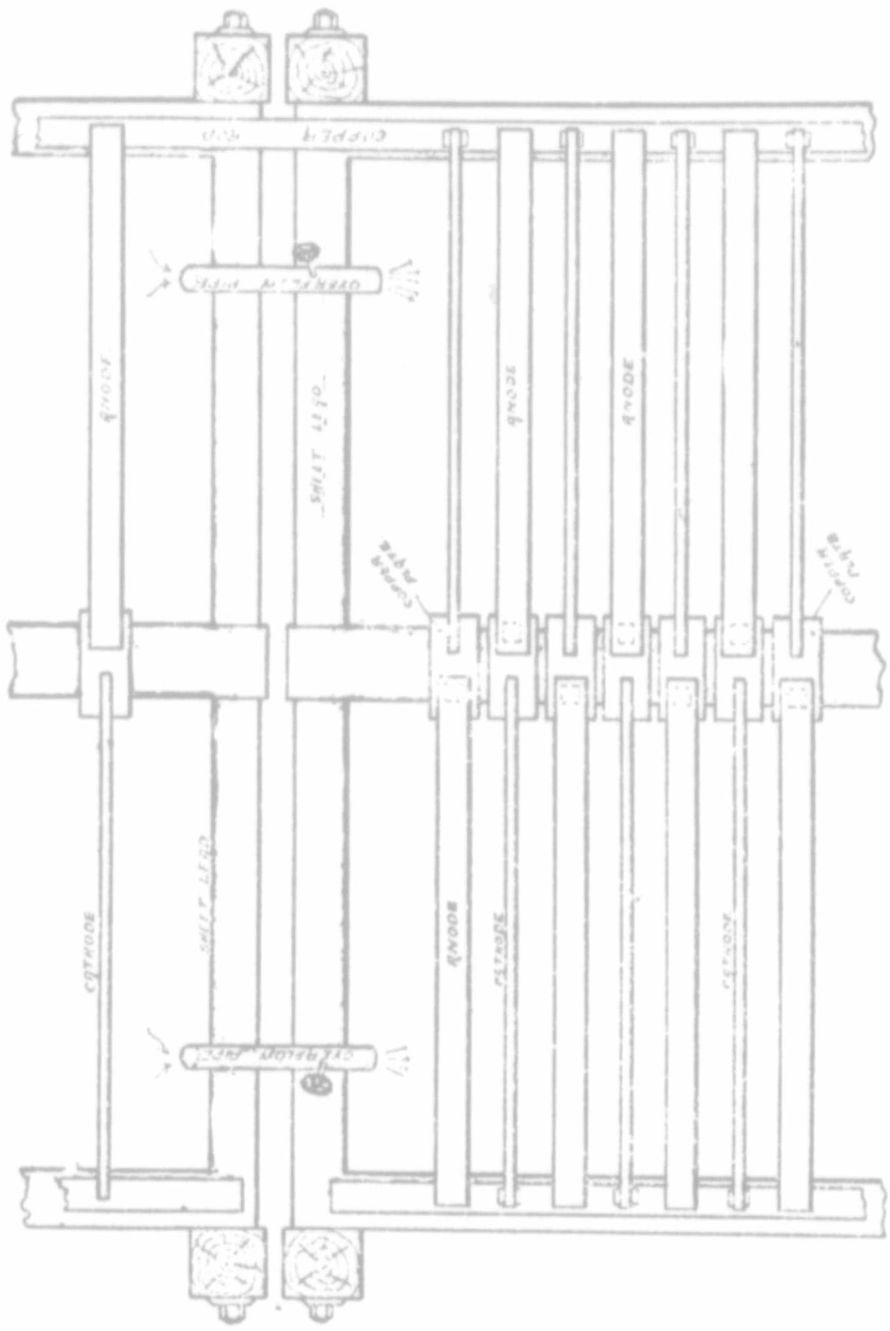

PLATE 2. PLAN OF TANK SHOWING HOW TWO OF THEM ARE CONNECTED BY LEAD PIPES AND COPPER RODS.

P.BUTLER (del.)

Bay occurs the Blue Belle, which is on the mountain between Phillips Arm and Frederick Arm. This is a property containing a low-grade ore body of great width, carrying a little copper. There is also a shoot of $52 ore. The limestones in their course west of Fanny Bay butt up against the granite and are cut by diorites, yielding where this occurs magnetite carrying some copper sulphides. In the line of the Alexandria southward are the Channes mines on Channe Island and Valdez Island. A typical one is the Hetty Green, in the drift of which the ore body occurs as a vein of quartz, which is talcose and yields traces of gold. Along this runs the pay-streak, which is a seam of quartz highly mineralized and carrying $100 per ton. It is 2 to 6 inches thick. The Estero Lagoon runs into the head of Frederick Arm. It lies almost parallel to the Cabelero Channel, and is only separated from Bute Inlet by a narrow strip of low land. Along the north side of this, at the junction of the granite and slate, are several large bodies of low-grade copper ore. A concentrating plant is being erected there by R. C. Forsyth. One mile south of the range of the Alexandria vein lies the Douglas Pine, which has shipped about fifty tons of copper ore. Many other adjacent claims show good prospects. On the west side of Bute Inlet, which is 30 miles long, occur several veins carrying copper and galena. Gold has lately been found on Ramsay Arm; Stewart Island has copper stock-works in hornblendic granite. Coming south from Bute Inlet we find many locations, chiefly on copper ores, as in Raza Island, the Hole in the Wall, Quathiaskl Cove, and others. On West Redonda Island are several locations, most of which show copper and carry some galena. The most notable is the Medora, which has a vein following the line of a diorite dike in granite. Here the veins depend for their value on the presence of galena. This vein has a 3-foot pay-streak yielding 7 per cent. galena and $22 gold. Zinc blende occurs in this and adjacent claims. From the north end of Redonda is a large deposit of magnetite, from which ore was formerly shipped. On Desolation Sound occur other veins which are similar to that on the Medora, and on which work is being done. On Theodosia and Lancelot Arm are several copper deposits at the junction of the limestone and granite. This

The Possibilities for Smelting in B. C.

By Mr. R. A. Hedley, Nelson, B.C.

This subject is a large one, and in undertaking it, I wish the Institute to understand that I do so, because I think it a subject, the discussion of which will benefit the country. My knowledge of the country and my study of its ores, enables me to make certain statements, which I feel myself qualified to make somewhat authoratively. My data, however, are insufficient to handle the subject very thoroughly.

Lead smelting offers some difficulties for any plant possible with present production of the lead producing mines :—

First, its capacity would not warrant the erection of a complete refinery, and without it, lead must be refined in the United States, paying a duty of two cents per pound, while lead in ore pays but one and a half cents per pound. As the bulk of the lead ore shipped is of high grade (over 65% lead) this renders it difficult to compete with the smelters of the United States, as the difference in freight paid is but slight.

To illustrate this point, let us suppose that ore is shipped to the United States carrying 65% lead. Assume freight at $8.00 per ton, duty is $19.50, making $27.50. Smelted here, bullion shipped at same freight rate will pay $5.20 and duty will be $26.00, making $31.20. It would seem then, better to leave a high grade lead ore severely alone, unless the product can be disposed of to better advantage than by refining in the United States, paying duty on the lead.

Suppose a 40% lead ore shipped : it will pay freight $8.00 and duty $12.00, making $20.00. Smelted in this country and bullion shipped, freight will be $3.20 and duty on lead $16.00, making $19.20.

This is in favour of smelting as regards these two items of cost. Now the ores carrying 40% lead or less are as yet but a small item, and generally speaking, carry a high percentage of zinc, or else the gangue is a barren silica, making fluxing costly.

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The firm of M. Guggenheim's Sons of New York is one of the most important factors in the metallurgical market of the United States. They own mines and smelting works in Mexico and Colorado which ship their concentrated output in the shape of copper matte and base bullion to a large central refinery which, situated on tidal water in New York Bay, and with every opportunity to secure scientific and skilled superintendence and labor, is able to treat them most successfully and economically.

The size of this establishment which, although only three years old, is already being enlarged, may be estimated from the fact that it is said to have refined over $50,000,000 worth of metal in 1896!

The plant (plate 1) occupies about 100 acres on the Arthur Kill, and has excellent deep-water docks as well as connections with several main lines of railway, and is thus enabled to receive its raw material and coal with the least possible loss and expense in handling. As the establishment is designed to treat all of the products of its feeders, the work is divided into several main lines, which may be said briefly to consist of (1) copper refining by electricity, (2) desilverzation of base bullion by the Parke's Process, and (3) the parting of doré-silver by the Moebins Processes.

As the processes of the diffierent parts of the establishment are closely dependent on one another, it will be necessary to give an outline of the whole system in order that our special subject, the Moebins Silver-Gold Process, may be fully understood, and as the method of copper electrolysis in use is similar and in many ways closely allied to the Moebins, I shall speak of it in more detail than will be given to non-electrolytic methods.

Before beginning the description of the plant it may be well to explain that several of the most important electro-methods in use in metallurgy depend upon the fact that certain solutions — usually acid — which, under ordinary circumstances have actually but slight power of dissolving metals, have this power greatly increased if a strong current of electricity is passed from the metal into the solution, and that the metal so dissolved is precipitated on plates of good conducting material at the point where the current exits from the solution.

they may be eaten without cooking, and will be found palatable and nourishing.

Another style of package contains, in addition to the contents already described, a second compartment, in which is a cocoa preparation, so that by a simple addition of hot water both solid food and beverage, nourishing and palatable, are easily prepared.

These packages weigh only 10 to 12 oz. gross, and contain sufficient food for a day.

These preparations have been extensively used by the British government in connection with recent military expeditions, *e.g.*, Asbanti and Benin, and by explorers, such as Wellman, Andre and Nansen, with most satisfactory results, and our our own government uses for the mounted police somewhat similar preparations put up by another firm.

It is hoped that this brief paper may tend to minister, to some extent at least, to the comfort of the hard-wrought prospectors, to whom the mining community owes so much, by pointing out the direction whence comfort may be obtained in the matter of concentrated foods.

Notes on the Moebins Processes for Parting Gold and Silver, as carried on at the Guggenheim Smelting Works at Perth Amboy, N.J.

By Percy Butler, McGill College, Montreal.

The term Electro-Metallurgy, originally applied by Alfred Smee to the art of electro-deposition or virtually electroplating of metals, is now more correctly used to cover the various operations of the metallurgical treatment of ores and the refining of metals by electricity. During the last twenty years its practical development, which had been the dream and hope of the early electrician, has gradually but surely grown into an industry of no small magnitude, and the great improvements which have been made in dynamo-electric machines within a comparatively recent period have given a stimulus to work in this field of enterprise which will, no doubt, make it of immense scientific and considerable commercial importance in the near future.

Mr. J. B. Elkington was the first to practically demonstrate the value of electro-metallurgy in the modern sense, by introducing in the year 1865 a practical process for refining copper. Since that time many new ideas developed, through years of experience, have brought this copper process to a state bordering on perfection. The electro-metallurgy of the precious metals did not, however, develop so rapidly, and gold and silver were not successfully "parted" on a large scale by means of electricity until the year 1884, when Moebins of New York invented the process named after him, which process is still in successful use. Eleven years afterwards, or in 1895, he developed a modified method which is now called his Improved Process.

As I had the unusual privilege of spending the past summer in one of the largest and most successful of the modern electrolytic works on the continent, I have thought it advisable to offer a few notes on the methods there in vogue and to describe in some detail both forms of the Moebins Process for parting gold and silver, which are very successfully carried on there side by side.

means of a pressure bulb applied at *G*, and the sample is then returned to the burette for measurement.

The whole operation is then repeated until the volume of the sample remains constant. The difference between this residual volume and the original 100 c. c. represents the amount of carbonic acid in the sample. The quantity of oxygen is found in a similar way by passing the sample from which the carbonic acid has been extracted as above, into the bulb *H* which contains alkaline pyrogallate prepared as follows:

One hundred grains of caustic potash is dissolved in 500 c. c. of water and 40 grains of pyrogallic acid in 500 c. c. of water, and when using two parts by volume of the caustic potash is mined with one part by volume of the acid and put in the other tube.

After carefully noting the amount of air that is left in the burette after the first test the air is passed as before through this solution, the difference in volume giving the percentage of oxygen.

In testing for moisture a fresh sample of the air is employed and it is treated in the bulb *J*.

Had it been possible to obtain mercury to use in the bottle *A* instead of water, determinations of moisture might have been effected by filling with strong sulphuric acid and into it introducing the sample.

On June 6th a test of the air from the surface gave: oxygen, 19.7 p.c.; carbonic acid, 0.0 p. c.; while a sample from under ground gave: oxygen, 18.8 p. c.; carbonic acid, 0.2 p. c.

The following is a tabulated list of the results of the analysis of air taken from the different parts of the mine. It will be noticed that the amount of carbonic acid greatly increased as the season advanced, and while systematic temperature determinations were not made, a general correspondence between the few taken and the air analysis is evident:

The Mineralogy of the Carboniferous.

By Henry S. Poole, Assoc. R.S.M., F.G.S., &c.

Within the geological horizons grouped as carboniferous in the Maritime Provinces there are, in addition to the regular stratified deposits, mineral infiltrations of later ages.

To these references in this paper will be made irrespective of their frequency or economic importance. Little more is proposed than to note the mere presence of certain minerals in the rocks of this formation. Touching the production of those that are found in marketable quantities, statistics are furnished in the Annual Reports of the Geological Survey, and as these statistics are freely supplied to all interested, it would be superfluous to here give extracts from them.

Coals.—The workable beds are all bituminous, no anthracite or smokeless varieties are known, and most of the bituminous seams are "coking" and with but few exceptions yield "coking" coals. A few only are dry and non-coking. Some "cannel" beds are known, but of a value yet undetermined. The variety "jet" occurs with fossil plants showing tissue with mineral infiltration, in strata overlying the well-defined New Glasgow conglomerate.

The bituminous coals in some of the fields graduate into shales rich in hydro-carbons; some of which were, about the year 1860, tested as oil producers, and subsequently thought of for enriching illuminating gas. All the beds so worked were spoken of as "oil coals," and one of the richest was named "Stellar coal," and then "Stellarite."

Dr. How, in his Mineralogy of Nova Scotia, speaks of "petroleum" occurring with the plaster deposits of the lower carboniferous; doubtless these viscous patches were of contemporaneous deposition, so too may have been the smaller blotches of similar material found associated with calcite in the fire-clay beds between some of the coal seams of the Albion section. So far as known none has been analyzed. When freshly exposed the odour of kerosene was strong; in appearance generally like petroleum residue, only somewhat thicker, but in one

PLATE I—Illustrating Mr. John Preston's Paper "The Ventilation of a Deep Metal Mine as Affected by Seasonal Temperature."

will be noted that peas and beans contain nearly twice as much albuminoid or nitrogenous matter as flour. They are easily cooked by long boiling into a soft pulp, which, when flavoured with a little extract of beef, makes a most nutritious and satisfying food.

In this connection, I would like to call attention to a preparation of peas, which is but slightly known in this country, although it is a well known article of food in Scotland. It is known as peas brose meal. It is steam-cooked before being put on the market, and all that is required to make a very toothsome dish is the meal and boiling water.

Finally, let me say that a well known medical authority has stated that life may be sustained for a very long period upon such foods alone as beans and peas.

Leaving the cereals and leguminous products, we find that in the other foods mentioned in our table from three-fourths to nine-tenths of the whole is water. See what this means. When a miner carries a bag of potatoes weighing fifty pounds he is carrying only twelve pounds of solids and thirty-eight pounds of water; of the latter he has in all probability an abundance at his door.

Can this water be in part or wholly removed, and leave the solids unimpaired? The answer is that whilst for various reasons it is not in some cases easy to remove the whole, it is possible to remove a very large portion, and leave the solids in such a condition that when water is again added we may have the food practically in its original natural condition; and moreover it is to be noted that when the water is withdrawn we not only have the food concentrated, but it is also brought into a condition in which it will "keep" for a long period of time, and will not readily spoil as the ordinary vegetable will.

No doubt the great majority of the members of this Institute are familiar with various foods that have been concentrated by removal of a portion of the water they originally contained. Here, for instance, is condensed milk, which instead of containing 87½ per cent. of water now contains only 26 to 28 per cent., cane sugar, of course, being added.

only enterprise to make a success out of the business. About a million and a half dollars had been invested in the enterprise, and from three to five hundred persons were employed at their Sudbury mines and smelters all the year round. In addition to this large expenditure on plant and wages, large sums were expended monthly in freights to Canadian railways, and on machinery and supplies purchased in Canada. Surely it would not be wise to disturb such an important industry. He believed that an export duty at the present time would displace aCnadian nickel in the American market in favor of the mines of New Caledonia. He would strongly urge upon the Government the desirability of appointing a commissioner to inquire into all the facts before committing itself to any definite policy in the matter.

MR. HARDMAN suggested that Mr. Bell's resolution be brought up at another session, as the programme for the afternoon was a long one.

MR. WM. BRADEN (Pilot Bay, B.C.): The placing of an export duty on ores would be a hardship upon the miners of British Columbia, as it would bar out the United States smelters from competition for these ores.

MR. BELL having agreed to postpone further discussion until the Thursday morning session, the matter then dropped.

(The Secretary introduced his resolution on Thursday morning, when it was adopted unanimously on a standing vote being called for by the Chairman.)

THE PRESIDENT'S ADDRESS.

THE PRESIDENT: Gentlemen,—It becomes my pleasant duty, as President of the Federated Canadian Mining Institute, to welcome you to-day to our second annual meeting. To the distinguished representatives of the American Mining Institute, who honor us with their presence, I tender, on behalf of the members of this Institute, a most hearty and fraternal welcome. Never, I snppose, in the history of Canada, did a body of men interested in devising ways and means to aid in the development of their country, and especially the advance of the enterprise in which they hold common ground, meet at a time more opportune, more interesting, and more pregnant with great events, than do we of the Federated Mining Institute to-day. For years we have met together annually in our Provincial Associations to discuss the mineral resources of the Provinces and of the Dominion, to consider and overcome, when possible, difficulties natural, legislative, and technical, and perhaps above all to seek to awaken here in Canada and beyond her borders, an interest in the magnificent mineral wealth of our country. We have had at times reason to be discouraged at the apparent slow growth of confidence on the part of the public, perhaps especially so in the case of the Canadian people, whom we felt never fully appreciated the great importance

tank. By loosening the bolts which connect the plate to the neck piece, the entire mechanism can be bodily drawn out.

The action of the pump is as follows :

The pump being submerged water is supplied through the valve 9, and discharged through the valve 10; compressed air is supplied through the pipe 11. In operation the pump is submerged in the sump up to about the line *a a*. The water flows in by gravity, filling the interior of the tank. As it does so the float rises with the water, and when the tank is full the float engages with a collar near the top of the vertical rod 3, thereby tripping the supplementary valve 4, and through it operating the main valve and admitting air directly to the surface of the water. When this occurs the pressure of the air forces out the water, and as it falls the float falls with it, being finally caught by the stop and guide 5. 5. As the water continues to decend it uncovers the sinker 2 which has its weight, while under water, counter-balanced by a ball weight inside the upper casting. As the water decends below the upper edge of the sinker, the weight of the latter pulls the rod downward and reverses the valves, thereby discharging the air from within the tank and allowing the water to flow in again, when the operation is repeated. It will be seen that the operation of the pump thus depends upon the inflow of water, and should the water supply be restricted the pump will simply wait until the water has risen to about the line *a. a.* before the valves operate. On the other hand if the water comes faster this pause will be shortened, the pump thus accommodating itself to the inflow of water up to the point where the flow of water matches the ultimate capacity of the pump. On the other hand, should the operation of the pump be suspended for a time so that it becomes drowned, it will still work in the ordinary way up to its full capacity until the water level has again been brought down to the line *a. a.* An external hand lever is attached to the valve rock arm in the upper casting, so that in case of need the pump can be operated by hand and thus draw down the water level until the sump is emptied and the entire pump exposed.

tower, is so much greater in the long spans that it counteracts the tendency of the carriage to sink so deeply into the sag of the main cable. In other words, the angle of bend is less, and hence the longer life of the main cable.

If, therefore, the main cables of the twenty cableways on the Chicago drainage canal, had been 2½ in. or 2⅝ in. diameter, instead of 2¼ in., and of milder steel, I do not hesitate to predict that their life would have been more than doubled.

The engineer, however much he may urge to the adoption of elements of large factors of safety, is constantly held in check by commercial considerations.

The rapid wear of the Chicago drainage canal cableways, however, did not prevent them from holding the record, cost of plant considered, as the most economical machines for excavating the rock work of the canal. The cantilever conveyors by all odds the most perfect hoisting and conveying machines on this great work, cost over twice as much as the cableways, and the daily operative expenses were only ¼ of a cent per cubic yard cheaper than the cableways. This is according to the reports of the engineers in daily attendance on the work. One quarter of a cent saved per yard, meant about $1.25 per day, while the interest on the *extra* cost of the plant was $3.00 per day.

The author hopes this paper will be taken as simply recording the development up to date. So many important improvements are now under consideration, that in a very few years he hopes to show the cableway still further in the front rank with labor-saving devices.

to keep the silver from depositing on both sides of the belt the inner surface (of the belt) is automatically oiled.

The belt runs over a roller placed at either end and by means of a series of cog-wheels one of these rollers is connected to a belt run by electric power received from a generator capable of delivering 300 ampères at 150 volts whose power is supplied by a 40 H. P. Westinghouse engine.

Electrolyte.—The electrylyte is the same as that used in the other process, and is supplied to the top tanks from which by means of overflow pipes across and down the rest of the tanks are supplied; the lowest tanks of all emptying into the collecting reservoir.

Electric Current.—Copper rods run along the top on either side of the tank and connect the tanks "in series" circuit. Contact is made with the anodes by means of platinum-tipped contact levers, and the belt is put in circuit by means of silver contact brushes.

Mode of Procedure :—

The fine crystals deposited on the belt whilst moving at the rate of three feet per minute through the solution are scraped off automatically by brushes which, made of thin rush-wood, are fixed in closed boxes placed at one end of the tank. The silver drops into these boxes which are removed and cleaned at intervals, the silver going direct to the melting room. The gold which is left in the diaphragms, is washed and then taken to the gold room for wet treatment.

Gold Room.—Here, all the gold slimes are treated with nitric acid in large porcelain bowls heated by steam (plate 10); after several days treatment it is taken to the melting room, and in the form of a heavy chocolate colored mud is melted in a small furnace, borax being used as a flux. The refined gold thus produced is cast into the form of a brick, three—and sometimes four—of which are obtained weekly: the largest turned out whilst I was there weighed 465.5 ounces of 998.5 fine.

The nitric acid used in the gold treatment is ladled into large porcelain jars and allowed to settle: it is then taken to barrels and the silver in solution precipitated by means of common salt, the reaction being represented thus :—

$$Ag\ NO_3 + Na\ Cl = Ag\ Cl + Na\ NO_3.$$

2nd—The smelting and refining industry would be established on Canadian soil, thus benefitting railways, merchants and laboring classes.

3rd—By establishing a large market for the Canadian coal and coke.

4th—Of the several thousand tons of lead (and zinc) manufactures now being imported, these industries would spring up and thrive in Canada.

5th—The miner would still have the same market and keener competition for his ores, which conditions would not be true under the provision for an export duty on ores.

6th—Consumers would have a home market for the supply, better assuring thereby more equitable prices than now.

Thus is shown the wide range of usefulness such a prohibitory tariff (similar to the one levied by the United States) would have, as being the means of marketing British Columbia lead in Canada, and thereby establishing a highly important smelting, refining and manufacturing industry in Canada.

He therefore moved:

Resolved,—That a committee be appointed to draft and present to the Dominion Parliament and other proper channels, a petition setting forth as it being the sense of this Institute (representing as it does, the mining and kindred interests of Canada) the desirability that an efficient import duty should be placed on lead and lead manufactures by the Canadian Government.

MR. BELL seconded the resolution, which was carried unanimously.

The following committee was then appointed: Messrs. W. Braden, (Convenor), W. A. Carlyle, F. C. Loring, H. E. Croasdaile, J. E. Hardman, Dr. Goodwin and the Secretary.

The meeting then adjourned.

A REPORT ON THE GASPE OIL FIELD RECOMMENDED.

The session re-opened at three o'clock, the President in the chair.

MR. HAMILTON MERRITT presented the following report of the committee appointed at the morning session:

Your Committee begs to report that it views with satisfaction the fact that the various Provincial Mining Bureaus are armed with authority to collect mining statistics and to visit mines and mineral areas; and it considers that the strict enforcement of the law in this regard is of paramount importance.

"In view of further valuable discoveries of oil in the Gaspe Peninsula, it is the opinion of your Committee that in the public interests it is most desirable that the Geological Survey of Canada should continue the investiga-

"The Directors have further to report that 21 drilling derricks have been erected in the neighborhood of the prospecting wells; 14 wells are sunk to the petroleum deposits in the overlying porous sandstone. Eight are pumping wells, with a daily average output of about 8,000 gallons. Six others contain oil which will flow without pumping when connected by short pipe lines to the main pipe line to receiving tanks. It is estimated that the daily output from these six wells will average 7,000 gallons. Seven other wells are in the course of being sunk, and are at the depths of from 900 to 3,000 feet. As these wells reach the oil deposits, the output will be largely increased. Three more new derricks recently erected in the amber oil districts are being fitted with the drilling plant necessary for reaching the oil.

"The Directors, in view of the increased output from additional wells, consider it most important, and in the interest of the shareholders, to construct, at the company's wharf property, a refinery capable of treating up to 40,000 gallons of crude oil daily; and this the Directors have now under consideration. The treatment of only *20,000 gallons daily* of the Company's crude oil would, apart from the by-products, for which there is a profitable market, give a daily production of about 12,000 gallons of refined oil or kerosene, or 3,600,000 gallons per annum, from which a profit of £72,000 per annum could be obtained, and double this sum would be realized if the refinery was worked to its full capacity. As the output of petroleum increases other refineries may be erected with a like result."

Mr. J. Obalski, inspector of mines at Quebec, said he had received no information further than that published in his last report. The Petroleum Oil Trust, Limited, had spent very large sums of money in sinking wells at Gaspe, and he believed some oil had been obtained.

M. E. D. Ingall, A.R.S.M., said the Geological Survey had no information of any such great yield as that reported.

Mr. Bell: In this prospectus great prominence is given to the reports of the Survey, but the statements of Logan, Dr Bell and others were made many years before the operations of the Petroleum Oil Trust were begun. In view of the importance of such an oil field to Eastern Canada, it would seem highly desirable that the Survey make a report upon the territory as early as possible.

Mr. Hamilton Merritt was of the opinion that returns of mineral production should be compulsory.

Mr. Obalski: The Mines Act in Quebec gives compulsory powers.

After further discussion Mr. Hamilton Merritt moved, seconded by Mr. Hardman, that:

"In view of the difficulty of obtaining official information regarding the production of petroleum in the Province of Quebec, this meeting is brought

The zincings are taken u a hopper through which they descend to the ground floor where they are heated in Faber du Faur retort furnaces. These retorts serve to volatilize and condense the zinc leaving the doré-silver which are then heated in concentrators—which are practically water jacketted English cupel furnaces with cement hearths—and finally cupelled and cast into moulds of proper size and shape for anodes which are taken to the Parting Plant ready for the Moebins Process proper.

The Parting Plant.—This parting plant is located in the same building as the lead refining, but recently an extension has been added to meet the growth of business and on account of the large quantity of precious metals handled it is kept cut off from the rest of the establishment. The building, which is made of brick roofed in with sheet iron, is about 35 feet wide and 150 feet long; the floor, except in the melting room where it is made of iron flags, consists of 1½-inch planks resting on masonry foundations and covered with ½-inch asphalt laid hot and rolled evenly. Here, the anodes as they arrive from the lead plant are first weighed and then 'parted' by what is known as the Moebins Process.

(i) *Moebins Process Proper :—*

This consists, commonly speaking, of immersing the anodes—enclosed in canvas bags—in a weak solution of nitric acid through which a current of electricity is passed; the silver dissolves and as the anodes become disintegrated the gold falls to the bottom of the bags whilst the silver, passing through in solution, is deposited on thin silver sheets placed outside which take the place of the cathodes of the copper plant.

Tanks.—The tanks are ten in number and are made of 3-inch pine so bolted together that they admit of tightening to render them water-tight and are divided into six cells. These cells which are about 2 feet square and 2 feet deep, are lined inside with canvass and thickly coated all over with an acid-proof paint. On the top of each tank rests a compound frame-work which can be raised or lowered by means of a windlass.

Frame Work.—The frame-work (marked *F* figs. 6, 7, 8, 9) consists of two wooden frames—one resting on top of the other; to the lower which is stationary are attached two connecting rods, *R*, which support

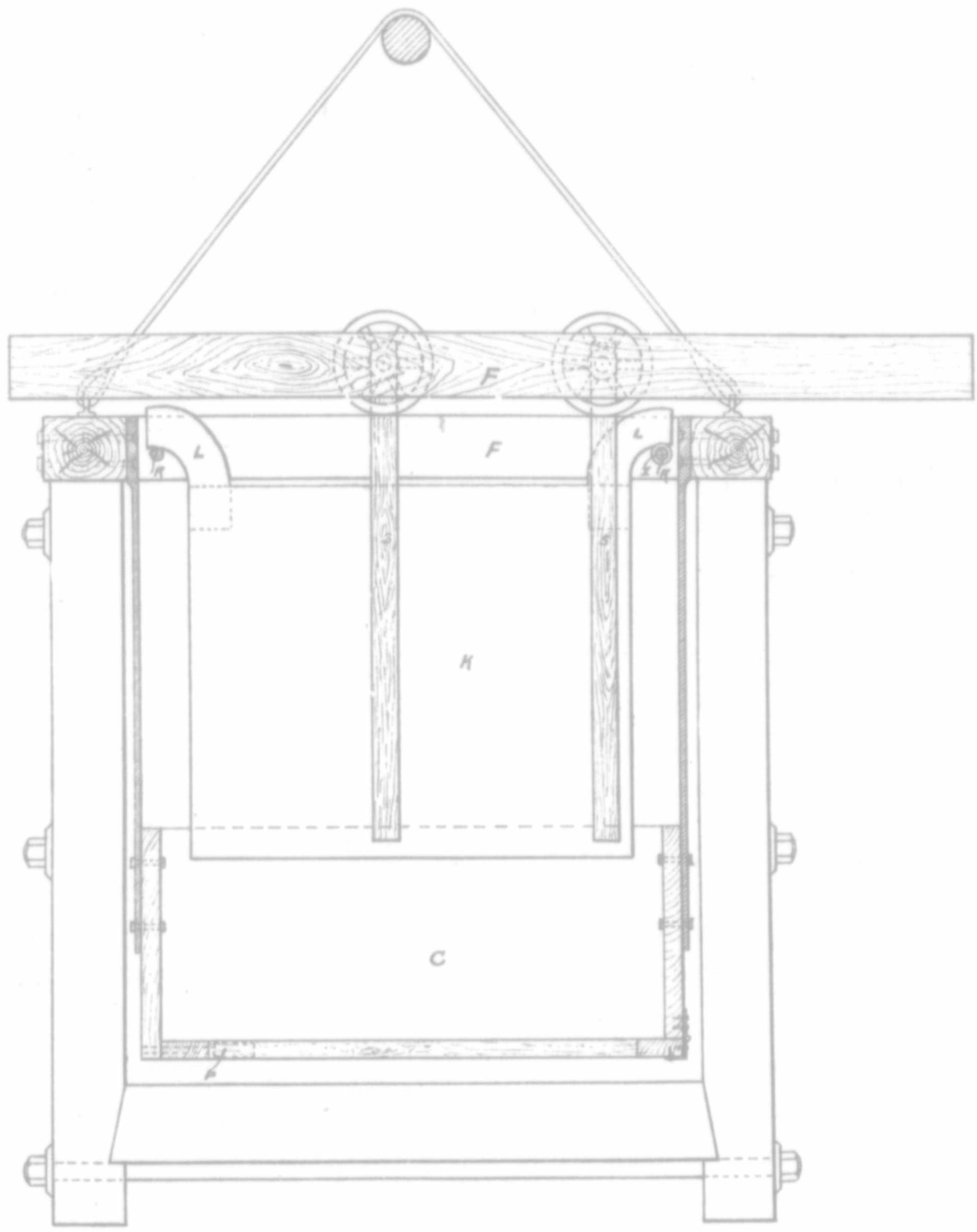


PLATE 7. CROSS-SECTION OF TANK-CELL SHOWING CATHODE.

P. BUTLER (Del.)

present meeting the scheme of consolidation will be fully discussed and probably carried into effect. In union there is strength. If a single powerful institute, carried along somewhat on the lines of the American Institute of Mining Engineers, can better protect the mining interests of this country than can separate Provincial organizations, then we should adopt that plan without delay, because, unless all signs fail, we will shortly have excellent work cut out for us in preserving the good name of our common country, and especially of the interests with which we are so closely identified.

Speculators and boomers, common to every "civilized" country, are not unknown in Canada. It is feared that such men will carry more "steam," especially at the present time, than is safe either for their victims or for the good name of this Dominion. At such a moment this Institute, whilst fully believing in the natural mineral wealth of Canada, can yet afford to act as a sort of "safety valve" to guard against the evil effects of "wildcat schemes" and the exaggerated reports that too often back them up.

Former experiences of mining ventures in Canada, teach that there are other causes than these traceable to Canadian speculators and "boomers," against which the new-comers must be warned (causes which they themselves can very largely control) and to which many of the failures in the past may well be attributed.

First. Undue haste in seeking to force company shares to a premium before the properties which the shares represent have attained proper development.

Second. The expenditure of large sums of money in the erection of permanent buildings and plant before the "mines" at which they are located are properly proved.

Third. Lack of experienced management.

Without presuming to dictate to our English and European friends, the members of this Institute may be permitted to express the opinion that the Canadian mining engineer, acquainted with his particular field of operation, experienced in the ores of this country, and fully understanding the climatic conditions under which the work has to be carried on, is better fitted to cope with and overcome natural difficulties, than, for instance, an engineer who may have gained his experience on the free milling reefs of South Africa. Climatic conditions must be taken into account and due allowance made therefor. Our Canadian climate in many sections of the Dominion precludes as rapid an opening of properties as do the climates of Australia, South Africa, or even Nova Scotia. For quite half the year the prospector is debarred from the mountain tops and those bare portions of the mountain side which are the first to be explored. Necessarily then the time occupied in prospecting such a country as British Columbia must be

sand on the north shore, which may eventually become profitable to handle.

OCHRE.

Is prepared, as in the past, by two companies in the vicinity of Three Rivers, with a production of 1,239 short tons of burnt ochre, which has been used in Canada, or shipped to the United States; 50 men being employed.

COPPER.

Our low grade ores have been worked as usual at Capelton, the product being 36,815 gross tons, of which 29,512 were shipped to the States, a small cargo to England, and the balance used on the spot for sulphuric acid manufacturing; 270 men being employed.

At Harvey Hill some work has been done, but only 20 tons of high grade ore shipped.

Several prospects have been made at a few points in the Eastern Townships, and the time may come when this industry will be one of the most important of this Province, if we take into consideration the numerous good mines actually idle.

LEAD, ZINC AND SILVER.

On the Calumet Island several good prospects have been made, showing the existence of an important mineral belt, containing zinc-blende and rich galena, carrying sometimes 200 ounces of silver to the ton. The Lake Temiscamingue mine has also been worked to some extent, but no shipping done, and we may say that last year's out-put has been 430 tons of zinc-blende, and 5,000 tons of galena; 45 men being employed.

GOLD.

Prospecting was going on in the Beauce district, on the Gilbert, on the Du Loup, and in Dudswell district. There were also some finds reported in the vicinity of Sherbrooke. Besides those we know of, every summer small parties find their living by washing in the rivers of our gold district. Some preparatory work was done last fall on the old diggings of the Gilbert River, and according to recent information, gold in paying quantities has been struck.

Scotia Mining Society, on the representation of the Institute, the obnoxious clauses of the Bill were deleted.

A similar Bill was also submitted to the Legislative Assembly at Quebec during the year, and successfully opposed. In this connection the thanks of the Institute are due to the energetic action of one of its most respected members, Mr. Geo. R. Smith, M.L.A.

British Columbia Institute.

One of the most important and gratifying events of the year in connection with the Institute, was the entrance of British Columbia into the Federation, enlarging our Institute by about 100 members, and making a practically unbroken union from the Atlantic to the Pacific, and one which may now very well merge into greater usefulness in a consolidated and powerful body, representing many working members and a vast amount of capital.

It is hoped that the members will give most earnest consideration to the details of the plan of consolidation which will come before them during the present meeting. The matter is of vital importance and deserves the fullest possible discussion in the most liberal spirit.

National Advertising.

Among other important questions that should be fully discussed is the advisability of impressing upon the Dominion Government the importance of establishing in the great centres of the world, such as London and Glasgow, Canadian commercial agencies, where exhibits of our minerals and other products could be permanently established, and our resources thus brought prominently before investors.

Lacking, as we Canadians do, the advantages connected with direct consulates, it is of almost vital importance that we should have fully qualified commercial men representing us in the great centres. In addition to this we should take advantage of such an opportunity of bringing our natural products to the notice of the world as will be afforded by the international exposition which will take place in Paris in 1900. Canada's exhibit should take front rank on that occasion, and any money that our Government may expend to attain this end will be well invested.

Foreign Trade Arrangements.

It is a matter of pleasure to note that the Federal Government has at present under consideration a project for the establishment of a line of steamers to ply direct between Canada and France.

The range of Canadian products for which a trade could be found in France, is to-day much greater than when the treaty now existing between the two countries was entered into. Many of our products are totally un-

medieval and modern uses, but why a modern concentrating plant has not been installed in a mine with possibilities like Tennycape, is the hardest of all to explain.

A mine that has been known to the world for over 25 years, and whose ores have sold in the United States market as high as $140.00 per ton, and whose average price for the past 20 years would be not less than $80.00 per ton, and whose product is practically inexhaustible, all high grade, crystallized ores, and should be produced at a cost not exceediug $15.00 per ton—why it still remains the same as twenty years ago, and has never had a plant with which its ores can be mined and treated with any degree of certainty or workable profit, to me is a mystery that I must leave for others to explain.

Immediately underlying the gypsum is a thickness of about 60 feet of brecciated limestone, known to the miners as "the soft ground." In this the manganese occurs in round boulders or pockets, varying in size from a few pounds to the famous "Dykeman pocket" of a thousand tons. When these pockets are taken out not a perceptible trace of manganese can be seen. Under this is a massive limestone, what the miners term "white rock," about 75 feet thick, colour light grey, and its solidity is such that in drifting or sinking in it very little, if any, timber is required. In this the ore occurs in lenticular veins, with well defined sides having a regular dip and strike varying in thickness, sometimes pinching out to a mere nothing, but always leaving a "leader" to follow.

Under this, and separated from the Devonian quartzite by a few inches of clay, is a shaly limestone with an average thickness of 15 feet, carrying numerous regular veins from the very smallest up to five or six inches in thickness.

This, possibly, is the most valuable division of the three. It has been estimated that if the entire belt was taken out and concentrated it would yield from 15 to 20 per cent. of the very best pyrolusite; and yet it has never been worked to any extent, simply because Tennycape has never had a concentrating plant that could profitably handle such rock.

Nothing but the very crudest machinery has ever been introduced in the mining of manganese in Nova Scotia. A pick and shovel, a hand drill and cobbing hammer, with a wheel-barrow and hand jig (which no doubt the ancient Egyptians also introduced) comprises the plant necessary to the manganese miner of Nova Scotia. What practically has not been saved at the cobbing table goes to the waste dumps, which are an accumulation since 1861. These dumps have been estimated to contain 50,000 tons of rock which will yield 10 per cent. ore. They have paid well, after a season of rain, to hand-pick them. Verily, verily, there has been sufficient wasted in our mines to thoroughly develop them.

We might write with satisfaction on the geological position of our manganese; its modes of occurrence; its distribution; its ancient,

in one piece. The grade is 1½ inches per foot. Every two apron plates deliver their pulp to one tail plate which is of the same size as aprons, and has the same slope. The inside plates are cleaned twice a month and the apron and tail plates are cleaned and dressed every morning. There are the usual traps and other devices for collecting mercury and amalgam which has escaped the plates. These are very essential in this region, where the enormous capacity of the mills and the quick treatment render mercury and amalgam very liable to be carried away in the tailings. The traps are cleaned out every two weeks when the accumulated pyrites is treated in a pan to recover the mercury and amalgam. How important these traps are, may be gathered from the fact that in a 60 stamp mill there is recovered every month by this means 90 ounces of amalgam and 184 ounces of mercury which previous to their introduction were entirely lost. In these mills an effort is made to keep the battery water at a temperature of 70 degrees Fah., as this gives the best results in amalgamation. To accomplish this in cold weather the exhaust steam from the engine is passed through the supply tank. This gives an opportunity for the introduction of oil and grease into the battery water, and this must be carefully guarded against. The ore in this district carries from 3 to 5 per cent. of concentrates of which only two per cent. are saved. This is accomplished on shaking tables similar to those in use in Gilpin County. The number of them is, however, very inadequate to the large amount of pulp to be treated, there being only 8 machines for 120 stamps. In this respect, therefore, the Black Hills region is not what it should be, but in the automatic handling of the ore and cheapness of milling it is an object lesson to the world.

Grass Valley, California Practice.—Grass Valley in Nevada County, California, is the leading gold producing region in the State. Since 1851 this district has been a large producer of gold, and at present the average yearly output is about $2,000,000. A description of the North Star mill, containing 40 stamps, will give a good idea of the whole district. The ore consists of quartz veins in exceedingly hard dioritic rocks and it is very difficult to crush. As it comes from the mine the ore is dumped on grizzlies which permit all material less than

$1,525,000, came from the alluvial deposits. A description of the Star of the East Mill which was erected in 1895 will, perhaps, give a good idea of the most modern Australian practice. It consists of 60 stamps arranged in two sections of 30 heads each. The stamps weigh 1,000 pounds, the drop is from 8 to 8½ inches, and the speed is 73 drops per minute. The centre stamp in every five, drops half an inch less than the others. This is said to give a better splash of pulp and thus increase the capacity. The order of drop is 5-3-4-2-1. The depth of discharge is two inches with new dies, but increases to 4 inches as they wear down and even more if the ore is unusually refractory. The ore assays from 13 to 17 pennyweight per ton, and the concentrates, of which 3½ per cent. are saved, run $75 per ton.

This region is very much behind America in the absence of rock breakers and automatic feeders. The feeding is done by boys and is of a very uncertain and irregular nature. There is no doubt that the cost of putting in rock breakers and feeders would soon be saved by the lessened expenses and the greater capacity arising from the regular feeding of smaller material: In order to keep the copper plates free from tarnish, a bucketful of lime is added to every 10 stamps every few hours. Two ounces of mercury are added to each mortar every hour. There are no inside plates used. The amalgamating tables are made of plain copper, having a grade of ⅞ inches per foot. At their lower extremity there are three mercury wells, two deep ones and one shallow one. These serve to catch escaping mercury, but the amount of gold they recover is very low. Below the wells are the blankets. The materials retained on these are collected and placed in a heap with the addition of lime and left to stand for two days; they are then added to the battery again. From the blankets the pulp passes on to shaking tables of which there are 8 for 60 stamps. These tables are of an inferior type, and do very poor work. The older mills in this district use mercury wells in preference to plates, and they actually do better work, for the ore is peculiarly suited for them, being very free milling, and carrying only a small per cent. of sulphurets

This district as a whole is away behind the times in regard to the handling of the ore — the crushing and feeding and concentrating.

some foot-note of explanation afforded that will show to the uninitiated that this section of the mining industry approximates very closely in value and in national importance to the record credited in the report to the more "precious" metals.

In considering this question of comparative values it must be remembered also, that the Statistical Department of the Geological Survey has to depend upon the Customs Department for data as to values of iron and steel imported into the country, and these appear in the reports at the actual invoice prices of the finished article, affording a very unfair comparison as against the value of the Canadian industry, credited simply with the value of the iron ore consumed.

To review the different sections of mining separately, in so far as we have returns at hand for 1897:—

COAL.

The coal areas of the Dominion are estimated at 97,200 square miles, not including areas known but as yet undeveloped in the far north. There are, first, the coal fields of Nova Scotia and New Brunswick; second, those of Manitoba and the North-West Territories; and, third, those of the Province of British Columbia. A very complete description of the Canadian coal areas can be had on reference to the *Canadian Mining, Iron and Steel Manual of 1897*. The operations for 1897, so far as reported by the Bureaus of Mines and the various companies interested, show as follows:—

In Nova Scotia, coal raised	2,345,138	tons.
New Brunswick	6,000	"
Manitoba and North-West Territories	297,000	"
British Columbia, Vancouver Island Collieries	798,458	"
	3,446,596	tons.

The production of coal for 1897 may thus be put down at a value of at least $7,000,000.

The ontput for 1898 will be increased by the coal raised by the Crows Nest Coal Co., whose colliery in the East Kootenay is now being opened and equipped with an entire electrical power plant, the first complete electric installation in Canada. The importance of the coal industry to inter-provincial trade, however, is the paramount one.

Quoting from the figures given in the *Canadian Mining Manual* of 1897: "In 1894, 49 steamers, 18 sailing vessels, and 2 barges were employed in the St. Lawrence maritime trade, when $369,688.00 were distributed for labor in transportation, trimming cargo, handling, &c., and $55,556.00 for wharfage, and $55,333.00 for pilotage, in all a total for these three items of $480,577.00."

shaking tables, locally called "bumpers." They are a peculiarity of Gilpin County practice, being a variation from the ordinary Rittinger pattern. One of these machines treats the pulp from 15 stamps. The speed varies with the percentage of pyrites present, but averages 130 strokes per minute. The concentrates carry from 1 to 1½ ounces of gold to the ton, but are not treated in the mill, as smelters are near at hand, where they are sold for 95 per cent. of their assay value, minus the smelting charge, which varies from $5 to $8 per ton, depending on the demand. The amount of water used is from 1½ to 2½ gallons per stamp per minute, being exceptionally low owing to the small capacity of the mill, and the steep grade of the tables. From this description it will be seen that the object aimed at is to keep the pulp in the mortar for a comparatively long time. This is rendered necessary by the very refractory nature of the ore, which carries more heavy sulphides than any other ore treated by plate amalgamation in the chief mining centres of the world. A rough analysis of the ore gives the following:— Metallic sulphides, 10 20 per cent.; quartz, 15-20 per cent.; vein matter, other than quartz, (chiefly felspathic material), 60-70 per cent. Of the metallic sulphides, those of iron and copper preponderate. On this ore, therefore, on which the quick drop, shallow discharge methods utterly failed, we find the peculiar practice of Gilpin County eminently successful. The richness of the ore may be obtained from the following, which represents the out-put of one mine for 1890:—150 tons of hand picked sulphurets, averaging $92.79 per ton; 1,376 tons of concentrates, giving $15.06 per ton, and 10,321 tons of mill stuff, averaging $7.42 per ton net. The extraction is very good considering the character of the material, and averages about 85 per cent., of which 25 per cent. is obtained from the concentrates. In this ore the gold is in a very finely divided condition and is intimately associated with the pyrites. From this it will be seen that fine crushing is absolutely necessary. That the slow drop and deep discharge is particularly suited to this class of work may be gathered from the fact that over 70 per cent. of the material issuing from the 50 mesh screen will pass through 100 mesh. In this fine material the percentage of pyrites is much higher than in the ore. This is accounted for

The advantages of open pit mining have been dwelt upon to such an extent, that no argument will be made in defence of the plan. The annoyance incident to underground mining, where the excessive cost has to be met of timbering, shaft sinking, pumping, or the largely increased cost of breaking the ore (this one point sometimes makes a saving of 80 per cent.) the extra cost of blasting, makes the idea of open pit mining extremely popular.

The cost of removing the overburden varies much with the nature of the ground, especially with reference to the point of dumping the waste. It frequently happens that a cableway may be applied in such a way as to span the opening, and carry back the waste to a depression so that the overburden may be delivered directly to its dumping ground.

The cableway must also be considered as superior to any method of working with incline railways, as is frequently done where the pit is shallow. In whatever way the incline railways are put in, or railways in the bottom of the mine, they are sure to cover a certain amount of ore. A blast is certain to throw considerable material on the tracks, the cost of removing which must be considerable.

The cost of loading the material into the shallow skips used on the cableway makes a very appreciable saving over the cost of loading into cars. The records of the Chicago Drainage Canal show that while laborers sledging and filling into cars averaged only 7 to 8½ cubic yards per man, per day, in filling into skips for the cableways the laborers averaged from 12 to 17 cubic yards per day. The extraordinary difference, however, made on the Chicago Drainage Canal would not be so great, were it not for the fact that considerable of the stone on the canal had to be sledged before it was small enough to be lifted into the cars. In mining operations where the material breaks up easily under the hammer, this difference would not be so marked.

The cableway has been applied for stripping coal mines in Pennsylvania. Two cableways, one for handling lime rock from the quarry to the crusher, and the other for handling iron ore have recently been installed in Alabama, U. S. The latter hoists and conveys the iron ore, which lies in a thin layer near the surface, from the mine to the crusher.

tion by the Sulman-Teed bromo-cyanide process. One of the most successful companies has undoubtedly been the Mikado, which yielded a fair profit to the English shareholders upon the first fourteen months operations, and it is said will pay a handsome dividend on its production in 1898. Other producers of bullion last year were the Foley, Olive, Sultana, Regina, Hammond Reef and Crystal. A number of new mills have been put into operation, so that the output for Ontario will no doubt show a considerable advance in 1898. There seems to be no question but that Ontario is rich in gold, and only requires thorough investigation and development.

A matter of note is that important indications of gold bearing quartz are found in the Sudbury district at Lakes Wahnapitae and Tamagaming. This district, already famed for its deposits of nickel ore, is said to be very promising in gold.

Silver.

The total ontput for 1897, 5,558,446 ounces, valued at $3,322,905.

These minerals continue to be the principal source of dividends in British Columbia, substantial profits having been realized by the Slocan companies, amongst others by the Payne, Whitewater, Reco, Ruth, Slocan Star, and the Hall Mines, Limited.

In Ontario, it is worthy of remark, that a number of mines in the neighborhood of Port Arthur have been reopened.

In Quebec important operations were begun, and shipments made from Calumet Island, Ottawa County. A valuable deposit of argentiferous galena has also been discovered in Brome County, on the shores of Lake Memphremagog, which we learn is now being investigated.

Lead.

The total production in 1897 amounted to 39,018,219 lbs., of a value of $1,396,853.

Asbestos.

The Geological Survey report gives the output of asbestos and asbestic as 25,262 tons net, valued at $324,700.

The shipments reported by the Quebec Central Railway for the year 1897 show :

Black Lake	1,020,425 lbs.
Thetford Mines.....	16,110,135 lbs.
	17,130,560 lbs.=8565-560 net tons.

The Asbestos and Asbestic Co. of Danville, Que., formed in 1896, largely of English capital, have established, and in 1897 largely extended

Gypsum.

The output for Nova Scotia and New Brunswick combined, reached 150,000 tons.

Total productions for Canada in gypsum reached 239,691 tons.

Other Industries.

The other industries, such as oil and natural gas, salt, graphite, and building materials, show no specially new features, and returns of same are not yet to hand.

On the whole the progress shown in the various mining industries of Canada during 1897, is more than encouraging. As a people, we are on the high road to a successful development of the natural mineral wealth of our country, and to national prosperity.

In connection with the actual work of this Institute during the past year:

Publications of the Institute.

We may be permitted a certain amount of pardonable pride in the publications of our Institute, which we think compare favorably with those of any similar mining association of its age and advantages. Our last volume contained some twenty-nine papers, of service not only to active operators, but as a volume of reference to those interested in the mineral resources of the country. An important feature is the educational nature of these publications, which are now placed in the hands of the studens of McGil University, and of the different mining schools, at a merely nominal charge, representing indeed an actual financial loss each year to the Institute, but which it is hoped will finally prove of permanent benefit to the whole country. Exchanges of publications are kept up regularly with Associations of a similar character throughout the world, and through this system a knowledge is spread regarding the rich mineral resources of Canada.

Grant to Publications.

It was very necessary, in view of the somewhat restricted financial condition of the Institute, to devise better ways and means for carrying on our work, and it was hoped at the commencement of the past year that some assistance towards the publications might be obtained from the Dominion Government. This has not yet been granted but it will be brought again to the attention of the Government, and we have reason to believe that the outlook for obtaining State assistance is hopeful. This work is, to a large exten, a labor of love on the part of the members of this Institute, and whatever good is obtained thereby accrues to the country and the Dominion as a whole, and the expense should theretore, we think, be borne—at least in part—by the Government of the country.

quantity of mica well adapted for electrical purposes, of which a good part has been sold in Canada and in the United States. It is very difficult to give exact figures regarding this mineral, on account of the numerous qualities and sizes, representing as many different prices, but according to the best informations, I estimate that about 200 short tons of thumb trimmed mica have been taken out, 90 men being employed. I understand that the demand is less than previously, on account of the high duty in the United States, and that only the best grade of electrical mica is wanted.

No mine of white mica was worked last summer.

PETROLEUM.

Prospecting and boring are going on as usual in the vicinity of Gaspe. Last season, some excitement prevailed on account of a larger quantity of oil being struck in one of the wells which, in fact, has been flowing for some time. Nevertheless, nothing very definite has yet been ascertained. About 30 wells have been bored, some of them having struck oil in greater or less quantity. I am confident in the future of this district, as an oil bearing one, but the country is large, and its stratigraphical structure not very well known.

We don't know that any shipment of oil has been made, so far except some barrels as specimens, and in fact, there is not yet regular pumping done.

FELDSPAR.

In the vicinity of East Templeton Station, a quarry of feldspar has been worked with 15 men, for the whole season, the quantity shipped being 1,260 short tons. The material appears to be of a good quality, and is sent to the United States, for ceramic purposes.

A few other deposits, some of them connected with white mica mines, exist, but are not worked.

KAOLIN.

I want to make a special mention of the discovery of this material, in our Province. In 1894, I visited the township of Amherst (Labelle), and my attention was called to a white material which, after testing, I was able to pronounce to be a genuine Kaolin. The indication was

The hoisting drum is independent of the other, and, being of the same diameter, winds at the same rate of speed, and keeps the load at the same height, if so desired. This drum has a band brake by means of which the load can be sustained. The reversing lever, friction and brake levers, are all brought to a central position, so that the operator can work all of them in one position. The load may be hoisted or lowered at any point under the line of the cable, and the horizontal motion is given to the load at any height to which it may be raised.

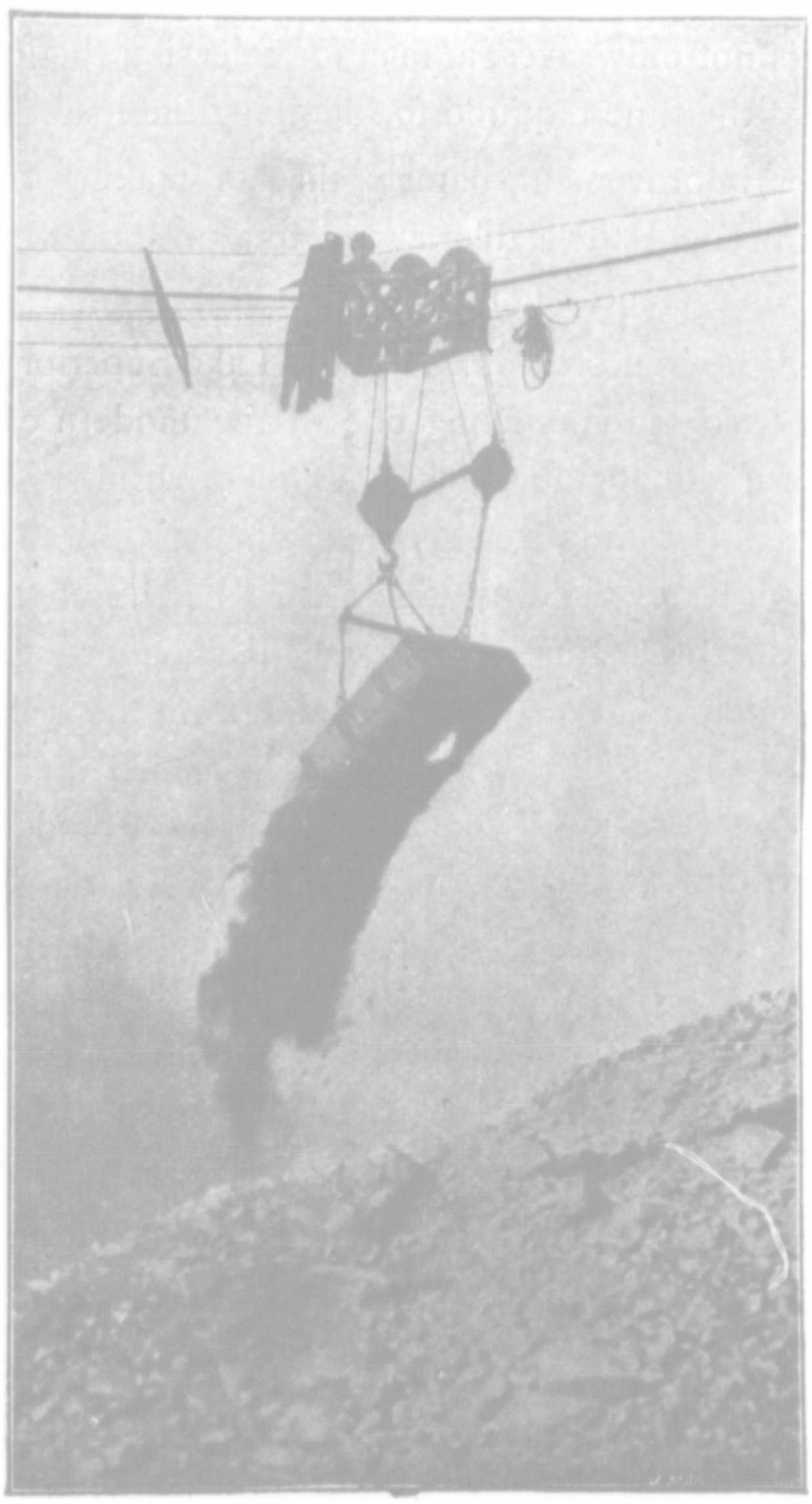


FIG. 7.—Aerial Dump.

district were designed for fast drop and shallow discharge and were very successful in treating the oxidized material from the upper portions of the lodes. Copper plates and riffles containing mercury were used to catch the gold, 70 per cent. being about the average extraction. When the oxidized zone was passed the ore became less quartzose and the percentage of pyrites increased considerably. Then a difficulty arose; the percentage extracted began to diminish from 70 to 50 and finally down to 30. Most of the mills were forced to shut down, and the end of Gilpin County's prosperity was thought to be at hand. But in the meantime, men with money and experience were working steadily trying to solve the all-important question. As a result of their efforts there arose that practice which belongs peculiarly to Gilpin County. This may be summarized briefly as the slow drop, deep discharge system. The stamps usually run about 550 pounds and make from 1¼ to 1½ revolutions with every drop. The speed is from 30 to 35 drops per minute, and the order of drop is 1-5-2-4-3. The depth of discharge is thirteen inches when the dies are new, but increases to 15½ as they wear down. The shoes are of ordinary cast iron 5½ inches deep and 8 inches in diameter, weighing about 85 pounds. The dies are 3½ inches deep, slightly larger than the shoes, and weigh 45 pounds. The shoes wear away at the rate of 11.3 ounces per ton of ore crushed, and the dies at the rate of 4.5 ounces per too. The capacity of the mills in this district is approximately 1.14 tons per day of 24 hours for each stamp. The screens used are burr slot No. 1½, which is equivalent to 50 mesh wire cloth. The screen surface is 4½ feet by 8 inches, and their average life is 81 days. The amalgamation is done both inside the mortar and on copper tables. Mercury is added regularly to the mortar, about one thimble-full every hour. The mortar contains both a back and front plate, made of plain copper. The former is 12 inches wide and 4½ feet long and is placed at an angle of 40 degrees. The front plate is 4½ feet long and 6 inches wide and set almost vertical. The amalgamating tables are of ordinary copper made in one piece 12 feet long and 4 feet wide, having a grade of 2⅛ inches per foot.

found most profitable in operation, first, to allow the bucket to dig a trench to bed-rock, then the material at either side of the trench was washed into the trench by an hydraulic giant. Had the tail tower, however, been as portable as it will be when it is mounted on wheels, there would be no necessity for the hydraulic work, although it is a question as to whether the fine gold resting on the bed-rock, cannot be washed cleaner in this way, than it can by any other method. With this method of mining, gold in pockets is easily recovered.

The labor force around this outfit consists of a lever-man, fire-man, signal-man, hopper-man and rigger. The pipe force, when the pipe

FIG. 11.—A Drag Bucket.

Manganese occurs here in Nova Scotia in the manganiferous limestone of the lower carboniferous series, which extends in an eastward or westward course through Hants and Colchester counties, and is also found in Kings, Pictou and Antigonish counties, as well as in the Island of Cape Breton. It overlies the Devonian quartzite which, in Hants county, skirts the southern shores of the Minas basin from the Avon river on the west to the Shubenacadia river on the east, and continues on, crossing the river about five miles from its mouth. It is faulty and tortuous. It is several hundred feet in thickness, and is overlain by large beds of gypsum.

The principal deposits in this belt are the Tennycape Manganese Mining Co's (including the Tennycape mines at Tennycape, the Feuchtwanger and Sturgis mines at Pembroke), the Churchill mine at Walton, and the East Mountain mine in Colchester. There are other minor deposits which have had but little development, as the Parker property at Tennycape, the Wm. Stephens property at Walton, the Scott property at Minasville, and the Cheverie property at Cheverie.

The Parker property and the Churchill mine are not on the regular belt, but are outliers showing a displacement of from a quarter to half a mile.

Through Hants county, a distance of 40 miles, the outcrops are numerous and easily traced. The deposits of manganese have their particular zones and are not disseminated through the whole length of the belt, as miles of the manganiferous limestone may be found not carrying any appreciable amount of manganese.

Having made a special study of the manganese deposits of this province, and having been associated with Tennycape for several years, allow me to describe its particular formation; and what is true at Tennycape is also true of other parts of the same belt.

The manganiferous limestone belt here varies in thickness from 150 feet to 300 feet, and is subdivided into three distinct divisions. In each division the occurence of manganese is quite different from the others.

The accompanying figure shows the relative position of each subdivision.

The Cableway in Open Pit Mining.

By SPENCER MILLER, C. E., New York.

The problem of Open Pit mining, whatever the mineral may be, consists of: First, the removal of the overburden; second, the removal of the ore and waste.

The overburden is usually a waste product and must be taken off at the lowest cost per ton, and the value of the appliance applicable for work of this sort depends largely upon the character of the ground to be stripped.

The advantages to be derived from a machine to hoist and convey loads, using a suspended cable as a trackway, have been appreciated by engineers for a hundred years or more, but it has remained for the last few years to see any practical development of such a machine, and the modern "cableway" stands to-day as the result of such development.

The wire rope tramway, a device which conveys loads, but has no capacity for hoisting, is not considered in this paper.

The first practical form of cableway, called a "Blondin," was put into use about 1860, in the slate quarries of Pennsylvania. (See Fig. 1.) It consisted of a cable suspended on an incline of about 25 degrees. A cable carriage operated on this cable, and a fall block, adapted to rise and fall from the cable carriage, and a hoist rope, which performed the double function of hoisting the load to the carriage, and conveying the carriage up the inclined cable. These cableways fitted the particular conditions that existed in the slate quarries so perfectly that they were frequently duplicated., and are still to be found in slate quarries, with very little improvement.

Some experiments were made to improve the cable carriage, so that it would work on a flatter angle, and the "Harris carriage" is undoubtedly the best example of its kind remaining in the market. It works between stops, fixed at top and bottom of inclined cable, and

the electrodes underneath which hang the collecting boxes—one for each cell—also rigidly attached to the lower frame; the upper frame, which moves on wheels across the lower by means of an eccentric, has attached to it strips of wood (*S* plate 9), which hang down—two on either side of each cathode—into the electrolyte and act as scrapers to keep the deposit on the cathodes of uniform thickness.

Electrodes.—In each cell there are 25 electrodes, consisting of 5 cathodes suspended alternately with 4 canvas bags in each of which are 5 anodes. The cathodes, (*K* plate 9) which are about 18″ × 15″ are made of thin sheets of pure silver to the two upper corners of which are attached curved lips, (*L* plate 7) which rest on the copper rods, *R*. These sheets before being immersed in the electrolyte are painted and coated with graphite to prevent the silver deposit from adhering too strongly to them. The anodes (*a*, plate 8) are, as stated before, made of doré-silver about 3″ × 12″ and ½″ thick, and enclosed by canvas bags, (*B* plate 8) are suspended by means of platinum spring hooks, *h*, resting on copper frames, (plate 6 *f*) which in turn are supported by the copper rods *R*. The canvas bags are simply wooden frames about 20″ long by 1″ wide and 15″ deep, over which is stretched canvas cloth; these bags fit inside the copper frames (*f* plate 6) one end of which is insulated by rubber from the connecting-rods The connecting rods, (*R* plates 6, 8, 9) are about ½″ in diameter and run the whole length of the tank connecting the six cells in 'series' circuit. Plate 7 shows one lip of the cathode resting on rubber insulator, marked *I*.

Electrolyte.—The solution—known as the electrolyte is prepared in vats situated under the floor and is pumped up to distributing reservoirs placed overhead from which the tank cells are supplied through a rubber hose with porcelain stop-cock. It is made by dissolving granulated silver in a weak solution of nitric acid (1:30) and after further dilution copper is added to start the deposition. When normal it contains about 0 13 per cent. of free acid with 4 to 5 per cent. of copper and about 12 ozs. of silver per cubic ft. of electrolyte.

Electric Current—The strength of the electric current varies between 200 and 240 ampères depending on the number of tanks in circuit and the strength of the solution; whilst the electromotive force required for each cell varies between 1·25 and 1·6 volts.

of developing the natural mineral wealth of the country, and thereby strengthening and building up every other industry and interest in the community, but the year 1897 came in, and has proved a year that, nationally speaking, will pass into history, for Great Britain and her colonies as a year of marked triumphs. The expression of kindred within the empire, born of that wonderful gathering in the streets of London last June, when the outposts of the British people came together to honor the aged and beloved Sovereign, has found, for our advancement, a practical rallying cry in "Canada and the Klondyke." Within the next few months Great Britain will pour into this, the first of her colonies, thousands of her sons, and a vast amount of capital. The United States and other countries will contribnte their quota in men and money, and Canada stands upon the threshold of a great national advance, that means not only an early increase in material wealth, but what is equally as important, that her natural resources shall at last be better understood and better valued both at home and abroad. We who are directly interested in mining know that the "Klondyke" represents but a very small part of the great natural wealth this country contains, and we are therefore confident that properly directed, the workers and capitalists now coming to our shores, if by chance unsuccessful in their first adventures in the gold mines of Canada, can be absorbed to their own benefit and to that of the Dominion in the many other fields of lucrative labor and investment which this country affords. The wealth of our coal fields and iron mines is undoubted. We are rich in silver, copper, asbestos, mica, plumbago, phosphate, chromic iron, galena, corundum, talc, and almost every mineral known to science. Aside from mining, our rich agricultural lands, our forests and our fisheries, all afford ample scope for the profitable employment of capital and labor.

At such a time as this a distinct national duty rests upon all Canadians, and certainly upon the members of this Institute, to conserve, by every reasonable means, the interests of the workers and the capitalists that are now seeking our shores. They must be made to feel that Canada is a country where law and order will be guaranteed, and where the rights of individuals will be as safely guarded as in any part of the British Empire. Canadian citizenship should be made so attractive to the new-comers that when they come they shall elect to remain and assist in the general development of the country.

To better meet the requirements of the times, so far as this Institute is concerned, it is felt by many of our members that the time has arrived when we must merge our Provincial Associations into one strong united Dominion organization, embodying the mining men of all the Provinces. Of this the members have already been duly notified, and during the course of the

I estimate approximatively that not more than $900 of gold has been taken out during the year.

The question of the Beauce district has been discussed at length at previous meetings, and although not yet satisfactorily settled, I personally am fully confident in the final success of that region.

GRAPHITE.

The graphite industry is one of the most difficult to operate advantageously in Canada, as we have to compete with old establishments in the United States, taking easily their supply from Ceylon.

In the Buckingham district we have three companies with well equipped mills — two using the wet and one the dry process — and it appears to me that their product is as good as any other one, and all that we require is a regular market for it. But little work was done last year and we have not the account of the production.

ASBESTOS.

The market for asbestos has been fair; three companies at Thetford and one at Danville, employing altogether 800 men, have been in operation for the whole year, having shipped 12,565 tons, of fibre; about 42,000 gross tons of the new product called asbestic, have also been prepared, of which a very large quantity has been shipped, and the contracts made for the coming year will, it is expected by the company, take the entire out-put. Shipments have been made to England, Germany, Australia, South Africa, besides the United States and Canada.

The Black Lake Mines have not been in operation this year, and the production of two Companies, having their mill in the Laurentian district, near Ottawa, was small, little work being done.

PHOSPHATE.

About 1,000 tons shipped.

MICA.

Several prospects were made in the Gatineau district, but of small importance. In the vicinity of Perkin's Mills, in Templeton, three important Companies have worked regularly, and taken out a large

provided for in the present treaty, and where such is the case we are debarred from shipping to France in Canadian "bottoms," *i.e.*, in steamers plying from Montreal, or other ports in Canada, to English ports, and there making trans-shipment to France. Upon such shipments France inflicts a maximum rate of duty, under clauses 54-59 of her customs law in regard to direct trans-shipment by water. To secure the privilege of having our goods entered at the minimum rate of duty granted to our American and English competitors, enjoying the advantage of direct steamers, we must either have a direct Franco-Canadian line, or arrange for an enlargement of our treaty rights that will permit of our saleable products being shipped by available Canadian vessels via British ports, and still be allowed entry into France at the minimum rates of duty, which are frequently 100 per cent. lower than the maximum rates now imposed, otherwise the Canadian producers must continue as at present to ship via American ports, thus being seriously handicapped by the addition of inland freight rates to New York and other ports of departure. This matter deserves the most earnest and immediate consideration on the part of our Federal Government.

Thanks to Secretary-Treasurer.

I cannot close without bearing testimony to the invaluable service rendered to this Institute, and to the enterprise of mining in Canada, by our esteemed Secretary, Mr. B. T. A. Bell. To his untiring energy is due in a very large measure any success that this Institute has been able to claim in the past. If we now merge into a larger field of usefulness as a consolidated association, as I trust we shall, it will be largely due to the earnest work of our Secretary, Mr. Bell, to whom the mining profession of Canada, if not the country itself, owes a debt of gratitude.

To the members of the Council I tender my best thanks for the loyal support they have accorded me during my term of office as President, and upon behalf of our Council, as well as for myself, I desire to acknowledge specially the valued counsel and assistance which the Treasurer of the General Mining Association of the Province of Quebec, Mr. A. W. Stevenson, has repeatedly rendered to the Institute during the past year. Upon every occasion that we have sought his matured advice upon matters of importance to the Institute, he has given us of his time and work most cheerfully, and I feel, therefore, that we cannot pass this over without public recognition.

Gentlemen, the important work of the meeting of 1898 now lies before you, and to it I know you will give freely of your best energies and abilities.

Product.		Quantity.	Value.	Employes.	Wages.
Cement, natural rock	Bbls.	84,670	$ 76,123	70	21,500
Cement, Portland	"	96,825	170,302	161	67,560
Pressed brick, plain	No.	7,148,908	53,727	143	40,084
Pressed brick, fancy	"	895,000	9,350		
Roofing Tile		35,000	400		
Terra Cotta		.....	35,800		
Paving Brick		4,567,880	45,670	66	23,226
Sewer Pipe		.....	73,551	64	19,600
Petroleum	Imp. galls.	25,556,591	.....	.....	.....
Illuminating Oil	"	10,891,337	1,131,083	364	196,956
Lubricating Oil	"	1,959,810	199,755		
Benzine and Naphtha	"	949,341	77,340		
Gas and Fuel Oils and Tar		8,021,633	281,035		
Paraffin Wax and Candles	Lbs.	2,139,278	88,378		
Natural Gas		.....	308,448	84	42,338
Salt	Tons*	54,686	249,880	210	58,530
Gypsum and products of	"	1,729	17,950	.....	.....
Graphite and products of	"	400	8,500	15	5,000
Calcium carbide	"	574	34,440	30	12,544
Iron	"	24,011	288,127	130	40,000
Nickel	"	1,999	359,651	535	253,226
Copper	"	2,750	200,067		
Gold	Ozs.	11,412	190,244	430	212,966
Totals 1897		.....	3,899,821	2,302	993,530
Totals 1896		.....	3,794,003	1,822	818,726

*Net tons of 2,000 lbs.

The following papers were then read:—

"Notes on Some West Kootenay Ore Bodies," by Mr. J. C. Gwillim, B.A., Sc., Slocan City, B.C.

"The Albertite Deposits of New Brunswick," by Mr. John Rutherford, M.E., Windsor, N.S.

"Notes on the Analyses of a Rare Mineral New to Canada," by Dr. W. L. Goodwin, Kingston, Ont.

The session adjourned at six o'clock until Friday morning.

THE GASPE OIL FIELDS.

The President took the chair at eleven o'clock on Friday.

Mr. B. T. A. Bell asked if the Bureau of Mines at Quebec, or the Division of Mines and Minerals Statistics at Ottawa, had received any statistics respecting the reported flow of oil in economic quantity at Gaspe, Que., quoting the following extract from the prospectus of "The Irish Proprietary Oil Fields of Gaspe, Canada, Limited."

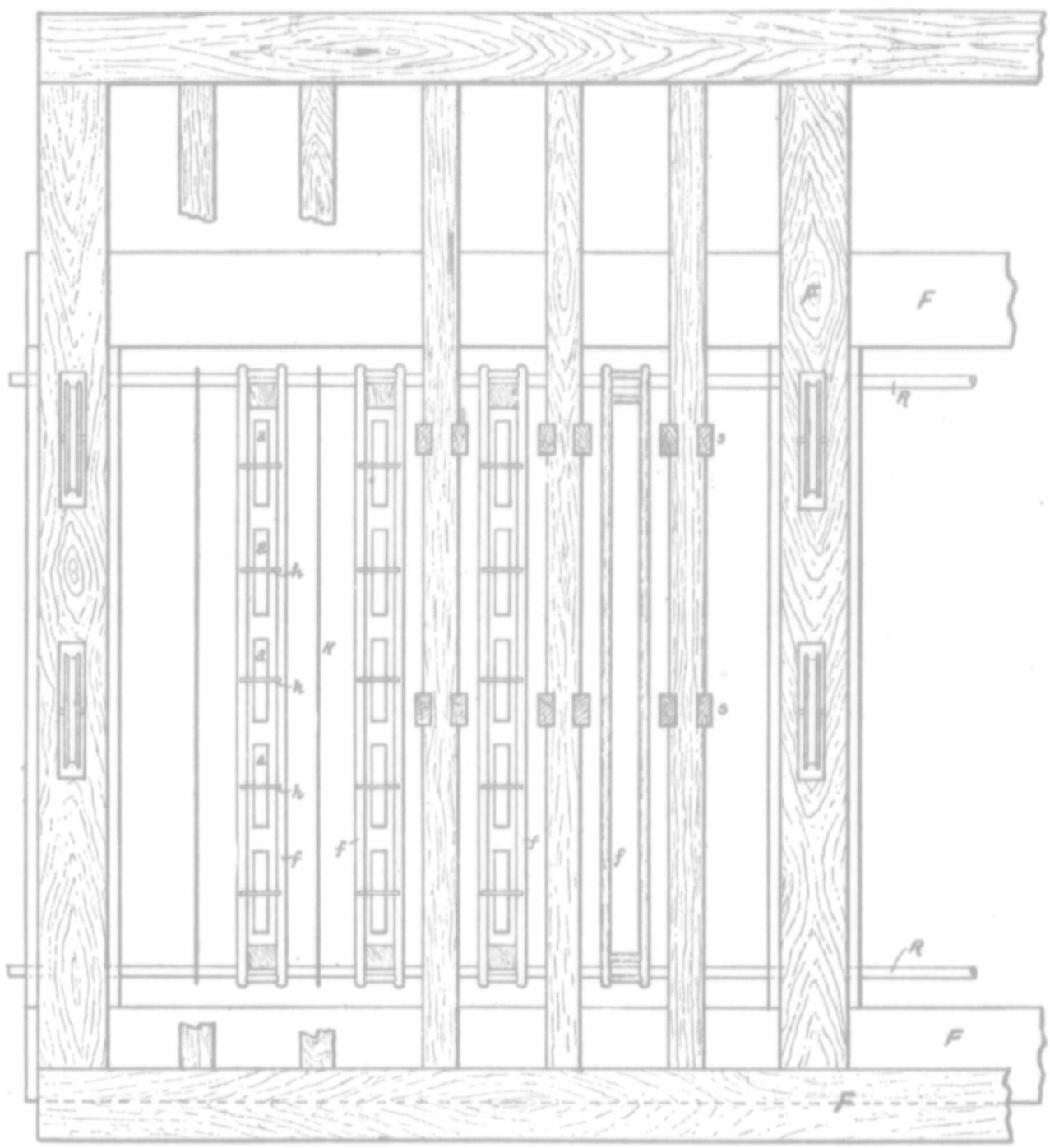


PLATE 6. PLAN OF TANK-CELL.

P. BUTLER (Del.)

Proceedings Annual Meeting.

MONTREAL, 2ND, 3RD AND 4TH MARCH, 1898.

The Annual Meeting of the members of the Federated Canadian Mining Institute opened on Wednesday morning, 2nd March, in the Club Room, Windsor Hotel, Montreal. There was a large and representative attendance at this, and the succeeding sessions, including parties of mining students from McGill University and the School of Mining, Kingston. The President, Mr. George E. Drummond, occupied the chair.

ANNUAL REPORT.

THE SECRETARY read the minutes of the previous meetings, which were confirmed. He then presented a detailed audited financial statement of the affairs of the Instituie, showing: Receipts, $1,011.96; and Disbursements, $1,068.11; Assets, $144.55; Liabilities, $404.50. He briefly reviewed the work of the Institute during the year, dwelling particularly on the work accomplished on behalf of the mining industry in opposing the Bill of the Canadian Society of Civil Engineers in the Legislatures of Nova Scotia and Quebec, and also with regard to the tariff respecting mining machinery.

MR. HAMILTON MERRITT thought every mining engineer in Canada would endorse the action of the Institute in blocking such an arbitrary measure as that of the Canadian Society of Civil Engineers. He thought the thanks of the Institute were especially due to their Secretary for his energetic action in the matter, and to the co-operation of the members of the Mining Society of Nova Scotia. He would therefore move: That the Federated Canadian Mining Institute approve of the action of the Council in exerting their influence to oppose the effort of the Canadian Society of Civil Engineers to compel mining engineers to become members of their Society before being able to practice in Canada.

MR. HARDMAN having seconded the motion, it was put to the meeting and carried unanimously.

THE SECRETARY said he believed the time had come when the present federation should cease and a consolidated organization of the mining men of all the provinces of the Dominion take its place. A committee had been appointed by the Council of the Institute to prepare a report on the subject, and had issued a circular asking for the views of the leading mining men. The responses had been most satisfactory, and it was likely steps would be taken to organize such a body at the close of the sessions.

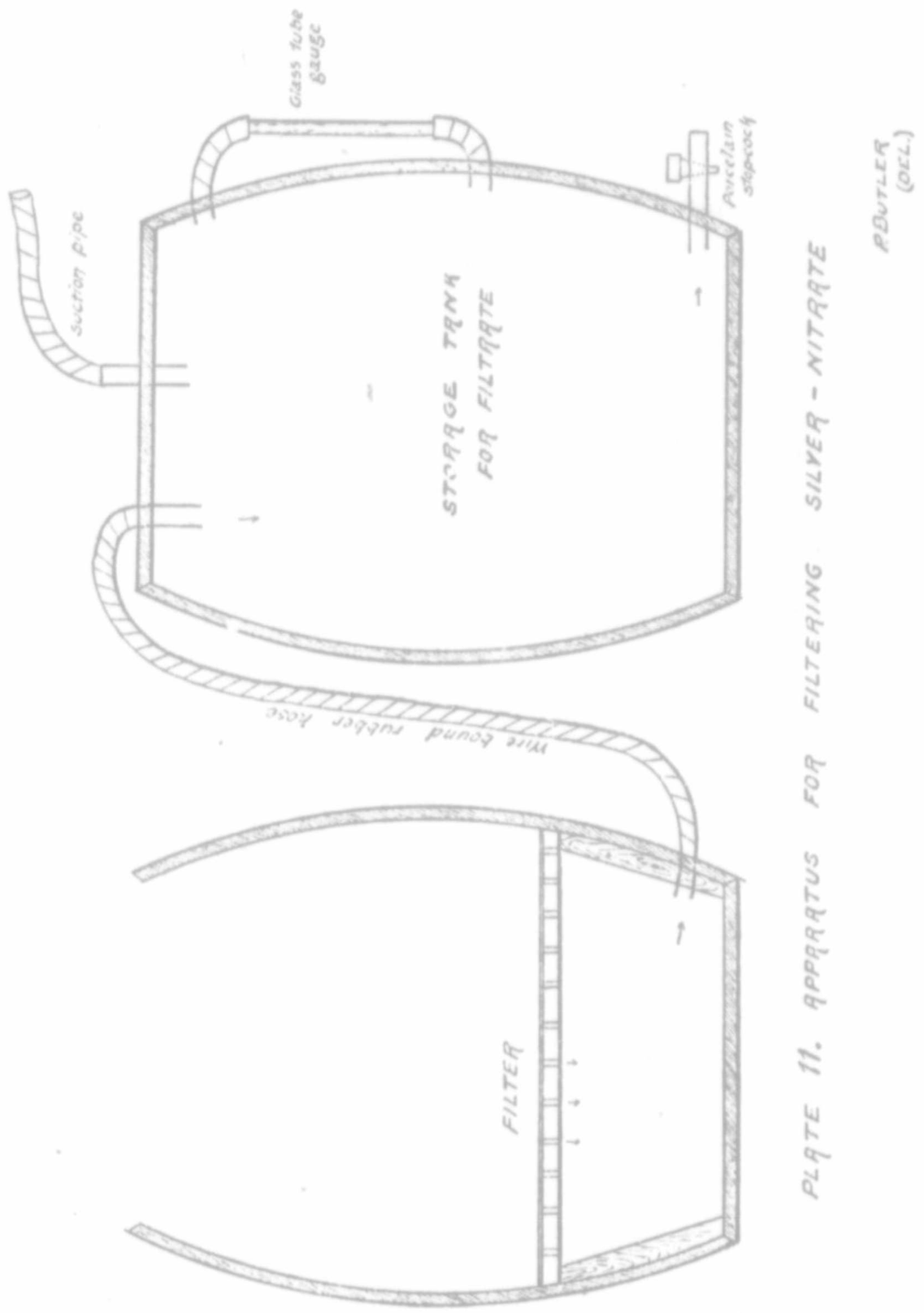


PLATE 11. APPARATUS FOR FILTERING SILVER-NITRATE

A BUTLER (DEL.)

face to face with the question of compulsory statistics, it is therefore desirable that a committee, to be nominated by the Chairman, be appointed to take the matter into consideration, and report at this afternoon's session."

The motion was carried unanimously.

The Chairman nominated the following committee: Messrs. Hardman, Obalski, Ingall, Hamilton Merritt and Secretary.

AN INCREASED DUTY ON LEAD AND LEAD MANUFACTURERS.

MR. W. BRADEN, Pilot Bay, B.C.: I desire to submit the motion of which I gave notice yesterday, having reference to an increase in the present duty on lead and lead manufactures.

One of the greatest possibilities for industrial Canadian enterprise is the smelting and refining of the ores produced in British Columbia within the limits of Canadian soil. Any means to accomplish this end, and not conflicting with any other interests, should obviously be supported.

Through the encouragement offered (though slight) by the Dominion Government, and the rapid growth of the mining industry in British Columbia, there are at present in operation two smelters, and one which is idle. The two in operation are matting plants smelting with copper base; the one idle plant is essentially a lead smelter. Does this not seem a pregnant fact?

1st—The United States smelters pay a premium—so to speak—for lead ore of the character produced in British Columbia.

2nd—Up to recently there has been comparatively little "dry ore" produced, thus making the "precipitation process" of smelting these ores unprofitable. During the past year this "dry ore" production has exceeded 100,000 tons.

3rd—The United States Government have so arranged the Customs Tariff on lead in ore and pig lead, that should lead ore be smelted in British Columbia, a higher duty would be levied on the resultant lead if shipped into the U. S. market.

A method to remedy this condition whereby such a compound tax on the lead ore miner of British Columbia, and indirectly on the people of Canada, is needed. It is an unsatisfactory state of affairs, when the mines of Canada produce more than sufficient lead within her own limits to supply her consumption, and import every pound used.

Therefore, it is indubitable that were a prohibitory import tariff placed on lead by the Dominion Government, Canada would be benefitted in many ways, with no single interest to suffer.

1st—The lead mining would receive an impetus by having a market for their ores close at hand.

Resolved,—That the sense of this representative meeting of the members of the Federated Canadian Mining Institute is opposed to an export duty being placed on any Canadian ore, matte or bullion, believing that such an impost would be prejudicial to the best interests of mineral development in the Dominion.

CAPTAIN ROBT. C. ADAMS, Midway, B C.: I have very great pleasure in seconding the resolution.

ALDERMAN DAVIES, Toronto: I understand that the money spent in Canada in mining nickel and in smelting the matte, is insignificant compared with the hundreds of thousands of dollars expended in refining our raw material in New Jersey. An export duty would mean that expenditure in Canada, giving labor to Canadians. We are becoming more and more independent of the United States, and the more industrial development we have in Canada, the greater the population we will attract to the country. I think Mr. Bell's proposition entirely in the wrong direction. We have the greatest country in the world, and what we want is more money. If an export duty was imposed English capital would be found to build nickel refineries in Canada.

MR. BELL: Alderman Davies' remarks are the merest frothy clap-trap. The Canadian Copper Company has invested at Sudbury several millions of dollars in establishing mines and smelters, and a nickel industry that is distinctly creditable to the country. The erection of a refinery is entirely an economic question. If any one is prepared to refine nickel in Canada, the proper course would be to assist such an enterprise by a bonus similar to that already given by the government to the manufacturers of pig iron and the smelters of silver lead.

MR. JOHN PATTERSON (Hamilton): I have been interested in the nickel question for some time, and I am a firm believer in the imposition of an export duty on Canadian nickel.

MR. BELL: You are interested in promoting an opposition company.

MR. A. W. DINGMAN (Toronto): I do not think the present time opportune to impose an export duty, and its imposition would certainly not bring about successful nickel refining in Canada. A great deal of misapprehension existed about the nickel industry. It was not the highly remunerative business many people imagined. The Dominion Mineral Company, which was a Canadian and English company, had failed to make their Sudbury mines a success and were closed down to-day. The Vivians, of Swansea, the great Welsh smelters and refiners, had also tried, unsuccessfully, to operate their Murray mine in the same district. The Drury Nickel Company, a Chicago enterprise, which had worked the mineral at Sudbury had also gone into liquidation. As a matter of fact the Canadian Copper Company was the

Mining in Quebec in 1897.

By J. Obalski, M.E.

The state of the mining industry in the Province of Quebec, during 1897, is shown by the following notes:—

I would mention copper, asbestos mining, and charcoal iron making as very important industries, with mica and chrome coming after.

IRON.

The Radnor forges furnace was in operation during the whole year, and the Drummondville one since July. They have produced 8,386 gross tons of pig iron, 680 men being employed by this industry.

The consumption of raw material has been 19,766 gross tons of bog ore; 2,545 gross tons of limestone; 10,318,000 bushels of charcoal.

The quality of the product need not be mentioned; it is a credit to our country; in fact, it is highly praised, not only in Canada, but in the United States and Europe, competing with the best brands on either of the continents.

CHROME.

This year's shipment has been 2,340 gross tons, mainly to the United States, and we have still in hand 2,000 tons; about 60 men being employed. Our ore is mostly high grade, but I consider that with concentrating plants, we could use our low grade ore and the refuse of the mines, and considerably increase our shipments. This industry is in its infancy, but nevertheless, with only hand working, we have taken out, since 1894, over 10,000 tons, representing an approximate value of $140,000, of which 8,183 tons have been shipped. I refer to a pamphlet I am just publishing on the subject.

TITANIC IRON.

I would make mention of the discovery of important deposits in the Lake St. John district. People have also an eye on our magnetic

and the mortar is also a block of granite. The fine stuff is panned down and the gold recovered by washing in a wooden dish called the "batea."

In the fifteenth century a small mill was in operation in Europe, which was practically the Saxon as we know it, only in a very crude form. It was driven by a water wheel on the same shaft with which was a large wooden barrel, with wooden cams projecting from it. The whole was made of wood, except the stamp head and mortar, which were either iron or stone. The ore was usually crushed dry, but at the beginning of the sixteenth century wet crushing was introduced as an improvement.

The date of the first use of mercury in extracting gold is unknown. Pliny mentions the fact that mercury will take up gold, and it is probable that it was known long before his time. The first use of mercury on the American continent was in Mexico about the year 1557. It soon spread, however, to Peru and neighboring countries.

The first stamp mill in California was erected in Mariposa County in 1850. It consisted of eight stamps driven by water power, each stamp having its own mortar. In this mill the cams acted to one side of the centre line of the stamp stem, and the stamp revolved, thus being the forerunner of the modern California stamp. Soon the large wooden barrel and short cams gave way to the small shaft and long curved cams, as we know them to-day. It is sometimes thought that the revolving stamp greatly increases the grinding action in the mortar, but this is an erroneous idea, as in a properly lubricated mill little or no rotation occurs during the fall of the stamp.

Having now given a very brief account of the development of the modern stamp mill, the writer will endeavor to give as briefly as possible the prevailing practice in several of the most famous mining regions of America and Australasia, and to show how in each case the practice varies with the character of the ore and local circumstances.

Gilpin County Practice.—Gilpin County, Colorado, with its area of only 122 square miles has produced up to 1897 over $76,000,000 worth of gold, the largest yearly out-put being $3,340,300 in 1889, while for 1897 it is estimated at $2,000,000. The first mills in this

was used, consisted of a pipe-man, and two assistants to loosen heavy boulders and move them out of the way. Boulders up to 600 pounds weight could be easily picked up by the bucket when loosened, but it is found more desirable to keep them out of the hopper and confine the bucket work to the more gravelly material, which carries the gold. One man is also employed in maintaining the dump and bed-rock flumes.

Several interesting installations of cableway are found in Canada. Mr. F. T. Snyder describes a Lock-Millar cableway (Fig. 12) 450 foot span in use at Keewatin, Ont., by the Ottawa Gold Milling and Mining Co. This cableway has a capacity easily of 200 tons per day, and is run by belted drums from a line shaft in the mill. The operator is in full view of the bucket at all times.

The Asbestos and Asbestic Co., (Limited), of Danville, Quebec, employ seven cableways which spans from 150 to 450 feet, having a capacity of two to four ton loads, averaging 200 tons per day. The cables are inclined all the way from 1 degree to 30 degrees. The horizontal ones employ an endless rope and double drum engines. Fall rope carriers will shortly be installed on the long span cableways. A side pulling line is employed, secured to the hook of the fall block out of line with the cable. Mr. H. J. Williams, Superintendent, says he is very partial to cableways for large capacity and long distances.

Bell's Asbestos Co., Thetford Mines, P.Q., employ six cableways 200 to 400 foot span, inclined at about 45 degrees. As the output of all these cableways is only 500 tons per day, it suggests the thought that possibly one traveling cableway, with all the modern appliances, might do all the work of the six now in use. The traveling cableways on the Chicago drainage canal handled 1,000 tons per ten hours, or twice the output of the six cableways above.

An interesting example of open pit mining with cableways was given to this Institute two years ago by Mr. R. E. Chambers, M.E., of New Glasgow. His paper on "A Newfoundland Iron Deposit" describes a double traveling cableway, 300 foot span, in use in Belle Island, situated in Conception Bay. A bed of iron ore, averaging eight feet thick, dipping at an angle of about 20 degrees, is being mined by the cableway method

Legislative Work.

With regard to the action of the Institute in connection with the tariff as applied to mining machinery, the movement was made with a view to securing a more definite interpretation of the old law, in order to remove the friction consequent upon the somewhat ambiguous phraseology of the item, which provided for the free admission of "machinery of a class exclusively used and required for mining."

A misapprehension seems to have been created in the minds of mining engineers that this item implied absolutely free mining machinery. As a matter of fact this was not so, the item reading "exclusively used and required in." The Institute took particular pains to be informed as to what the exact interpretation of the Department would be, and were officially informed by the Controller, and other Ministers, that it was the intention to charge duty upon all machinery which could be used in other industries, such, for instance, as air compressors, rock drills, pumps, etc. The action of the Institute was, therefore, directed towards securing, if possible, free admission of all machinery other than that upon which the Government had decided to charge duty. In this way a distinct service was rendered by the Institute, for whilst the Government would not grant this in the exact form asked for, the Institute was requested to substitute a list of items which might be specified as a free list—a most difficult task, but one which has been accomplished with fair success. It is a matter of gratification to state that the Government have, to the knowledge of our officers, given a very liberal interpretation to the law throughout the past year, their endeavor evidently being to promote, by a liberal interpretation, as far as they legitimately could, the mining interests of the Dominion.

Civil Engineers' Bill.

The 1897 meetings of the Institute had hardly closed before we were informed of the endeavors of the Canadian Society of Civil Engineers to promote a Bill in the Nova Scotian House of Assembly for the protection of engineers. This, in the opinion of the officers and council of the Institute, was an excellent piece of legislation, in so far as it related to the profession of civil engineering. Unfortunately, however, the Bill contained certain clauses which, if carried into effect, would seriously interfere with the profession of mining engineering. While the Mining Institute heartily endorsed the principle involved in this legislation to protect legitimate engineers against the vagaries of the mining quack, yet they felt that it was the province of the mining men themselves to move in the matter at the proper time, and only after the fullest consideration. The council, therefore, felt it expedient to interfere, and having secured the co-operation of the Nova

a small one, but may lead to the discovery of an extensive field of said material. Subsequently, Mr. R. Lanigan, from Calumet, secured some property there, made some prospects, and came to the conclusion that workable deposits existed. He also sent specimens to porcelain works, and received high testimony, regarding the quality. I submit herewith some specimens of the finished product. The "Imperial Porcelain Works," of Trenton, United States, have pronounced it of a superior quality.

The district above mentioned is 5 miles far from the Monfort R.R., which connects with the C. P. R.

MOLYBDENITE.

We have inquiries from a party in England, about this mineral which I understand has some new use as an alloy, but the price offered (14 cents per lb.) does not give much chance for the opening of our small deposits, which, besides, not being developed, are rather far from ordinary communication. We know of only three deposits giving indications of some importance, one on the north shore of the St. Lawrence, and the other in the Gatineau valley. The latter was discovered in Egan township, about 110 miles from Ottawa, the surface indications would warrant further developments.

BUILDING MATERIAL.

There is nothing special to mention in this line. We have shipped 3,208 tons of 2,000 lbs. of slate, 90 men being employed, and also 1,072 tons of flag stones.

I am not prepared to give any figure on the building stones, notwithstanding its importance.

Re granite, the Stanstead, Whitton, and Lake St. John quarries have been in operation, as usual, the latter only for local supply.

The limestone quarries, on the Trenton belt, between Quebec and Ottawa, have been extensively worked.

We record, for 1897, a production of 14,000 barrels of Cement, but new Companies are in process of formation, and preparations are made to considerably increase it for the coming year.

run on the main cable, and also, on these horns the carriers were taken when distributing them along the cable.

The original carrier was of wood and iron. The development of a few years has brought the carriage and carriers up to a standard form, as shown in Figure 5. The cable carriage is built with two, or three,

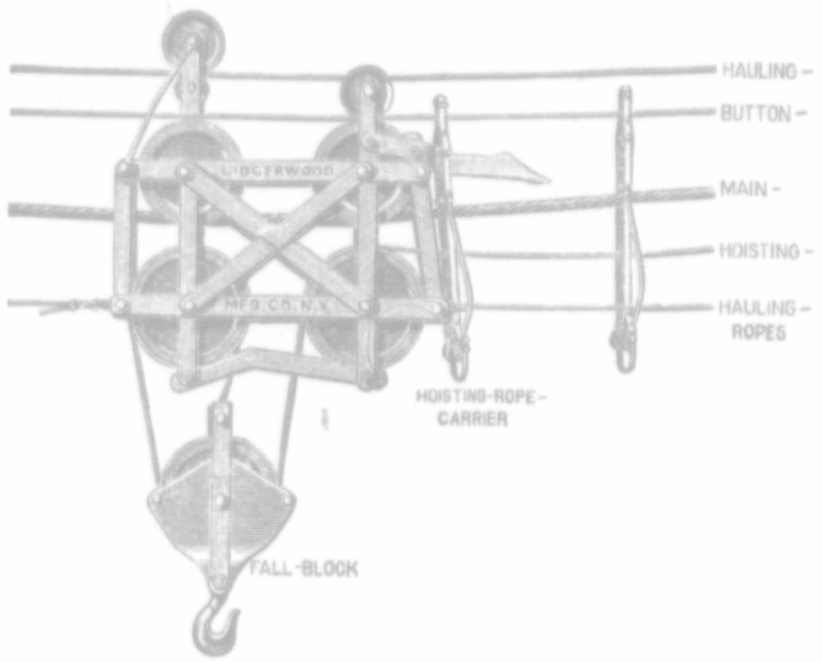


FIG. 5.—Standard Two Wheel Carriage and Fall Rope Carriers.

main cable wheels. The various ropes are indicated in the illustration. The horn in front of the carriage picks up the carriers as it passes toward the engine, and also carries them out as the carriage recedes ; the buttons on the button ropes take the carriers from the horn and leave them spaced along the main cable at proper intervals for supporting the hoisting rope. These buttons increase in size, receding from the head tower, as also do the corresponding slots in the head of the top of the carrier.

Figure 6 illustrates one form of engine with double cylinders fitted with reversible link motion. The drums are of large diameter, friction type, one to carry the hoisting rope, and the other is turned with a curved surface as shown, and carries the endless rope. The endless rope is wrapped around the drum five or more times, enough to secure sufficient friction to keep it from slipping in the opposite direction to that in which the drum is turning, and the ends are passed over the sheave wheel on the towers, and made fast to the front and rear wheels of the cable carriage.

their important works. About 300 men are employed, and while we cannot give the actual output of asbestos from these works, the tonnage has been very considerable during 1897, and will likely be an increasing one. The Ottawa County product was small.

It is pleasing to note the considerable trade that has sprung up for the refuse sand and short-fibred asbestos for use as fire-proof plaster, for which purpose it is admirably suited.

Copper and Pyrites.

Copper ore mined in the Province of Quebec during 1897, 39,928 net tons. Of this quantity 31,080 tons went to the U.S., the remaining 8,848 tons being treated in Canada. These figures show an increase over those of 1896 of 7,448 tons exported to the U.S., and a decrease of ore treated at home of some 1,344 tons. The market in the U.S. has been in a healthy condition, with an active demand and well sustained prices throughout the year.

In Canada the reduction of the import duty on sulphuric acid has resulted, as feared, in opening our market to the American manufacturer, in consequence of which there is a decrease in the home production and also lower prices.

The Bureau of Mines of Ontario reports a production of metallic copper to the extent of 2,750 net tons, of a value at the works of $200,067.00.

Shipments of blister copper to Great Britain are reported by the Hall Mines smelter at Nelson, B.C.

Nickel.

The Geological Survey report for 1897, just published, places the total production in Canada as 3,997,647, valued at $1,399,176.

Mr. Archibald Blue, Director of Mines of Ontario, reports :—

Nickel ore smelted in 1897	96,094 tons.
Metallic nickel contents	1,999 net tons.

Value at the works, $359,651.00. In certain quarters efforts are being made to induce the Government to impose an export duty upon Canadian nickel.

Whilst it is of great importance to this country that her minerals shonld be brought to the highest possible point of manufacture before exportation, yet in simple justice to the capital already invested in nickel, under existing conditions, no radical change should be made without the most careful consideration. It is quite possible that the imposition of a duty might, for the time being, serve to displace Canadian nickel in the United States market in favor of New Caledonia.

double that required in a country where there are no winter snows to cover up the formation.

That these natural disadvantages can be successfully met and overcome, has long ago been amply proven by actual and profitable work upon the part of mine operators now in the field.

During the present meeting papers and reports will be placed before you from eminent authorities in various branches of mining, that will convince the close observer (and a full discussion of these papers and reports is desired) that Nature has endowed this Dominion with enough good, honest mineral wealth to give ample scope, and at least reasonably remunerative returns to the energetic, intelligent and persevering work of many thousands of men, and plenty of opportunity for solid, if intelligent, investment of capital.

Whilst desiring to avoid touching upon details that may, during the course of our meeting, be presented by the representatives of particular industries, it devolves upon me to review, as briefly as possible, the general work of mining in Canada during 1897, and afterwards to place before you a synopsis of the work accomplished by this Institute during the year.

The official returns of the Geological Survey of Canada, just published, calculates the total production of minerals in Canada during the year 1897, at $28,789,173, an increase of $6,179,348 over the production of 1896. In 1886 the total production of minerals in Canada only reached a value of $10,000,000. What can better attest the importance of developing the mining industries of the Dominion, than this advance of nearly 188 per cent. in the short space of eleven years? Few countries during the same period have shown such a percentage of increase in the production of natural mineral wealth.

The total values, as given in official returns, fail to convey an adequate idea of the real monetary value of the mining industry to this country, nor yet of the relative value of one mineral as against another. In the item of iron, for instance, it is taken (*vide* report of the Geological Survey of Canada for 1896) simply at the value of the ore mined, and not, as in the case of other minerals, at its value in a marketable state. The iron ores mined in Canada are almost wholly used in this country, smelted into iron and steel ready for the market, with fuel which, by the way, is credited in these Government statistics solely and alone to the coal miners, without giving one word of credit to the iron industry, which affords the market. The item of charcoal fuel, used in smelting Canadian iron ores, is altogether omitted. In dealing with the iron industry it would be well to give some more general information as to the value of all necessary raw material used. It is a debateable question whether in the table entitled "Proportionate value of different mineral products," page 8 of the report of the Geological Survey for 1896, iron should not be taken at its real value to the country, or at least

In the Hidden Treasure mine, which is typical of the district, the consumption of mercury was 6½ flasks per year for 75 stamps, or at the rate of 4.3 pennyweights per ton. The outside plates are cleaned and dressed every 24 hours, and the inside ones are cleaned every 48 hours, except when treating especially poor ore, when the period is much prolonged. Of the total amalgam recovered, fully two-thirds is obtained from the mortar, being about equally divided between the two plates; thus it will be seen that the three amalgamating contrivances each collect about the same amount of gold. On retorting the amalgam yields about 40 per cent. of bullion, which usually runs from 782 to 786 parts of gold per thousand and from 207 to 211 parts of silver. The rate at which the mercury is added is determined by the consistency of the amalgam on the plates. There is an opening in the front of the battery above the screen frame where the mill man can insert his arm and tell from the feel of the front plate whether the proper amount of mercury is being added.

The amalgam as obtained from the plates is ground in a mortar with hot water until of an even consistency. The water is then decanted off and mercury is added until the amalgam is quite thin. This is poured from one dish to auother until all sand and dirt has been removed. It is then squeezed through canvas and the resulting hard amalgam is roughly moulded into balls and placed in a retort lined with thin paper. The amalgam is hammered down until two thirds full. The cover is put on and luted down with clay and retorted in the usual way.

The only chemical used in the mill is potassium cyanide. Of this 260 pounds were used in crushing 28,793 tons of ore. The tables were dressed with a weak solution of two ounces of potassium cyanide in three gallons of water every 12 hours. The ore treated in this mill carried 13 per cent. of concentrates, chiefly iron pyrites. The pulp after leaving the tables passes over blanket strakes 3 feet long and 18 inches wide. These collect any escaping mercury and amalgam and also the heaviest pyrites. The present tendency, however, in this district is to discard these strakes, as any material they collect would certainly be saved in the subsequent concentration. This is done on

Both cableways were also employed for stripping off the top layer of earth and other refuse. The span of each cableway is 900 feet and the load handled six tons. This is an entirely new departure for mining and quarrying in that section of the country. As the installation is recent, I have very little data as to the cost of operation.

The development of the last seven years has added to the cableway :

The Button Stop Fall Rope Carrier
The Aerial Dump.
The Travelling Towers.
The Self Filling Buckets and Drags.
Spans have been increased from 800 to 1,650 feet.
Loads have been increased to 25 tons.

And incident to the above :—

Daily Capacity has increased from 400 to 1,200 tons in 10 hours.

The cost, per ton handled, has been reduced fully 50 per cent. in the last seven years.

With this development a serious difficulty has appeared, viz., the rapid wear of the main cable of the cableways on the Chicago Drainage Canal. With previous cableways running at moderate speeds and small daily capacity, the life of the cable would be eight or ten years, while on the canal, the cables would last but a few months. It is of course not proper to measure the life of a cable in years, or months, but in tonnage. The Austin Dam cableway, 1,350 feet span, handled at least 250,000 tons of material during its construction, and when taken down on the completion of the work was in good condition. The cableway at Pt. Pleasant W. Va., has been in steady use for several years, and is 1,506 feet span, and the main cable is in good condition.

It is worthy of note that no cableway, having a span of over 1,000 feet has ever worn out its main cable. The strain on these cables, due to the weight of the load, and the weight of the cable itself, is estimated to give the same factor of safety with the short as with the long cables, and yet the long span cables handle more tons of material. The reason, therefore, for this, is found in the observed fact that the weight of the cable between the load carriage and the

ten stamps those having the 46 inch sluice plate) flows direct to the vanners, while that from the remaining thirty passes over shaking tables of the Rittinger type before reaching them. The concentrating plant consists of four Frue vanners and 12 Triumphs, there being two machines for each five stamps. They are run at a speed ranging from 200 to 230 strokes per minute. The Frues give better results than the Triumphs and need less attention. Mercury is added to the mortar at the rate of 2 ounces per hour, and is regulated, of course by the condition of the amalgam on the plates. Of the total amalgam 66 per cent. is recovered from inside the mortar. The general clean up takes place twice a month, and this is the only time that the inside plates are cleaned. The outside plates are cleaned and dressed every morning. The loss of mercury varies from 10 to 14 pennyweight per ton of ore. The W. Y. O. D. Mill is the newest in the district, being erected in 1890, and has several improvements. The drop varies from 5 to 7 inches, and the rate from 90 to 100 drops per minute. Chrome steel shoes are used which give perfect satisfaction. The outside plates have a width of 50 inches and a total length of 14 feet. The inside plate is 4 feet long and 4 inches wide, and 66 per cent. of the amalgam is obtained from it. The ore is crushed in a Gates rock breaker. There is also an increase in the amount of silver plating on the amalgamating plates. They contain 5 ounces of silver per square foot of surface. The concentrating is done of Frue Vanners which save 2½ per cent. of sulphurets assaying $100 per ton. This is shipped to the chlorinating works where it is treated for $16 a ton. The mercury lost is 11 pennyweight per ton of ore. The percentage of gold extracted runs from 87 to 90. All the mills of this region use silver plated copper, the tendency being to increase the amount of silver. Hitherto the amalgamating was all done outside the mortar, the quick short drop and large capacity being the rule, but now it is becoming the custom to use one plate in the mortar and rather lessen the capacity and increase the percentage saved.

Australian Practice at Ballarat, Victoria.—This is the most productive region in Australia, and has been so since the discovery of the placers in 1851. In 1894 the output was $3,896,000, of which

two inches to fall through into the ore bins beneath. The remainder is passed through rock breakers of the Blake pattern, having a receiving capacity of 9 inches by 15 inches. Three of these are sufficient to keep 40 stamps supplied. From the crusher the ore falls into bins which deliver on to Challenge automatic feeders of which there is one for every battery of 5 stamps. The stamps weigh 850 pounds, made up as follows:—

Steam	358 lbs.
Head	228 "
Tappet	112 "
Shoe	152 "

The height of drop is from 6 to 8 inches, and the speed 82 to 85 drops per minute. The crushing capacity is 1 6 tons per stamp per 24 hours. No attempt is made here to keep the depth of discharge constant, consequently it varies from 2 to 6 inches. The screens in use are perforated tin plate equivalent to 30 mesh wire cloth. There is only one plate used in the mortar the front one, 52 inches long by 4½ inches wide It is made of silver plated copper containing one ounce of silver per square foot of surface. Outside amalgamation is carried on by means of three plates; the battery or lip plate, the apron plate and the sluice plate. These are all made of ⅛ inch silver plated copper similar to the inside plate. The battery plate is 4 feet 2 inches wide and 18 inches long. From this the pulp flows through a distributing box and falls 3½ inches on to the apron plate. This is 4 feet 5 inches wide for a length of 2 feet 6 inches, it then tapers down to a width of 22 inches in 2 feet, and discharges on to the sluice plate which is 22 inches wide and 12 feet long. The grade of the apron is 1½ inches per foot and for the sluice plate it is 1 inch per foot. The outside plates in this mill are a splendid example of bad practice. They should be of the same width for the entire length. It is common to see the amalgam actually scoured off the surface of the plate by the very rapid flow of pulp caused by narrowing the plate from 53 inches to 22 inches. This has become apparent to the management of the mill lately, and now two batteries of five stamps each have the sluice plate widened to 46 inches, while the rest of the mill use the 22 inch sluice plate. The pulp from

If we consider the large consumption of such material, in our country, which is partly supplied by an importation of over 200,000 barrels, we may look for a good future for this industry.

The established lime kilns and brick yards are going on as usual. It is not easy to give exact figures regarding the same, as they are scattered all through the Province, but by careful research, I am able to give the following:—

Lime.—Approximatively, we have, in round numbers, 300 lime kilns, producing one million of bushels of lime, of a value of $140,000, with 250 men employed all the year round.

Bricks.—In round numbers also, we count 150 brick yards, employing 1,200 men, for the summer season, and producing 120 millions of bricks, of a value of $600,000.

In conclusion, I may say that the raw value, at the mine, of the minerals taken out from this Province, represents about $1,800,000, including the building material, the number of men employed the most part of year being about 4,000.

Making a cost of $7.50 per day. Estimating 300 cubic yards as the daily capacity, it will be seen that the actual operating cost is about 2½ cents per yard. Of course this does not include any labor force about the screens, nor does it include the wages of a foreman, nor any repairs, which, while slight, must be considered as an item of cost.

About five years ago some experiments were tried near Topeka, Kansas, in which a clam-shell bucket was applied to a short cableway. The only machine of which there is any record, does not show one in a

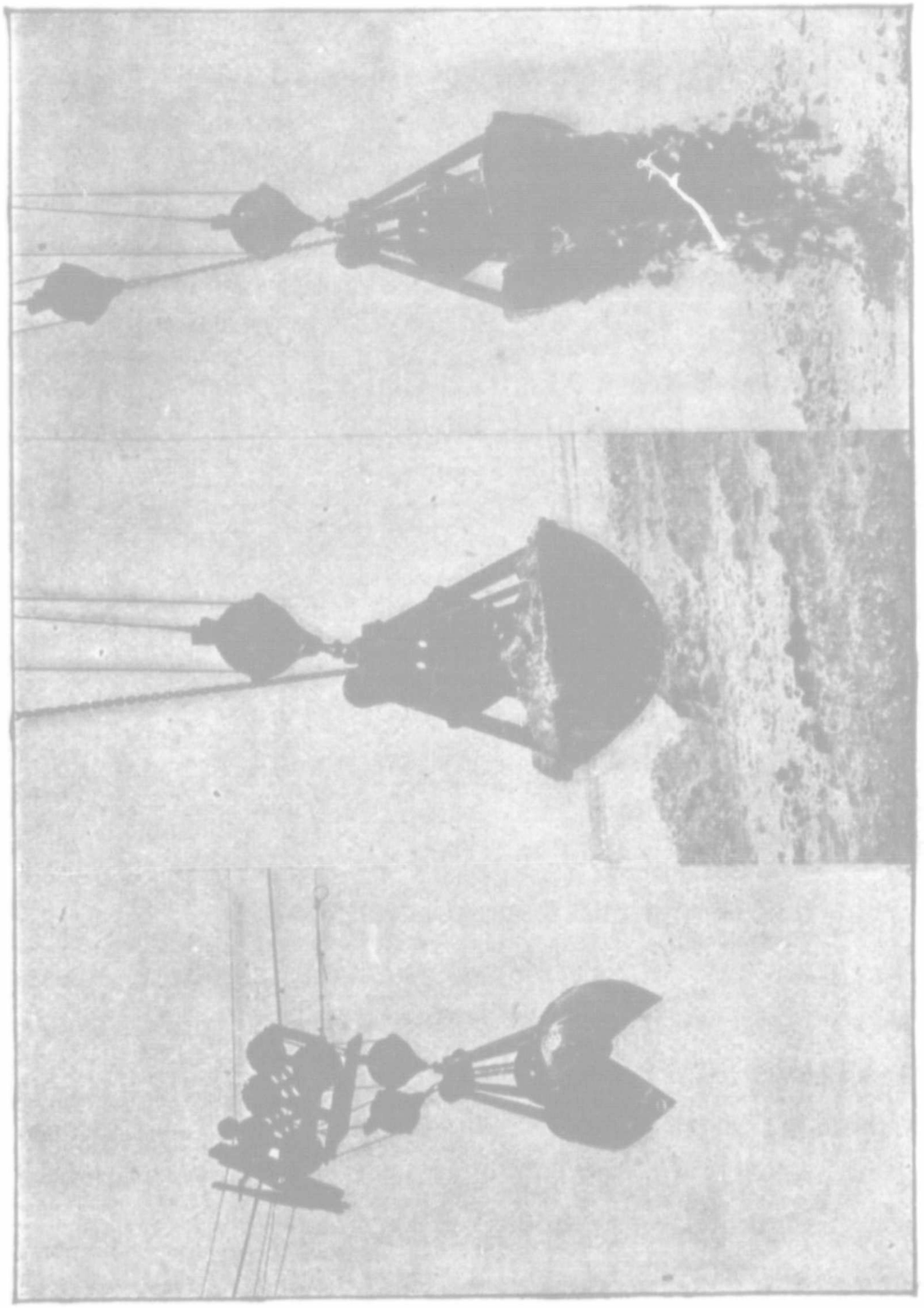


FIG. 9.—Self-filling Grab Buckets at different stages.

Some Comparisons in Stamp Milling Practice.*

By MELVILLE B. WEEKES, School of Practical Science, Toronto.

Gold has been the most valued and cherished metal from the very earliest times. As far as history goes back and among every nationality we find it the king of metals. In the most primitive state of gold milling the crushing was done in the hollow or cavity in the surface of a large hard stone; a piece of quartzite, or other hard material being used as a pestal. When the ore was ground sufficiently fine the light material was washed off with water, leaving the particles of gold in the bottom. Stone mortars in which this operation was conducted have been found Wales, in Central America and the Pyrenees.

The most primitive methods at present in use are found among the tribes on the Gold Coast of West Africa and in the interior of China. Here the gold-bearing quartz is broken into small fragments between two stones, and is then ground down to a powder between two pieces of granite or quartzite, the upper stone being worked with a rocking motion backwards and forwards over the surface of the other, which is usually a somewhat large smooth slab, sloping slightly away from the operator. The fine material gradually works down and falls from the stone into flat wooden dishes resembling prospecting pans. In these the gold is washed free from quartz in the usual way. The next advance was the employment of what is generall called the "Dolly."

In this the pestle, or hammer, is fastened to the end of an elastic sapling 12 to 15 feet long, one end of which is firmly embedded in the ground. The resilience of that bent sapling enables the operator to use a much heavier weight than he could possibly use alone. The connecting link between this and the old Saxon mill is found in some parts of the Andes. This consists of a small two-stamp mill driven by a water wheel, the whole being constructed of wood bound together with raw hide thongs. The stamp head is shod with a granite boulder

*Students Competition Quebec Mining Association.

perfected state ; but it is undoubtedly entitled to the credit of being the pioneer in the use of the self-filling bucket upon a cableway. This machine was used in handling deposits from river beds and streams, and delivering them to the sluice way on the bank. A description of this machine states as follows : "The one great drawback, to placer mining, has been the question of effective machinery for handling the earth deposits of our river beds and streams, consequently our placer mines have never been worked deep enough to even ascertain their possibilities, or determine their richness Tests have shown that the richest deposits lie near the bed rock, but to successfully work this deposit and extract therefrom the vast quantities of fine free gold has been the problem, difficult up to the present time.

An interesting form of cableway for placer mining was erected about a year ago in Alder Gulch, Mont., for handling placer. Alder Gulch was famous twenty years ago on account of its rich placer findings, and according to the shipments of Wells, Fargo & Co., from Virginia City, they have variously estimated the gold shipped from that Gulch at between sixty and seventy million dollars.

The old methods were so restricted, the difficulties so great, that all they got out from the placer was the coarse gold.

A group of English capitalists installed a novel form of cable way in order to solve the problem ; first, for the excavation of large quantities of material at a low cost per yard ; second, the delivery of the material at sufficient height, so that the gold saving flume could be used of sufficient length and grade, to thoroughly save the finer gold which escaped the original miners ; third, the delivery of the tailings at such an elevation that they would dispose of themselves.

The cableway shown in Figure 10, contains many novel features not found in any other cableway. The centre tower shown contains a hopper, the bottom of which is 40 feet above the bed rock. This hopper 27 × 16 × 8 feet slopes from each side to a center channel 30 inches wide, and this channel slopes back to the head of the flume, or the gold saving sluice. The "A" frame tail support was made light and portable, so that it could be easily shifted about the

Our charcoal iron has taken front rank in point of quality, and so far as coke iron is concerned, Canadian founders now acknowledge the product of the home furnaces to be equal in every way to the imported American article.

Ferro-Manganese.

During the year the plant of the Pictou Charcoal Iron Co. at Bridgeville, N.S., has been leased to the Mineral Products Co., who are undertaking the manufacture of Ferro-Manganese. The Company has secured important concessions in manganese mines in Albert County, N.B. These operations will be watched with considerable interest by the members of this Institute, who will wish the new venture every success.

Chromic Iron.

The returns for 1897 are not yet completed, but we are glad to be able to report shipments by the Quebec Central Railway to the extent of 2,593$\frac{837}{2000}$ tons. The quantity shipped in 1896 from the mines of the Province of Quebec, with points of destination, was as follows:—

To Philadelphia	750	tons.
Pittsburgh	1,232	"
Other points	55½	"
	2,037½	tons.

Mr. J. Obalski, Inspector of Mines, Quebec, estimated in his report for 1896 that during the preceding four years some 10,590 tons of chromic iron had been raised, of which quantity 9,000 tons were shipped from the Province of Quebec. A concentrating plant is badly wanted to raise the values of a very large quantity of this mineral in the Eastern Townships, at present too low to market at a profit.

Mica.

Quebec Province reports a total production to the valuation of $125,000, and we are also glad to report English capital recently invested in Ottawa County mines. So far as trade is concerned, inquiries from abroad indicate a considerable increase in the consumption of this mineral for electrical purposes.

Phosphate.

Some phosphate has been taken out during the past year in workings for mica, and inquiries for this mineral are reported as more numerous, although the prices offered are yet too low to admit of actual business. The following valuable papers contributed to the Transactions of the General Mining Association of Quebec in January, 1895, point the way to the possible development of a home market for this important mineral.

"Canada—A Natural Manufacturing Centre for Fertilizers," by Mr. Henry Wigglesworth, of New York.

"Phosphoric Acid in Agriculture," by Frank T. Shutt, M. A., Chief Chemist, Dominion Experimental Farm.

"Canadian Phosphate and Fertilizers—Home Manufacture and Home Market," by Mr. J. Burley Smith, M.E.

"Phosphates Future," by Capt. R. C. Adams, Past President General Mining Association of Quebec.

Gold.

Of all our mineral wealth, gold has excited by far the greatest interest among investors during the past year. A large amount of foreign capital has been and is being introduced to develop new districts.

The total production in Canada in 1897 is reported by the Geological Survey of Canada as $6,190,000.

Yukon.—It will indeed be a fortunate thing for Canada if one-fourth of the rosy predications as to the wealth of the Klondyke placer mines are realized. For the moment that district is the Mecca of the gold seekers. Many of them may later on turn their attention and their labor to more profitable account in other better known and more habitable Canadian fields. Investigation and solid hard work will alone prove the richness or otherwise of the Yukon placers. Official returns submitted to Parliament estimate the total production of gold in the Yukon district in 1897, as not exceeding $2,500,000. What has been spent to secure that is not so easy to calculate.

British Columbia.—Mining in British Columbia during 1897 has been prosecuted on a more substantial basis than during the few preceding years. The "boom" element to a large extent disappeared from the country early in the year, and the work done last season was performed by those companies or corporations which were well financed at the start. There were very few new discoveries, that is to say, discoveries of new districts, and some of the older districts have not, upon development, shown the values that were expected of them, but almost all the sections which were producers in 1896 have increased their production in 1897, notably the Slocan, which has doubled its output, and the Trail Creek country, which has nearly, if not quite, doubled its production. It is only fair to say, however, that this is due almost solely to one mine, the Le Roi.

Dividends have been paid during the year by the Le Roi, Cariboo Mining, Milling and Smelting Company, the Fern, and other mines. The Cariboo Hydraulic, in which many Montreal people are interested, also showed a substantial profit on the year's operations.

Manganese Deposits of Nova Scotia.

By Mr. W. F. Jennison, Walton, Hants Co., N. S.

One of the most important members of the iron group is Manganese. Its discovery and use is of great antiquity, having been used by the ancient Egyptians and the Romans in the manufacture of glass, one of its many uses of to-day.

It may be found in all ages of rocks from the Archæn upwards, and its formation is continually going on as will be observed in many places. The writer has particularly noticed it in the region of the Manganese belt running through Hants county, N. S., where the waters from the springs and brooks, settling on the low lands, deposit a sediment of black oxide of manganese on the rocks and pebbles, and a slimy, bluish, oily looking scum on the small ponds and pools, which is often mistaken for oil.

It also forms an important part of the animal and vegetable kingdoms as well as of the mineral. The human system is said to contain a proportion of one part of manganese to twenty parts of iron, and it is hardly possible for us to dine without partaking of manganese through the vegetables served us.

Up to thirty years ago manganese was used principally in the manufacture of bleaching powders and glass, but about this time Weldon's recovery process was invented and put into practical use, which reduced the amount used in the manufacture of bleaching powders to about one-tenth the original consumption.

To speak briefly, Weldon's invention is a regenerative process, whereby it enables the manufacturer of chlorine to use the ore over and over again indefinitely.

About the same date of the Weldon invention came the introduction of manganese into the manufacture of steel, and this, with the increasing demand in other industries, over-balances the great reduction in its use due to the Weldon process, and the consumption now is greater than at any previous time.

by its greater specific gravity, which keeps it in the mortar for a longer time than the quartz and feldspar. This district is behind the times in some respects; there are no rock breakers nor automatic feeders, but the necessity for these is not so great as in mills of larger capacity and lower grade ores.

Black Hills, South Dakota Practice.—A marked difference is at once seen when comparing this with Gilpin County practice. The ore in the Black Hills is exceedingly low grade, averaging about 4½ pennyweights per ton, hence, if it is to be treated successfully the capacities of the mill must be large.

The gold is found in quartz and pyrites finely distributed through vast masses of mica and amphibole schists, and frequently impregnating the schists themselves. From a geological standpoint the region consists of an outcrop of Archaeon rocks, about 1½ miles long and ½ a mile wide, surrounded by later sedimentary rocks. The oxidized portions above water line are especially free milling, giving tailings that carry only 25 cents a ton, while from the unaltered ore they sometimes run as high as $2.25 cents per ton. A description of the Homestake mill will be typical of the whole district, as there is very little variation, and only in minor points.

The ore as it comes from the mine is thrown upon grizzlies from which the fine material passes directly to the ore bins. Until a few years ago the coarse ore was put through Blake crushers, the largest in the market having a receiving capacity of 9 inches by 15 inches. They were set to crush from 1½ inch to 1¾ inch stuff, and 8 of them working 20 hours a day easily kept 160 stamps supplied with ore. These have now been entirely superceded by the Gates gyratory crusher, which has a much larger capacity. In the Highland mill of 160 stamps, two No. 6 Gates crushers keep the batteries well supplied with ore. The feeding of the ore into the battery is done automatically. Both the Challenge and Tullock feeders are in use and give very satisfactory results. The mortars are small compared with those used in in Gilpin County. The inside bottom dimensions are, width, 10½ inches, length 50 inches, total inside height 47 inches. The depth of discharge varies considerably as the dies wear down, but in the Home-

is recovered from the mortar box, which owing to its high specific gravity it settles down in the bottom The percentage of extraction is very good considering the work the mortar has to do From 9 to 9½ pennyweight are obtained, while the tailings carry from 1½ to 2½ pennyweight per ton It is a fact worthy of notice that these mills sell the right to treat their tailings to Chinamen for $40 per month, and they make a good thing out of it. All the battery frames in this district are of iron of local manufacture.

Otago, New Zeland.—Erom 1861 to 1892 this district has produced gold valued at $96,553,535. The out-put for 1892 was $2,117,635 A description of the Phoenix Mill will be typical of the whole district. The stamps weigh 800 pounds each. The height of drop is between 7 and 8 inches, and the speed 75 to 80 drops per minute The depth of discharge varies from 2½ to 4½ inches. The crushing capacity is 1½ tons per stamp per 24 hours Both wire cloth and perforated sheet metal screens are used, but the former are much preferred. No mercury is added to the mortar box The gold in the ore is exceedingly coarse and free, and is collected in the mortar where it settles down by reason of its weight, and also on blanket strakes 6 feet wide and 15 feet long, having a grade of ⅞ inches per foot. The coarse gold is found in the mortar and on the upper blankets, and as you go towards the lower end the gold gets finer and finer. Four gallons of water are used per stamp per minute. The blankets at the upper end are washed every hour, while the lower ones are washed at longer intervals. The blanketings are collected and treated in a revolving barrel 5 feet long and 4 feet in diameter which takes a charge of one ton. To this a flask of mercury (75½ pounds) is added and some water, and the barrel is set revolving at a speed of 20 revolutions per minute. This is kept up for 24 hours, when the amalgamation is supposed to be complete. The charge is then emptied into a vat from which it is slowly fed on to Rittinger shaking tables with the addition of water This treats the charge in three hours. The material, amalgam, pyrites and heavy sand which are separated out by these tables is then treated in prospecting pans which have their inside surface amalgamated. This readily collects all the gold and amalgam

hence is limited in its usefulness. In some conditions, however, it serves admirably. Manufactured in conjunction with fall rope carriers, it bears the commercial name of the Harris-Miller cable and carriage. (See Fig. 2.)

The next form of cableway was one in which the main cable was suspended practically horizontal. The carriage in this event was moved back and forth by the use of an endless rope operated by a drum, being

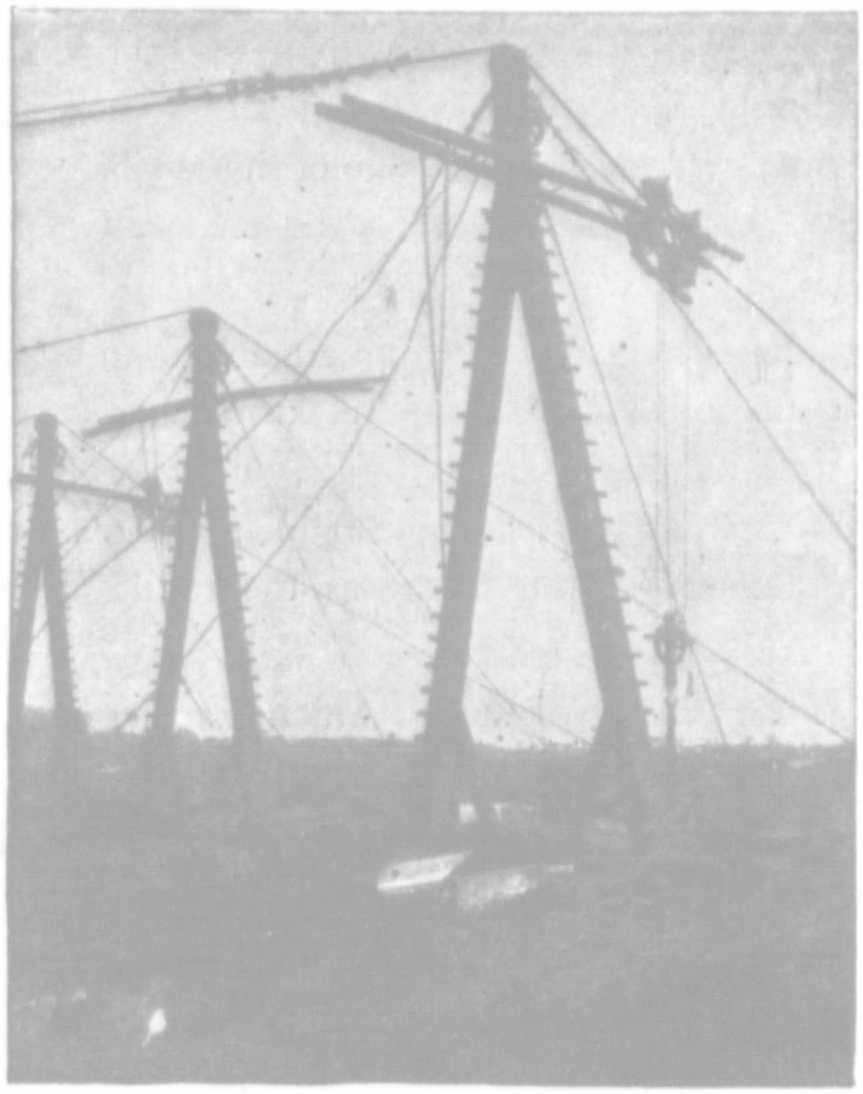


FIG. 1.—"The Blondin."

a part of the hoisting engine. Another drum performed the functlon of hoisting. Such a machine was first introduced for open pit mining at the Tilly Foster mines, New York. The reason for its adoption was that a derrick could not be constructed with sufficient reach to hoist and deliver material from the pit.

The problem at Tilly Foster was to convert the old mine into an open pit by the removal of something like 300,000 cubic yards of rock. It was calculated that this would uncover at least 600,000 tons of ore.

at Piziquid, now Falmouth, Hants Co., before the expulsion of the Acadians in 1755. The best evidence given of this is that on a farm, about a mile above the Avon bridge in Falmouth, on an area of about thirty feet square, having the appearance of a razed building, a specimen of pyrolusite had been found having attached to it pieces of glass and pottery. Evidently the French had used manganese, but for what particular use and at what date we have no reliable authority, and know but little of its history or discovery in Nova Scotia until 1861, when it was found at Tennycape, Hants County.

Nova Scotia has produced the purest and best ores of the world, and although the production has been small compared with that of other countries, yet, on account of its great purity and high crystalization, its product has great value and is used almost exclusively as an oxidizer and as a coloring material.

Dr. Penrose says "the most beautifully crystallized pyrolusite found in America is that from Tennycape Mine, Nova Scotia."

Prof. Howe reports Messrs. Tenant, of Glasgow, as saying in reference to the Tennycape ore, "they had never seen so fine." And the London *Mechanic's Magazine* said in 1886, *"these Nova Scotia ores, so much freer from iron than those found in Europe, will be a great boon."

Dr. How gives several analyses of Nova Scotia ores above 90 per cent. peroxide of manganese—(one as high as 98 per cent.)—and less than one-half per cent. of iron, and although I have a number of analyses of these ores, I can find only one showing a trace of phosphorus and none showing sulphur.

The following analysis made in Dr. How's laboratory by Mr. H. S. Poole is a fair average:

Hygrometric water	1,660
Water of composition	3,630
Peroxide of iron	.603
Soluble baryta	.724
Gangue (barytes)	1.728
Oxygen (by loss)	7.035
Peroxide of manganese	84.620
	100 000

*Mineralogy of Nova Scotia by Prof. How, D.C.L.

each case, and a separate steam engine was used for swinging the derrick. The comparison made was between a crude cableway and a derrick of the most modern type, the latter operated by a high speed engine and swung by steam. The recent improvements in cableways would probably make a still more favourable showing for the cableway, possibly 25 per cent.

On this plant, chain connected fall rope carriers (Fig. 3) were used to support the hoist rope between the towers, and the carriage, which consisted of a series of blocks, with 8 in. or 10 in. wheels to run on

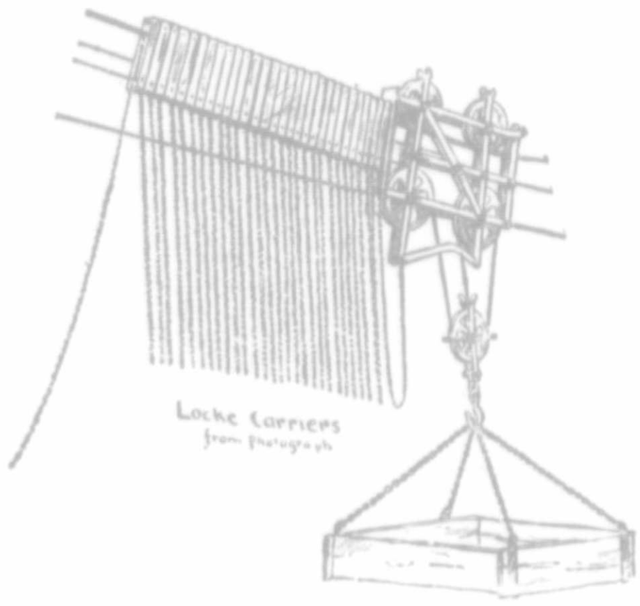


FIG. 3.—Chain Connected Fall Rope Carriers.

the main cable, spaced about every fifty feet, connected with ½ in. chains. These heavy and cumbersome fall rope carriers were the source of much annoyance. The hoisting rope does not need supporting oftener than every 100 feet, but with the chain connected carriers, the chains themselves must be supported so as to be out of the way of obstructions below, in fact the chains must not hang lower than the skips, say 15 feet. This brings the carriers 20 to 30 feet apart. The weight of the chains and carriers used on this plant was about a ton. The chains would swing about and get entangled in the fall block, and with each other; they limited the speed, and wore the cable, added to its strain and increased the power required in conveying the load fully 40 per cent.

Long and high speed cableways were not practicable with the chain connected fall rope carriers Figure 4 shows the first departure

tions in that section of country at as early a date as possible, and more particularly with reference to the boring explorations which have already been made there.

"Further your Committee believe it to be in the public interest that the Inspector of Mines for Quebec be commissioned to report to his Government at the earliest practicable date, in the form of a monograph, the fullest possible information respecting past operations in, and future possibilities of, that subject.

"It is also the opinion of your Committee that the policy of prompt examination of mineral fields being newly explored or developed, should be adopted by the Provincial and Dominion Governments, so that special bulletins containing all the information available should be issued for the public benefit."

DR. GOODWIN: This report really means that it is the opinion of the Institute that a policy of prompt examination of fields that have been newly discovered or newly developed should be adopted by the Geological Survey and the Provincial Governments.

The report was adopted.

MR. BELL moved that the balance of the business stand adjourned until the evening. The meeting then took up the constitution of the Canadian Mining Institute.

EVENING SESSION.

At the evening session Mr. Percy Butler (McGill) presented a carefully prepared paper "On the Mœbins Processes for parting Gold and Silver as carried on in the Guggenheim Smelting Works, Perth Amboy, N. J." illustrating the subject with a number of excellent stereoptican views.

MR. JOHN BIRKINBINE: Mr. President, I think that any discussion on this paper would be practically a repetition of what has been said. I think that the scope for the young engineer to-day, or the field for the young engineer in electro-metalurgy and electro-chemistry is greater than ever before. We have in our colleges quite a number of young men who are graduating as chemists and metallurgists. Now what we want to do is to bring together the electrical engineer and the metallurgist. He is going to fit himself for important positions in the future. It seems to me that there is a large field for those who take up electricity; not as you and I learned it, because when I studied about electricity it was a practically unknown quantity compared to what it is to-day. You must remember in 1876, at the centennial exhibition, over 20 years ago, there was an electric light shown which illuminated a portion of the buildings and sometimes it did not. Seventeen years after that Chicago was a blaze of glory. That is merely an indication of the pro-

THE CHAIRMAN: Is this not going beyond the scope of our Institute, into politics?

MR. BELL: There is a difference between matters of policy and politics. I take it it is quite within the sphere of a body of mine owners and mining engineers to discuss methods of legislation likely to affect the interests of the industry.

After some discussion Mr. Braden's resolution was held over until the Friday session.

MR. F. T. SNYDER submitted his paper on "Some Modern Forms of Mining Machinery." The paper was discussed by Messrs. Hardman, Miller and Snyder.

The session adjourned at one o'clock.

THAT CIVIL ENGINEERS' BILL.

The members met at three o'clock, the President in the chair.

PROF. MACLEOD (Secretary of the Canadian Society of Civil Engineers) explained that immediately it was found that the clause respecting mining engineers contained in this Bill was objectionable to the Mining Institute it was withdrawn.

THE CHAIRMAN: So far as we are concerned we did feel that any legislation governing the profession of mining engineering should emanate properly from an institute representing mining engineers, and not from a body of civil engineers.

MR. P. W. ST. GEORGE, C.E.: We only hope that instead of, as we saw in the papers, your opposing the Bill going through any other House, you will do all in your power to help us.

THE CHAIRMAN: Certainly; as long as you leave the mining engineers alone. I hope we will all move for the good of the profession.

THE SECRETARY: It would have been better if the Canadian Society of Civil Engineers had sought our co-operation before.

MR. JOHN BIRKINBINE then delivered an address on "Commercial Progress as Influenced by the Development of the Iron Industry."

MR. BLAKEMORE moved a vote of thanks to Mr. Birkinbine for his valuable contribution to their proceedings.

MR. MERITT seconded, and the motion was carried by acclamation.

THE PROGRESS OF MINING IN ONTARIO.

MR. A. BLUE, Director of Mines, reviewed the progress of mining in Ontario, quoting the following summary of the mineral production of the Province:

down to the blast furnace as "autimony skimmings." Through a discharge-spout at the flue end of the furnace the molten bullion runs into the desilverizing kettles located on a lower level.

Threse kettles, which are large cast iron bowls embedded in the floor and heated underneath by furnaces, are used to separate the precious metals from the lead. This is done by what is known as the Parke's Process, which is based on the fact that silver and gold have great affinity for zinc when all are in the molten condition, and will combine with it to form an alloy which is lighter than lead and does not dissolve into it.

The operation is as follows :— Zinc is added in three separate portions and intimately mixed with the bullion by means of a mechanical stirrer. In the first two 'zincings'—as the additions of zinc are called—not quite zinc is added in order to have the zinc saturated with the precious metals, whilst in the third zincing the product of which forms the first zincing of the next charge, a larger quantity is added than necessary so that no silver etc., may remain. After each successive addition of zinc the temperature is lowered and the zincings—in the form of skimmings—are transferred by means of perforated scoups from the surface of the molten lead to a perforated iron box, called a skimmer.

The skimmer (Plate 5) is cylindar shaped and consists of an air-tight chamber, *A*, rigidly connected to a perforated box, *B*. Between the chamber, *A*, and the box, *B*, is a sliding cover, *c*, which fits into the box, *B*. This cover is attached to *A*, in such a way that when steam under a pressure of 65-85 lbs. to the square inch is introduced into the chamber *A*, through a pipe *S*, the cover is forced down compressing the contents of the skimming-box This skimmer is raised and lowered by means of an overhead electrical travelling crane which can be used for any of the four desilverizing kettles.

The desilverized lead is then siphoned off into another furnace, where it is further refined to free it from traces of excess of zinc ; and from this it is tapped into a sump. Here, the lead remains for a short while and is finally siphoned off into moulds and when cast is ready for shipment.

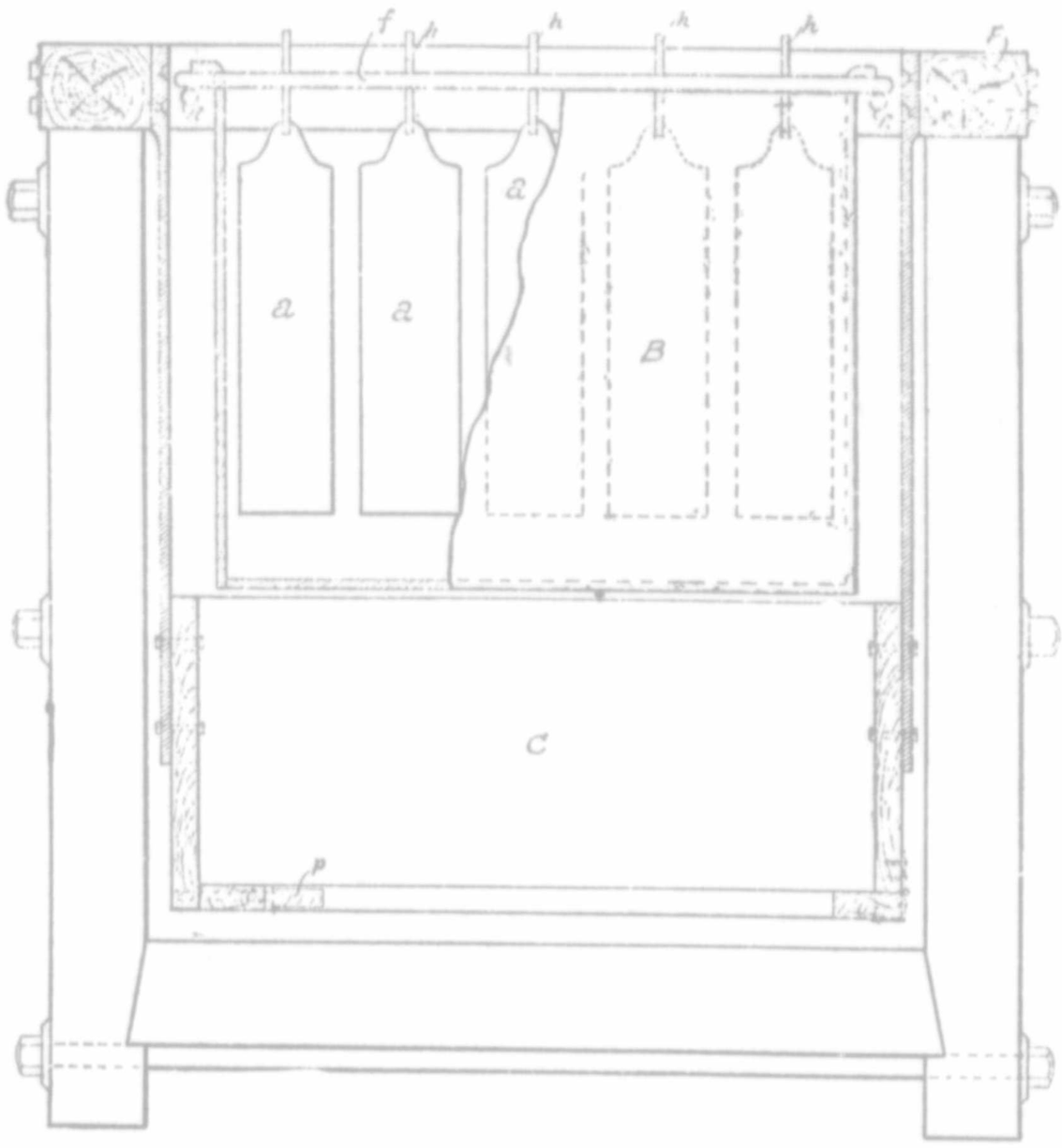


PLATE 8. CROSS-SECTION OF TANK-CELL SHOWING CANVAS BAG CONTAINING THE ANODES.

P BUTLER
(Del)

If I have taken much of your valuable time this afternoon, I plead in extenuation of my offence the vastness and richness of the subject, "the mineral wealth of Canada." (Loud applause.)

MR. HAMILTON MERRITT: I wish to congratulate you, Sir, on the admirable address you have given us. With respect to my own Province, Ontario, I would only remark that the gold mining industry is rapidly taking a prominent place. The important additions to the milling capacity of the Province, warrants us in the belief that the increased production in 1897 will be continued during the coming season. I beg leave to move a vote of thanks to the President for his excellent address. (Applause.)

ALDERMAN DAVIES (Toronto) seconded the motion, which was carried unanimously.

Mr. E. D. INGALL: With regard to gold mining in Ontario I would like to bear out all that Mr. Merritt has said. One point, however, that has not been emphasised enough is that throughout that Province there are areas of Huronian rocks, and among these, beyond any question, there will be found just the conditions which are shown to be those of the Lake of the Woods and Rainy River districts. Another point to which I would like to draw your attention is that in the report by one of our staff on the Nova Scotia gold fields, there will be found very much that is applicable to the gold bearing region of Ontario. I think we may regard with considerable confidence the future of gold mining, not only in Nova Scotia and British Columbia, but in the centre portion of our Province of Ontario as well. (Hear, hear.)

MR. J. OBALSKI then read his paper describing the year's mining operations in the Province of Quebec.

MINING LAW AND ITS BEARING ON THE DEVELOPMENT OF MINES AND MINING DISTRICTS.

MR. FRANK C. LORING (Rossland) presented his paper on this subject.

MR. J. F. LATIMER (Toronto) referred to some of his experiences in British Columbia last season. He had known posts to serve in many cases for two locations. There were discovery posts sometimes where there was no mineral at all.

DR. GOODWIN (Kingston): I notice that many of the things which are advocated by Mr. Loring are at present embodied in the Ontario Mines Act.

MR. MERRITT: The Ontario Mining Law might be greatly improved by the acquisition of some features in the law of British Columbia.

Mode of Procedure.—The cathodes are scraped once every day and the deposited silver removed to the melting room; this is done as follows:—The tank is disconnected and the whole of the frame-work together with the electrodes and collecting-boxes is lifted clear out of the solution; the cathodes are then 'stripped' by means of a pair of silver-tipped tongs—the deposited silver falling into the collecting-boxes These boxes are about 22″ square and 10″ deep, made of ¾″ pine and provided with a hinged grid-bottom covered over with canvas to allow the solution to drain off but which retains the silver. The frames are then raised about 2′ higher and the pin which holds the grid-bottom in place is knocked out when the bottom falls depositing its load of silver into a wooden tray previously placed underneath. As soon as all the cells have been relieved of their silver which is sent to the melting room, the frames are lowered and the tanks connected up again.

The gold, which is retained in the canvas bags in the form of a dark slime, is washed in three different waters and sent to the gold room to be refined.

(ii.) The Improved Moebins Process which, as its name implies, is only a modification of the former process makes use of a silver belt as an anode instead of silver sheets. Before I left they were using this in 12 tanks and were engaged in putting up 60 new tanks to be used in this process.

The tanks are arranged in twelve sections separated by 4′ aisles and each section consists of six tanks, arrayed in 3 tiers, 15″ apart; three iron cross-pieces rigidly attached to pillars and extending on either side of them form supports for each pair of tanks. The distance from the floor to the top of the uttermost tank is 5 feet 6 inches. The tanks themselves are made of one piece of pine wood 14 feet 3 inches long, 16 inches wide and 7 inches high, gougeed out in the centre and lined inside with canvas cloth and coated all over with an acid-proof paint.

In each tank there are 24 frames—known as diaphragms—about 18″ × 4″ and 1½″ deep, whose bottom consists of canvas, and in this an anode is placed resting on hickory supports. Running underneath and within ½″ of the frame bottoms is a belt 31′ × 15″ made of rolled sheet silver 1-32″ thick, on the outer surface of which the silver is deposited;

rival to meet it on equal terms being the Island of New Caledonia with its unlimited resources of nickel silicate, only a part of which are controlled by the French company 'Le Nickel.'" Again, on page 330 (Mineral Statistics, U. S., 1896): "At present, either one of the two great nickel regions of the world, namely, that near Sudbury, in Canada, or that upon the Island of New Caledonia, is capable of supplying all the nickel needed for the world's consumption; neither region is worked to half its capacity and neither need fear exhaustion even at an increased output for many years. It cannot be seriously maintained that these two rather small districts possess all the available nickel of the world, and we may as reasonably expect some future discoveries of resources still better than these as to apprehend that these will be exhausted or prove inadequate for the world's needs." Even stronger than these is the statement of Mr. Robt. M. Thompson, President of the Orford Copper Company, who sends me the following wire: "A Canadian export duty will close the United States market to the product of the Canadian mines, unless the mines pay the duty by lowering their prices, because the New Caledonia mines can supply the world's demands and are willing to sell us all the ore we require as low and even lower than the prices we now pay the Canadian mines. This applies as well to so much of the European consumption as is supplied by our refinery from Canadian mattes, aad these two items cover all the present Canadian products. Very few appreciate how small is the consumption and how great is the difficulty of refining nickel. We established our refinery at New York because we obtained there a reagent necessary for our process, and which is a by-product of chemical manufactures not working in Canada. To ship this into Canada will make the cost prohibitory." The statements of these eminent authorities are worthy of consideration, clearly indicating as they do, the danger that threatens our nickel mining and smelting enterprises if the pernicious representations of a few company promotors should result in an export duty being placed on this mineral.

As a matter of fact the mining industries cannot yet bear the burden of creating prematurely by main force all the other industries which may become desirable hereafter. Additional duties laid upon it will only weaken it without producing the benefit intended; neither the copper mines nor the nickel mines can stand the imposition of an export duty. Let the mining industry have a fair chance to develop and strengthen itself; to gather a population of consumers around it; to give natural birth to associated and auxiliary industries. Then the situation may be different. At present the proposal of an export duty is distinctly unwise, because premature—to say nothing of all other reasons for opposing it. I beg, therefore, to submit the following motion:

The Halsey Pneumatic Pump.

By Charles Fergie, M. E., Westville, N. S.

In bringing before the notice of this Institute the Halsey Pneumatic Pump, the writer does not claim anything original for the system of pumping water by the direct pressure of air. The system, though well understood for very many years past, has found little favor in actual mine practice, and this, no doubt, owing to the fact that there has not been, until quite recently, a satisfactory pump on the market.

There are now working at the Drummond Colliery two Halsey Pneumatic Pumps. The first was put to work eighteen (18) months ago, and so satisfactory has it proved that the writer had no hesitation in ordering a second, which has just been put to work. During the eighteen months the first pump has been at work it has not cost one cent in repairs; it is automatic in action and requires little or no attention, and shows a saving in consumption of air of at least 21 p. c. over and above that of a straight line plunger plump, formerly employed to do the same work.

A test was made in the mine with the Halsey and the straight line pump under identically the same conditions, and against the same vertical head. The test was made on a slope 414 feet long, and against a vertical head of 120 feet. The pumps were placed one on each side of the slope, each took its water from the same source, and delivered it at the same point. The compressor at the surface is distant 3,000 feet from the pump; the pipe line consists of 5 inch pipes for the first half, and 4 inch for the second.

When making the test for each separate pump all other work was stopped, and the compressor was simply to supply air for that particular purpose. Indicator cards were carefully taken at the compressor engines, and these brought out the fact that to do the same amount of work under similar conditions, the Halsey pump consumed .41 h. p. per gallon of water pumped, as against .52 h. p. for the straight line pump, or a saving of 21.16 p. c. in favor of the Halsey pump.

REORGANIZATION RECOMMENDED.

MR. JOHN E. HARDMAN presented the following report on behalf of the Committee appointed to enquire into the advisability of reorganization :

The Committee appointed by the Council of the Institute on the 29th of January, to take into consideration the present status of the Canadian Mining Institute and its ways and means, and to suggest such changes or alterations as might be thought expedient to advance the interests of the Institute or of its aims and objects, beg leave to report as follows :

After inquiring into the revenue of the Institute (which is based upon a contribution per capita of all the provincial associations comprehended in the federation), and into the expenses necessary and attendant upon the proper editing and publication of its transactions, and of the other expenses necessary to the proper carrying out of the objects of the Institute, find that the amount hitherto assessed upon the provincial organizations has not been sufficient to properly liquidate the expenses in any one current year.

Moreover, since the annual fee varies greatly among the constituent members of the Federation, it is not feasible to increase the amount of the assessments hitherto made. The Committee therefore considered in what other way the objects of the Institute might be furthered, and as the result of such consideration have arrived at the conclusion that the best means of promoting the welfare of the mineral industries of Canada will be through the formation of a new organization.

The members have already been acquainted with the proposed reorganization through the medium of a circular issued from the Secretary's office, under date of February 7th, a copy of which is attached as forming a constituent part of this report. Accompanying this circular was sent out a draft of constitution and by-laws (also attached) of the new organization, which your Committee recommend the Federation to promote.

We are not impressed with the necessity of adducing further reasons for our action than those stated in the circular, but we think that the Federation can most properly undertake the regulation of the practice of the professions of mining engineering and metallurgy, and not leave it to our brothers of the civil engineering branch to attempt its regulation through the medium of the Canadian Society of Civil Engineers.

We consider that the Federation has successfully accomplished the purpose of its foundation in that it has brought together, greatly for their mutual benefit, the different members of the different provincial organizations, and has created and extended a knowledge of our resources, methods and different personalities, and at the same time (as is shown by the two handsome volumes of transactions already published), has economized the

The precipitate (Ag Cl) is filtered by air suction, dried on the furnace flues and sent to the concentrators of the lead plant (plate 11).

Melting Room.—The silver removed from the tanks—of either process—is brought to the melting room where it is melted in large retort furnaces. These furnaces (plate 12) are made of fire-brick built into an iron frame supported on trunnions, and which, for the purpose of pouring are capable of being tilted by means of a lever. The heat is obtained by oil fuel burned with a blast. The retort which is made of a compound of which graphite is the predominant ingredient lasts long enough to refine about five tons of silver.

The silver is cast into bricks weighing from 1,000 to 1,175 ounces each; and a smooth surface is obtained by burning a little sugar on the molten surface of the casting and covering for a short while.

It is not within the scope of this paper to discuss the respective merits of the two processes just described, but I may say that on account of so much oil being used on the belts the silver deposited by the Improved Process was quite saturated with it and—though thoroughly washed—on being refined destroyed the graphite crucibles more rapidly than the silver from the sheets.

In conclusion, the plant has a daily output of from 24,000, to 28,000 ounces of silver varying in fineness from 940 to 990; but the additions in progress at the time of my leaving are expected to raise the output to three tons of silver per day.

Nevertheless, the cost of milling is remarkably low, being about 58 cents per ton. The loss of mercury is also exceptionally low, running about 3½ pennyweights per ton of ore. The capacity of the 1,000 pound stamps of this region is about 2.4 tons per stamp per 24 hours. The tendency is, however, to go back to the 850 pound stamps.

Bendigo, Victoria, Practice.— This district has also been famous since the first discoveries of gold in 1851. In 1892 the production of gold from quartz reefs was $3,500,000 approximately. The general working of the mills in this region is very much the same as in Ballarat, therefore little need be said of them. The stamps are about 900 pounds each, made up as follows:—

Stem	325 lbs.
Tappet	66 "
Head	159 "
Shoe	198 "

The speed varies between 68 and 75 drops per minute. The height of drop is between 8 and 9 inches. The depth of the discharge is two inches when the dies are new, but increases to 6 inches as they wear down. The crushing capacity is about 2 tons per stamp per 24 hours. The screens used are perforated sheet metal (iron or steel) containing from 120 to 180 holes per square inch, the most widely used one having 143 holes to the inch, and their diameter is .023 inches. These screens last only 8 working days. The absence of rock breakers and automatic feeders must be noted here also, and, in fact, throughout the whole of Australia The gold saving is commenced in the mortar by the addition of mercury, and is followed by amalgamating tables, wells and blankets The tables are plain copper, 5 feet wide, 13 feet long, and the grade is 1⅛ inches per foot. The wells are 5 in number, only the first two of which contain mercury. The blanket strakes are 5 teet wide and 13 feet long. The blankets are washed every two hours. In most mills no further concentration is done, although lately one mill has introduced the Gilpin County shaking tables, which give good results. The loss of mercury is 7 pennyweights per ton of ore. The amount of water consumed varies from 4 to 7 gallons per stamp per minute. About one-half the gold

stake mill an effort is made to keep this uniform. When new dies are put in a seven inch chuck block is used making the depth of discharge 9 inches. After two weeks it is replaced by a 5 inch chuck block the difference representing the wearing down on the dies for that period. Just before new dies are put in the depth of discharge has reached its maximum of 11 inches.

The stamps run from 850 to 900 pounds. The rate of drop varies between 85 and 90 per minute, and the height averages 9½ inches, but there is a tendency to slightly increase this. It is here that the marked distinction between Gilpin County and Black Hill practice is to be seen. The capacity of the latter region is 4 tons per stamp per 24 hours, nearly 4 times as much as in Gilpin County. The screens used in the Homestake mill are No. 8 diagonal slot punched Russian iron, which is equivalent to 30 mesh. These screens wear out very rapidly, seldom lasting longer than one week.

In some of the mills two amalgamated plates are used inside the mortar, but in the greater number only the front plate is used. It is made of plain copper, 5 inches wide, 3-16 inches thick, and extends the whole length of the mortar. This plate is fastened to the chuck block by means of screws. Mercury is fed into the battery at a rate depending upon the richness of the ore, and is regulated by the condition of the amalgam on the outside plates. At the Deadwood Terra mill (160 stamps) 10 pounds 14 ounces of mercury are consumed every day. The figures for the Golden Star mill (160 stamps) are 24 pounds 3 ounces. This great difference is accounted for by the fact that the ore treated in the latter is considerably richer than that treated in the former. About 78 per cent. of the mercury used is saved. The water consumed at the Homestake mill is about 1½ miner's inches per battery of 5 stamps per day. This is at the rate of 3 gallons per stamp per minute, and this may be taken as a fair average of the whole district.

As the pulp issues from the mortar it drops six inches to the apron plate. This fall is broken by a splash board which prevents the pulp from scouring the plate. The apron plates are usually 10 feet long and 4½ feet wide. They are of the best Lake Superior copper, and are made

The pulp as it leaves the blanket strakes is not further treated, as the concentrates are of too low grade to warrant working. The loss of mercury is 8 5 pennyweight per ton of ore, and this rather large amount is due, no doubt, to the high speed at which the amalgamating barrel is run, which should only have about 14 revolutions per minute instead of 20. Over 60 per cent. of the gold comes from the battery residues, and the remaining 40 from the blankets. Some few mills in this district use copper plates, but it is evident that if blankets will catch the gold (and they do so) they are to be preferred to plates as being less expensive, and requiring less care. One boy can attend to the blankets belonging to 15 stamps. It is a remarkable fact that one mill in this district, the Invincible, collected the gold by adding the mercury to the mortar, then by copper plates, wells, and finally blankets. As an experiment the supply of mercury was stopped and only blankets were used, and the amount of gold recovered actually increased. There is no doubt that the gold is remarkably suited for collection on blankets owing to its coarseness. The cost of milling is about 70 cents a ton, and the yield from 10 to 11 pennyweight

The following table gives the cost of milling and the yield in pennyweight, and other information regarding the district herein described :

Name of District.	Yield of Ore in dwts. per ton.	Cost of Milling in cents.	Weight of Stamps.	Crushing Capacity in tons.	Percentage of Concentrates.	Contents of Concentrates, ozs. per ton.	Loss of Mercury, in dwts.	Consumption of water in gallons per stamp per minute.
Gilpin County, Colorado....	6 — 8	75	550	1.0	12 —15	1 — 1½	3½— 8	1½— 2
Black Hills, Dakota	4½	70	850	.0	....	....	5	3 — 3½
Grass Valley, California	5 — 7	81	850	1.6	2½— 3	3 — 5	9 —14	3½— 4
Ballarat	8½— 9	56	1000	2.4	1 — 3½	1½— 3½	3 — 5	5 — 7
Bendigo	9 — 9½	58	900	2.3	1 — 2	1½— 2½	7 — 9	6½— 7½
Otago	10 —12	70	800	1.5	....	....	5 — 8	3½— 5

In the preparation of this paper the writer is indebted to the following works on the subject :—Stamp Milling, Louis ; Stamp Milling, Rickard ; Metallurgy of Gold, Rose ; Gold Milling in the Black Hills, Hofman.

British Columbia contributes to the total production of gold in 1897, 130,009 ozs., valued at $2,080,600.

Nova Scotia.—The output of gold for the past year is estimated at 29,000 ozs. of a value of $565,500.

In this field the work is being carried on quietly, but yet upon a practical and profitable basis, that must sooner or later attract the favourable attention of outside investors.

During the past year marked improvements have been made in the methods of gold saving and methods of working. Future success will come from the development of low grade ores, and here it is worthy of remark that the Richardson mine at Country Harbour has increased its milling capacity from 40 to 60 stamps. This is the largest gold stamp battery so far in Canada. The working costs are worthy of notice, the ore yielding something like $4 per ton, being won at the low cost of $1.60 to $1.65. Several of the Nova Scotian mines paid the owners good fair profits on the operations of the year.

It is gratifying to note that the recommendation of the Mining Society made last year to the Provincial Government, to appoint a metalliferous engineer to the Mines Department, has been favorably received, and it is hoped that a thoroughly capable and experienced metalliferous engineer may be appointed.

Quebec.—The operations in gold have been confined to one or two small companies doing work in Beauce County. The actual value of the output has not been reported. Some attention is being directed again to operations on the Chaudiere. One or two companies with small capital have been organized, and it is hoped that their efforts may be rewarded sufficiently to induce more attention on the part of capitalists to this unquestionably promising gold field. A vein of gold quartz is reported as having been located at Dudswell, on the line of the Quebec Central Railway. It is hoped that this will prove worthy of further investigation.

Ontario.—The Director of Mines reports the gold yield for the past year as follows :

Gold ores treated, 1897, 27,590 net tons, yielding gold, 11,412.17 ozs., of a total value of $190,244.00, being an increase of some $70,000 on 1896. This is largely from the Lake of the Woods and Rainy River districts. The 1897 output would have been greatly increased if the Sultana, the principal producer, had not been closed for the larger portion of the year, installing new mill and other machinery.

No figures have been reported as yet regarding the work in Hastings County, where quite extensive operations have been conducted by English syndicates on the mispickel ores, which have demonstrated profitable extrac-

This trade from the coal fields of the Maritime Provinces is one of very great and growing importance to the port of Montreal.

Comparative figures as to the tonnage of coal carried over the Intercolonial Railway from the Nova Scotian collieries to Chaudiere Junction and St. John for points west thereof, including tonnage to local stations, in the year 1895-6, as against the tonnage at the commencement of the trade in 1876, afford the best evidence of the growth of the business and its importance to our Railway systems :

In	1876-77	103,420 tons.
	1895-96	432,513 "

Coke.

Nova Scotia reports a production in 1897 of 58,000 tons of coke.

We are without actual figures of the production of coke in other sections, but it is gratifying to note that the coal companies of the Dominion are gradually extending their trade, export as well as native, through the medium of their coking plants.

Iron.

Blast Furnaces.

During the earlier months of the year the Nova Scotian furnaces, as well as the one situated at Hamilton, Ont., were practically closed down, awaiting the decision of the Government regarding tariff questions affecting the industry. That happily settled, the furnaces went to work, (the Hamilton furnace as late as 29th June) with the result that at the close of the year the returns show an output of coke iron pretty well up to that of 1896, and an increased output in charcoal iron. Advices received from New Glasgow, N.S. Londonderry, N.S., Radnor Forges, Que., and Hamilton, Ont., report a combined gross production of about 57,904 net tons of pig iron, 18,562 net tons of steel, 1,403 net tons of forgings, 4,646 net tons of bar iron, puddled bar and other finished products, the three last mentioned items reported by the Londonderry Iron Company.

The capital invested, the number of men employed, and the quantity of materials used, remain practically about the same as in 1896. The output of charcoal iron at the Radnor Forges furnace, included in the above returns, shows an increase of 50 per cent. over the operations of 1896. The whole outlook in the Canadian blast furnace business is promising. Tariff questions are at last upon a more settled basis, the wants of the country are increasing, and furnacemen and capitalists feel encouraged to go ahead and place the Canadian plants upon a thoroughly modern basis.

The chief interest in the analysis of the mineral from the economic point of view is the presence of tin in it. Minerals of the same class as this are often associated with tinstone, as are also the other minerals present in the deposit, a considerable area in the district contains rocks in which fluor spar and other fluorine and boron holding minerals occur. It would seem therefore, that these rocks shonld be carefully examined for other deposits in which tin may occur in greater amounts.

A quantitative analysis, in which however, the separations were afterwards shown to be imperfect, indicates the following composition :

Rare acids	75.75	per cent.
$Sn\ O_2$	0.92	"
Fe O	11.14	"
Mn O	10.22	"
Cu O	0.03	"
Rare earths	2.00	"
	100.06	

Among the rare acids niobic and titanic were identified. The rare earths present in this mineral include ceria, didymia, and the gttrium group.

hopper as a center. This cableway is now being remodelled, so that this tail towers will travel on wheels.

A peculiar form of bucket, known as the drag bucket was used for digging the placer, see Figure 11. In the operation of this machine the bucket is carried over the point where the material is to be dug. The pocket is then lowered to the ground, where it automatically settles into a position favorable for digging. The carriage is then run forward leaving the bucket on the ground. When the direction of the ropes leading from the carriage to the bucket is favorable, the hoisting line is hauled in and the bucket dragged along the ground, and the teeth of the bucket will plough into and cut their way through the gravel and the bucket completely fill, after which it is hoisted, conveyed and dumped automatically into the hopper.

Material from the hopper passes through a 5 foot 6 inch grizzly which separate the rocks and boulders, which pass down the chute to one side. This sluice is 30 inches wide and about 200 feet long, with iron riffles made of "T" iron in the first two boxes and with end wood riffles the remainder of the length. The tailings are delievered 25 feet above the ground level, and dispose of themselves without rehandling.

The hopper tower was built of 8 x 8 timbers on account of the fact that that size of timber was easily obtainable at the point; 10 x 10 timbers, or even 12 x 12 would make a better construction. At the top of the tower there is an auxiliary tower, or bonnet (supporting the main cable) which revolves, accommodating itself to the position the main cable occupies. This is done without the disturbance of the ropes leading from the head of the tower down through guiding sheaves to the engine. The engine is of special form, built by the Lidgerwood Mfg. Co. of New York, and has 10 x 12 cylinders, drums, 33 inch diameter; operating levers are carried to the rear convenient for the lever-man. The main cable is of 1¾ inch diameter crucible steel. This cableway has actually handled over 400 buckets in 10 hours. The bucket handled 1½ yards of material.

In spite of the heavy cost of fuel and labor, the actual cost of the material handled does not exceed three cents per cubic yard. With this particular cableway in operation, with its fixed tail tower, it was

Note on a Mineral of the Columbite Group.

By Dr. W. L. Goodwin, and Prof. W. G. Miller.

I had hoped, when I gave notice of this short paper, to be able to complete an analysis of this interesting mineral. But unexpected difficulties arose in the separations, owing to the presence of an unusually large number of the rare elements. The time has been too short to dispose of these difficulties, and I am therefore obliged to lay before you an analysis which is still very incomplete. For several years some of us have been on the watch for minerals containing the rare earths, judging that they would be likely to be found in the crystalline rocks of Eastern Ontario. Last summer, Professor Miller found the mineral under consideration, of which he gives the following description :—

"The mineral was obtained from a deposit in the Township of Lyndoch, Renfrew Connty, Ontario. The occurrence is on the side of a hill and the exposure is rather small. There is little chance for determining the character and relations of the deposit, on account of the immediately surrounding rocks being covered.

"The rock in which the mineral oocurs is made up chiefly of quartz and felspar, and it is therefore of the composition of a pegmatite. Both of these minerals occur in pieces of a large size. The quartz is more or less smokey in appearance. The felspar is partly pink and partly green. In thin sections under the microscope it is seen to be a perthite having a basis of microcline, through which is set another plagioclase.

The mineral under consideration is black, has a submetallic lustre. One specimen which was examined had a specific gravity of 5.36. It occurs in thin layers and nodule-like forms in the felspar. The nodules show a concentric structure. The structure and occurrence are illustrated in the accompanying photographs. In the same deposit occurs also, black mica, beryl, tourmaline, fluorspar and two other minerals of which no identification has yet been made.

The author prefers, however, whenever the conditions permit, to employ an engine with tandem drums, constructed however with special reference to cableway work.

Recent developments heve been in the direction of increasing the capacity of the cableway by increasing the number of trips per day. This has been largely accomplished by the use of the device known as the ærial dump, figure 7, whereby the act of delivering the load from the skip is done automatically by the moving of a lever by the engine man so that the load may be automatically delivered at any point desired. This not only saves a man for releasing the load, but it also largely reduces the time required for dumping the load.

A further improvement, namely, that of making the entire plant movable, has brought the cableway up to a position where it is a long distance travelling crane. (Fig. 8.)

In one of the iron ore mines in the Lake Superior region, the experiment was tried of remodelling one of the modern cableways, so as to operate a self-filling grab bucket. The experiment was partially a success. It required, however, some very material modifications to the machine in order that the operation should be entirely successful. At the present time that feature has been made an entire success, (Fig. 9) and two have been built to excavate sand from the bed of a river and deliver it to bins on dry land, where it is screened and shipped to St. Louis. This machine represents one of the most modern labor saving improvements as applied to the modern cableway. One of these plants has, by actual count, made 33 trips in 44 minutes. It averages, however, from 30 to 40 trips per hour, or from 300 to 400 trips per day. The bucket has a capacity of one and a half yards. The amount of material actually delivered is 18 car loads per day, averaging 18 yards per car, bringing the total up to 324 cubic yards. To deliver this amount of material to the bins requires a labour force of,

One engine man at	$2 50	per day.
One fireman at	1 50	"
One signal man at	1 25	"
Fuel (say)	2 00	"
Oil	25	"
	$7 50	

cost of publication of these constituent societies. Recognizing, however, that Canada is but just beginning her career as a mineral country, and that our position is much more prominent to-day than ever it has been, we cannot be blind to the necessity of providing more funds for the proper publication of our transactions than the Federation possesses under its present form of organization. It is only necessary to point to some of the drawings which are attached to papers printed for this meeting, to appreciate the necessity of improving in this direction.

Respectfully submitted for the Committee.

J. E. HARDMAN
Chairman.

March 2nd, 1898.

THE SECRETARY believed that Canada as a mining country was too young yet for the establishment of an exclusive corporation, and he would favor a new organisation on the broadest lines possible. With respect to existing provincial organisations it was not intended to interfere with them in any way. Some of them only existed in name and would go out of existence with the organisation of the new Institute.

MR. DIMOCK: I fully concur with Mr. Bell's idea — the membership should include all who are in anyway interested in mining. I am very glad to hear Mr. Bell say that it was not intended to do away with the provincial associations. We in Nova Scotia desire to maintain our society, for many Nova Scotia mining men can get into Halifax once a year to attend our meetings who could not get away to a meeting outside of their own Province.

MR. E. D. INGALL was heartily in favor of the organisation of a strong representative body of Canadian mining men.

THE CHAIRMAN: So far we have always worked harmoniously together. It is to be hoped that the members of the provincial societies will feel that the new organisation will in no way interfere with these interests.

THE SECRETARY: The question before the meeting is, whether we shall dissolve the present Federation, and in order to bring the discussion to a focus, I would therefore move: That this meeting adopt the report of the Committee, and Resolve that the Federation be dissolved at the close of the present sessions.

MR. MERRITT seconded the motion.

The Chairman put the motion, which was carried unanimously.

THE SECRETARY moved: That Messrs. Hardman, Blakemore, Stevenson, Wylde, Fergie and Hamilton Merritt be a committee to consider the best means of winding up the affairs of the Federation.—Carried.

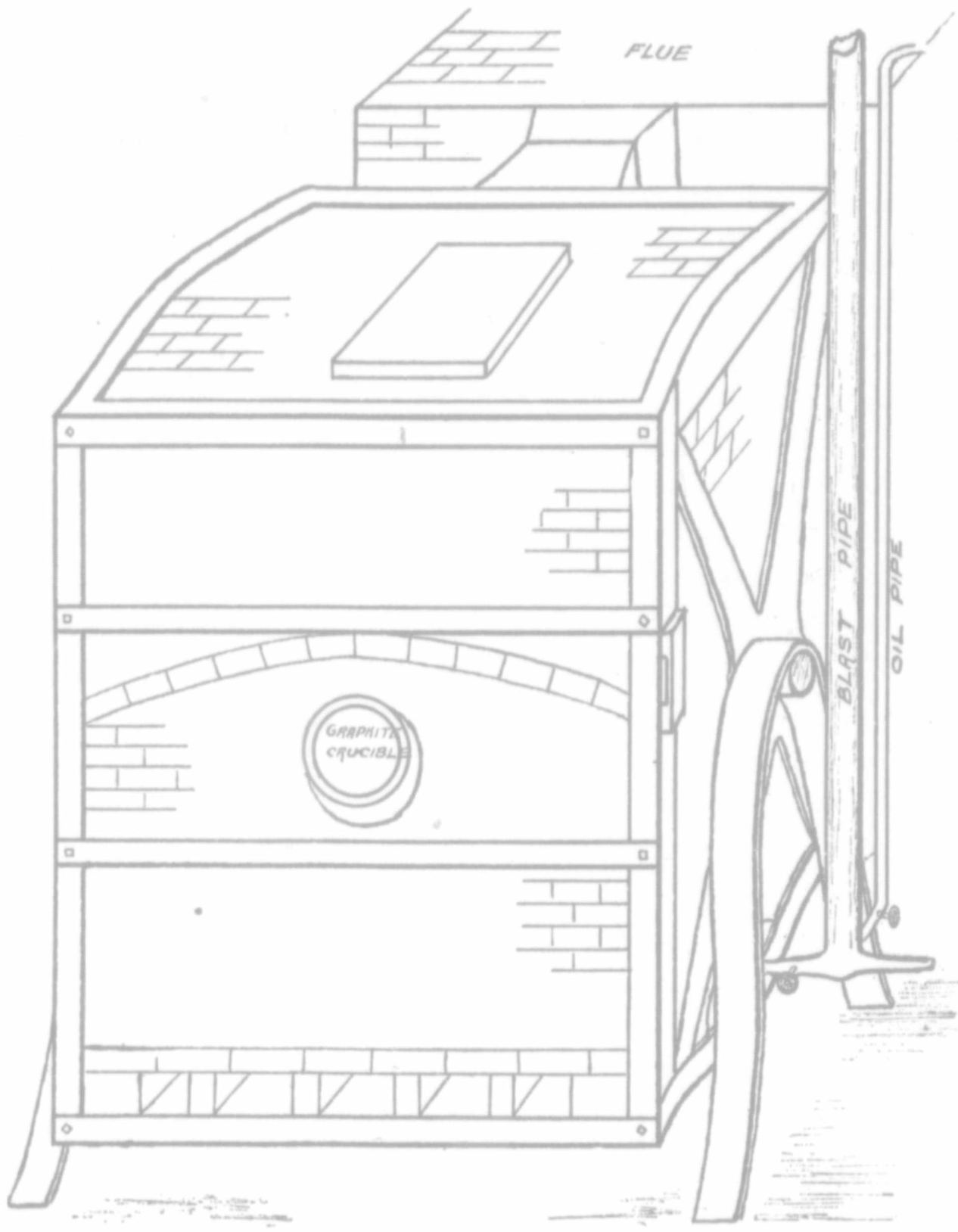
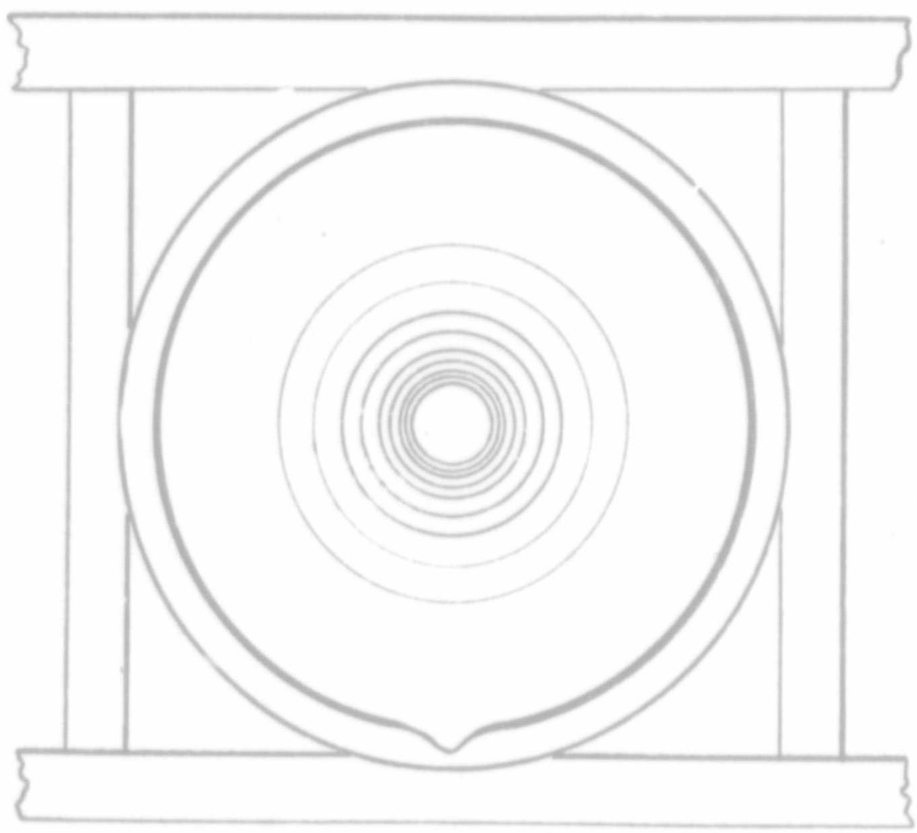
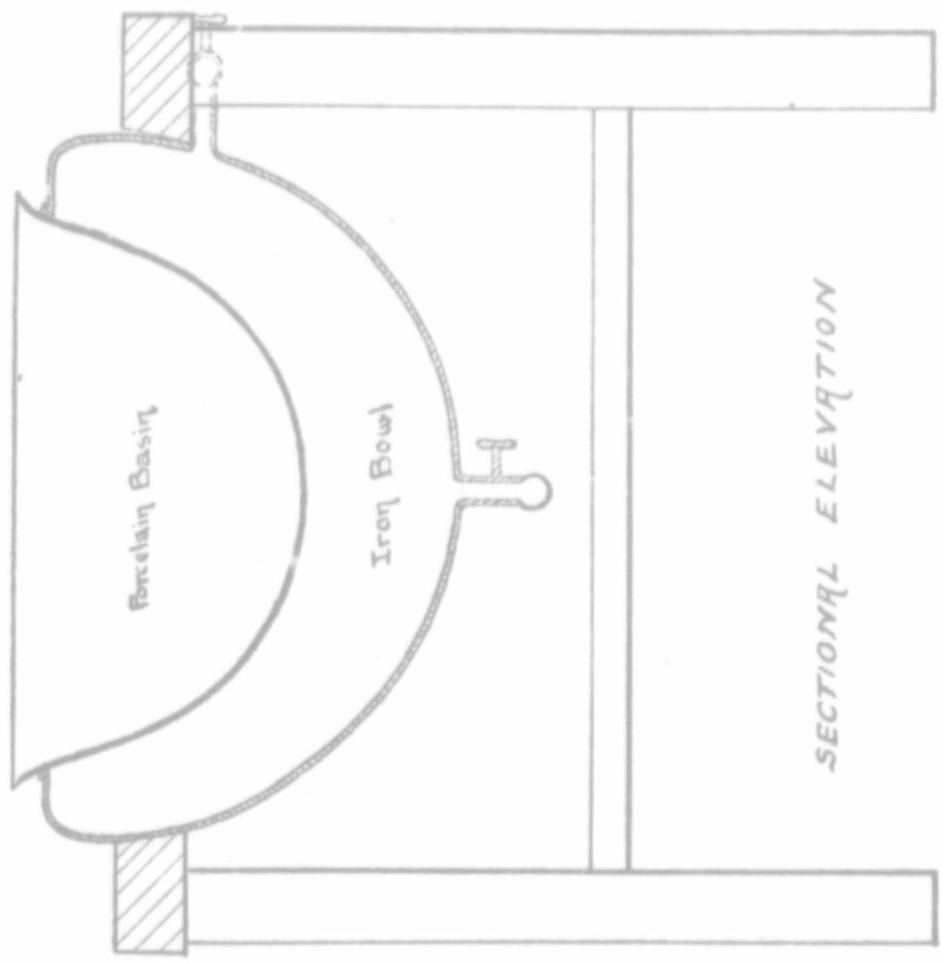


PLATE 12. SILVER REFINING FURNACE

P.BUTLER (Del.)





PLAN

SECTIONAL ELEVATION

P BUTLER (del.)

PLATE 10. PORCELAIN BATHS USED IN GOLD-ROOM.

MR. HARDMAN suggested that the Committee report before the close of the sessions, and recommended that Mr. A.W. Stevenson, C.A., be appointed liquidator.

The meeting then adjourned.

OPPOSED TO EXPORT DUTIES.

The members re-assembled at three o'clock, the President in the chair.

MR. B. T. A. BELL: Perhaps I may be permitted to call the attention of the members of this Institute to the effort being made in certain quarters to have the Dominion Government impose an export duty on certain ores and minerals shipped from Canada into the United States. I need hardly say that any such policy at the present time would be a fatal mistake and would be disastrous in its consequences to many of our most important industries. However desirous we may be to have smelting and refining industries established in Canada, these can only be built up by favorable economic conditions. Experience has shown that for successful smelting much more is required than the neighborhood of a mine, and the concentration of smelting works at a few points where suitable fuel and fluxes, market connections and variety of ore supply can be obtained is proof that the lesson has been learned. An export duty would seriously cripple the operations of many of our silver-lead and auriferous pyrrhotite mines in British Columbia; it would certainly annihilate our pyrites industry in Quebec, and give to the New Caledonia mines the United States market for our Sudbury nickel ore and matte. I understand this movement is particularly directed against the nickel industry by certain promoters of a company which proposes, provided this export duty is placed on our nickel ores, to establish a nickel refinery and a nickel-steel works in Canada. It is claimed that Canada possesses the greatest nickeliferous pyrrhotite deposits in the world, and that nickel can be refined as cheaply in Canada as in the United States. Perhaps I may be permitted to quote some authorities in refutation on these points. Mr. Joseph Wharton, an authority on nickel refining, says in his excellent monograph on "Nickel and Cobalt," published by the United States Government in 1897: "It is conceivable that the intimations of an export duty upon nickel ore and matte which from time to time appear in Canadian journals may some day be realized, and cause serious search to be made in this country for the deposits of nickel ore which doubtless exist, and of which the now dormant Gap mine is an instance. Such an export duty would, no doubt, direct attention afresh to the great deposits of nickeliferous pyrrhotite in Norway and Sweden, which have been for many years neglected. Barring such a contingency, the Sudbury region seems destined to remain for a long time, one of the two chief sources of nickel of the world, *the only*

It will be readily seen that if the air supply is of a higher pressure than that required to lift the water, the pump will be filled with air at full pressure, while air at a more moderate pressure would do the work. On this account, where the pump draws its air from a general supply, the throttle valves should not be opened any wider than is sufficient to operate the pump at the required speed.

The makers of the Halsey pump claim for it the following advantages:

1st. The automatic feature of the system by which it is impossible for the pump to either pump itself dry, and in consequence run wild on the one hand, or to fail to keep up with the supply of water and thereby flood the workings on the other. Up to its limit of capacity the pump simply takes its water as it comes, either slowly or rapidly.

2nd. The absence of all fitted or finished parts in water chamber, and consequent durability under adverse conditions, such as gritty or acid water.

3rd. The utilization of the pipe line to its fullest capacity, the delivery of the pump not being measured by a certain number of strokes per minute, but by the capacity of the pipe to carry the water, the pump being presupposed to be proportioned in accordance with the pipe employed.

4th. The absence of stuffing boxes or packing of any kind about the valve motion.

5th. The absence of adjustments of any kind to adapt the pump to different conditions of pressure, etc., it being only necessary to put the pump in the water, connect the pipes and turn on the air.

6th. The property of the pump by which, if necessary, it will work when completely submerged or drowned.

Another feature might be named among the advantages for the pump, and which the makers do not appear to have laid claim to, viz: that the entire working parts of the pump can be dismantled and taken to the surface for repairs if need be, without disturbing the main

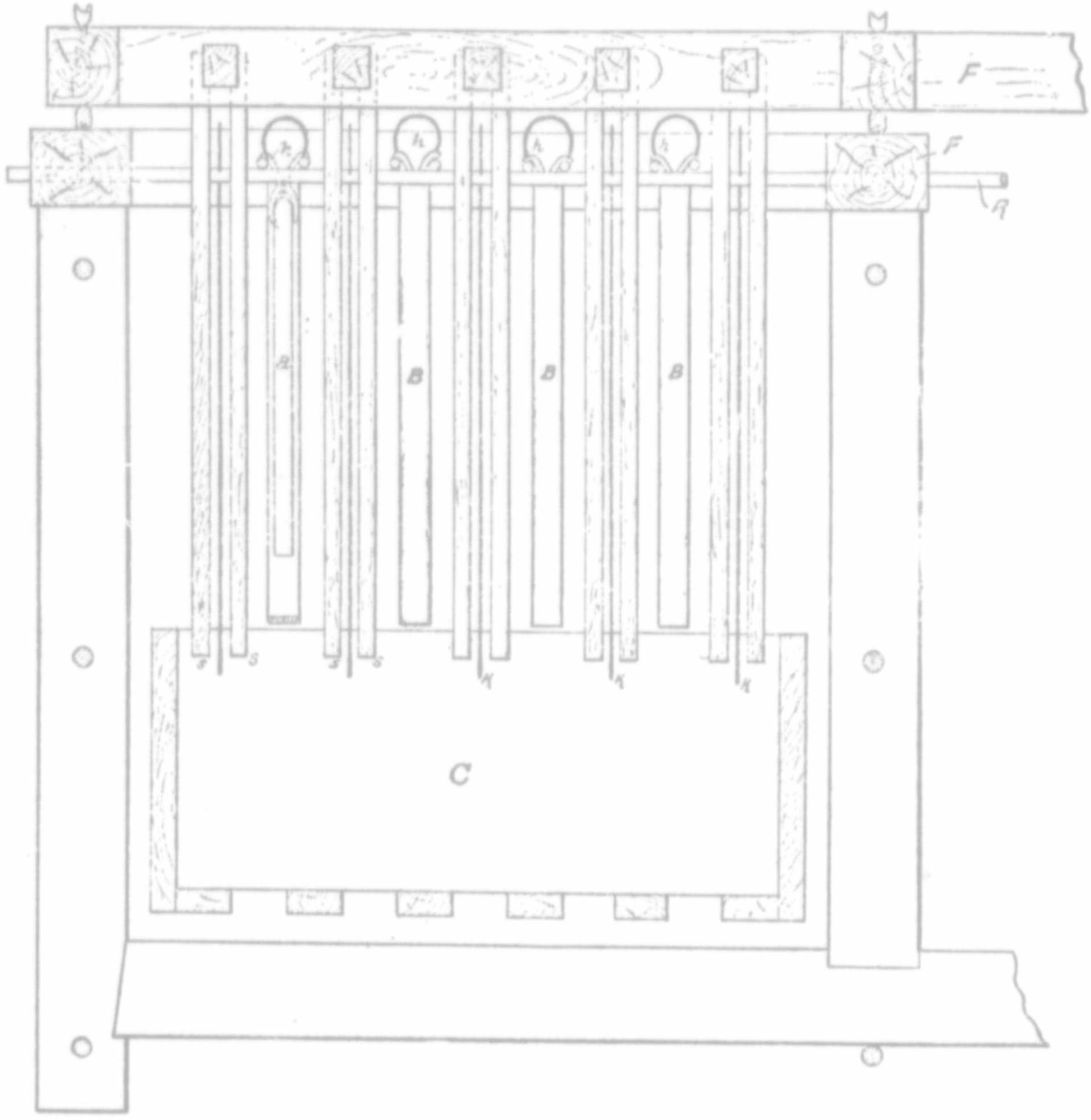


PLATE 9. LONGITUDINAL SECTION OF TANK-CELL.

P BUTLER (Del)

ER (Del)

MR. LORING: An important point is with regard to this indefinitness of location. Many men make what they call blazing locations—the line is blazed so indefinitely that to-day a prospector may have a location here and to-morrow somewhere else. One man in Rossland made from 15 to 20 snow locations on which he realized a handsome profit and is now in Europe. There was no valid discovery. He blazed the ground, and that is all there was to it. The mining inspector should have some facts with regard to where the location is made. Another important objection to the British Columbia law is the size of the claim. I do not think that any man can properly prospect 30 acres of land. The location should not be over 1,000 feet square. I would advocate less than that. In some parts of Colorado the claims are only 150 feet wide and 1,500 feet long. I do not believe that anyone can properly prospect on these mountains.

THE CHAIRMAN: What is your opinion as to the size of the location?

MR. LORING: 1,000 feet square. At present it is 1,500 feet square or 50 acres. The theory, to my mind, is that mining property is different from other property. If you cannot work your claim you have no right to keep it. You are preventing an increase to the wealth of the country.

THE CHAIRMAN: What time limit would you give to the miner?

MR. LORING: I would say a twelve months' limit, and I do not believe that $100 worth of work within twelve months is enough.

MR. INGALL: I understand that for some years the law of the apex was the lay of the location.

MR. LORING: Yes.

MR. LATIMER: I think there are cases in which the law should allow one to follow the vein, and there are others where it should not.

MR. LORING: The apex law is the best. If I owned a vein I would prefer the old law.

THE CHAIRMAN: I think it would be well for us to put ourselves on record.

MR. LORING: Yes; now that legislation is contemplated in British Columbia.

DR. GOODWIN suggested the appointment of a committee to draw up a resolution.

THE CHAIRMAN appointed the following to report at a later session: Messrs. F. C. Loring, W. Blakemore, Dr. Goodwin, Hamilton Merritt.

The session then adjourned.

EVENING SESSION.

The evening session opened at 8 o'clock, the President in the chair.

MR. JOHN E. PRESTON (McGill) read a capital paper on the "Ventilation of a Deep Metal Mine as Affected by Seasonal Changes of Temperature."

MESSRS. C. J. CHRISTIE and W. HYDE, both of whom had been in the Klondyke for many years, entertained the members with a graphic and vivid description of their experiences in the gold fields of the Yukon.

MR. SPENCER MILLAR, New York, terminated the session by presenting his paper on "Cable-ways as Applied to Open Pit Mining," illustrating his subject with a large number of stereoptican views of cable-way plants in Canada and the United States.

THURSDAY—MORNING SESSION.

THE PRESIDENT took the chair at 11 o'clock.

The following papers were presented:—

"The Possibilities for Smelting in British Columbia," by R. A. Hedley, Nelson.

"The Mineralogy of the Carboniferous," by H. S. Poole, M.A.A.R.S.M., Stellarton, Nova Scotia.

"Concentrated Foods for Explorers and Prospectors," by J. T. Donald, M.A., Montreal.

"Mining on the Coast of the Mainland, B. C.," by G. F. Moncton, F.G.S., Vancouver.

"On the Strange Singularity of Colour in Some Forms of Asbestos," by R. H. Jones, F.S.A., London, Eng.

"Mining Machinery in the Slocan." by Howard West, A.R.S.M., New Denver, B.C.

"Notes on the Michipicoton Gold Field," by Prof. A. B. Wilmot, Toronto.

"Odd Notes on Mining and Smelting," by A. H. Holdich, Nelson.

THE SECRETARY reintroduced his resolution respecting the proposal to place an export duty on ores and minerals, and as noted elsewhere, the motion. on being put to a standing vote, was carried unanimously.

MR. W. HAMILTON MERRITT, presented the report of the Committee appointed to consider certain portions of Mr. Loring's paper on Mining Law.

INCREASED DUTY ON LEAD.

MR. W. BRADEN, Pilot Bay, B.C., desired leave to submit a resolution recommending an increase in the present duty on lead and lead manufactures.

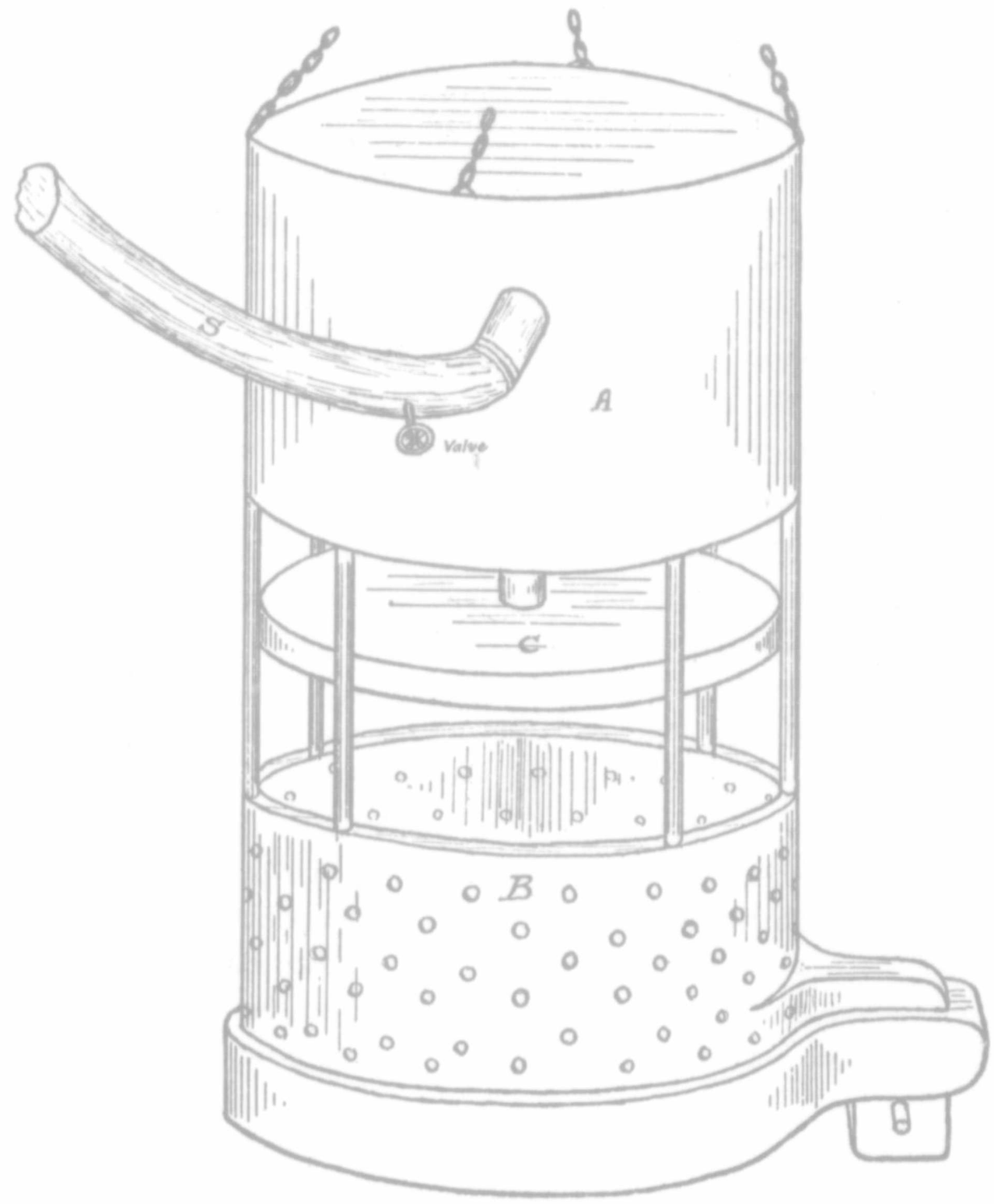


PLATE 5.- SKIMMING - BOX.

P. BUTLER (Del.)

therefrom, and represents the beginning of a development in the line of improved fall rope carriers. As will be observed an auxiliary rope, about 5/8 in. in diameter, is suspended above the main cable, held in a parallel position to the main cable by passing under wheels in the cable carriage. On this rope a series of buttons are secured, whose diameter increases with the distance from the head tower. Slots in the head of the carriers, corresponding to the diameter of the buttons, allow each of the carriers, in passing down the incline, to be stopped at its proper button. These carriers have small wheels to roll on the auxiliary or button rope. Thus, the heavy, cumbersome chains are dispensed with, and these fall rope carriers, spaced by buttons, and weighing in all

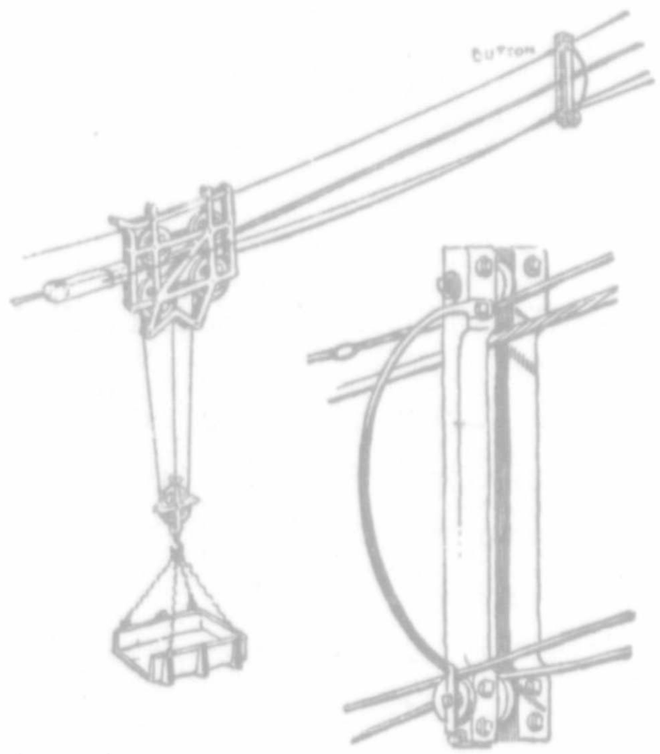


FIG. 4.—First Form of Miller Carrier.

about 100 lbs., answer all the requirements of chain connected carriers, weighing, with the chain, 2,000 lbs., the latter causing an increased strain on the anchorage of about five tons.

The button stop fall rope carrier was next applied to a horizontal cableway of 855 ft. span. Means had to be provided for drawing the fall rope carrier out with the carriage, as gravity was not to be depended upon as in the last case. To this end a horn was placed upon the carriage, which served the twofold purpose of lifting the carriers bodily from the cable, thus dispensing with wheels on which the carrier might

gress made. I want to congratulate the young man on his paper. I think the idea of introducing student papers at a meeting of this kind an admirable one.

DR. GOODWIN also congratulated Mr. Butler upon the excellence of his contribution.

VOTES OF THANKS.

MR. BELL moved a vote of thanks to the management of the Windsor Hotel for the excellent accommodation provided and the uniform attention of its employees during the meeting; to the Montreal Street Railway Co. for its kind invitation to the members for a drive through the city; to the Faculty of Mining at McGill for its invitation to the new mining laboratories; to the students who had contributed papers; to the press for their excellent reports of the proceedings; and to Mr. George Macdougall for his assistance and the use of the lantern.

The motion was carried. The proceedings terminated with a hearty vote of thanks to the Chairman.

ANNUAL DINNER.

On Thursday evening a large company sat down to dinner in the Windsor Hotel, Mr. George E. Drummond, President of the Federated Mining Institute, in the chair. Among other notables present were Hon. Mr. Marchand, Premier Province of Quebec, Hon. Mr. Tourgeon, Commissioner of Colonization and Mines, D. C. Fraser, M.P., His Worship Mayor Prefontaine, M.P., and the Rev. Dr. Barclay, Some capital speeches were made. The enjoyment of the evening was considerably enhanced by a splendid vocal and instrumental programme.

Dr. Penrose, in his excellent volume on manganese, gives a tabulated statement of its principal uses, and I cannot do better than reproduce it here

Alloys	Spiegeleisen Ferro-manganese	*Alloy of manganese and iron.
	Manganese-bronze	Allow of manganese and copper with or without iron.
	Silver-bronze	An alloy of manganese, aluminum, zinc and copper with a certain quantity of silicon.
	Alloys of manganese with aluminum, zinc, tin, lead, magnesium, etc.	
Oxidizers.	Manufacture of chlorine, Manufacture of bromine, As a decolorizer of glass, As a dyer in varnishes and paints, Leclanche's battery, Preparation of oxygen on a small scale, Manufacture of disinfectants (manganates and permanganates.	
Colouring material.	Calico printing and drying, Colouring glass pottery and brick, Paints	Green, Violet.

Manganese never occurs in its metallic state, but always as an oxide, carbonate or silicate.

In Nova Scotia the following oxides occur and are named here in order of their importance to the producer: pyrolusite (MnO_2), psilomelane, braumite (Mn_2O_3), manganite and hausmanite (Mn_3O_4). Psilomelane and manganite being the hydrous forms of pyrolusite and braunite. It has been said that some pyrochrosite has been discovered at Tennycape, but it has never come under the observation of the writer.

Legend says that Nova Scotia has the honour of being the first producer of manganese in America. The date of its discovery is very obscure, but the "story goes" that the French used *savon des veniers* (the fanciful name for pyrolusite) in their making of glass and pottery

*An alloy containing 25 per cent. and under of manganese with iron is known as spiegeleisen; on alloy containing over 25 per cent. manganese with iron is known as ferro-manganese.

This excavation was something like 450 feet long by 300 feet wide. It was quite imperative that a skip load of material should be lifted up directly at the place where it might be filled, and it was therefore necessary to use a hoisting and conveying device, which would reach out further than it would be practicable to use a derrick. At that time, about 1888, the cableway was in a crude state of perfection, but in spite of the crudeness of the machine it was found to be by far the most practical device that could be used for that purpose. The plant, as originally installed, consisted of four cableways, and a large derrick with a 100 foot boom. The cableways were much preferred to the der-

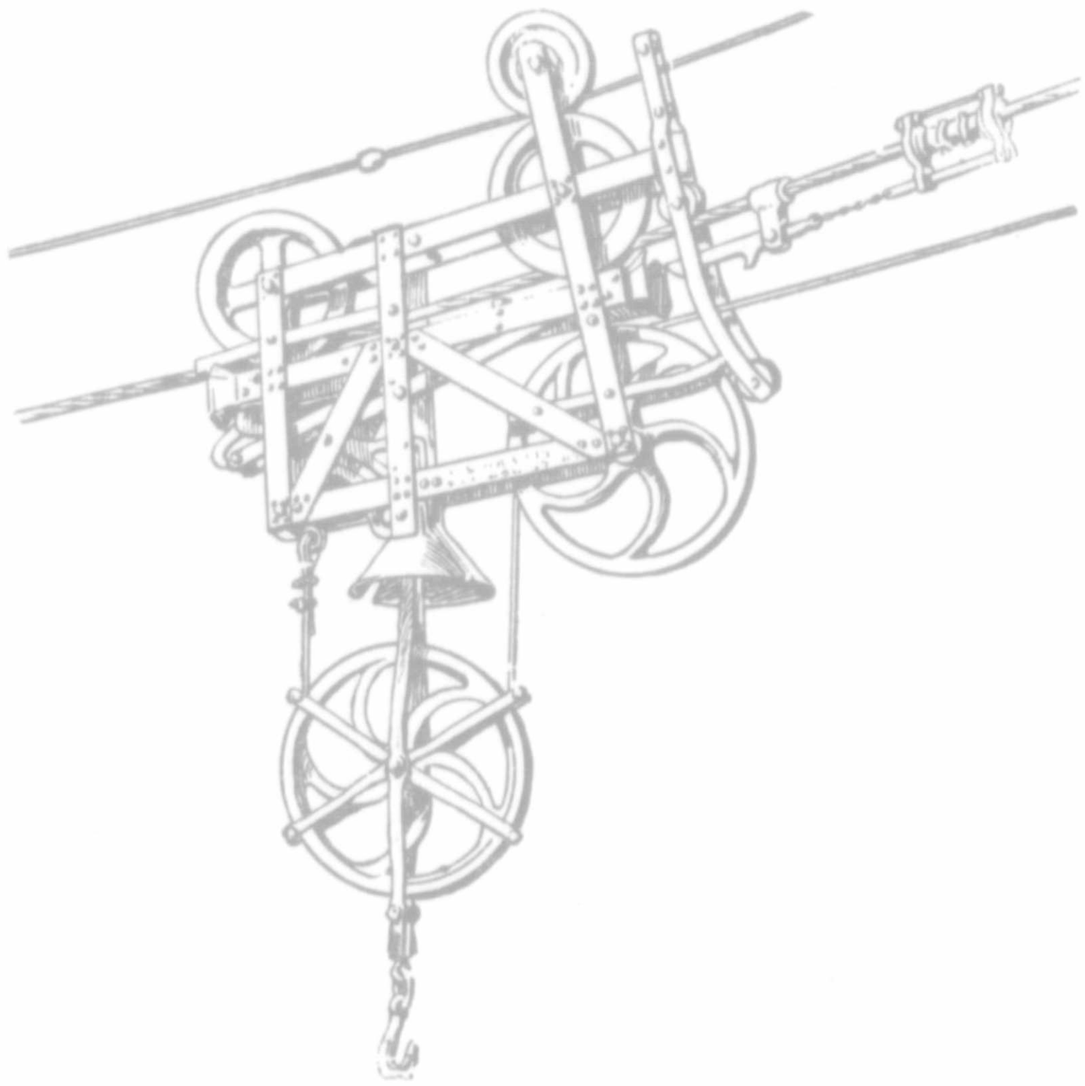


FIG. 2.—Harris-Miller Carriage and Fall Rope Carrier for Incline Cableways.

rick, and by them practically all the work was done. It was found by actual records that the cableway would take out ten per cent. more loads per day than the derrick, in spite of the fact that it was reaching out some 300 feet, while the derrick on the other hand could only reach out 100 feet. Similar engines were used for hoisting the load in