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VOL. II. FEBRUARY, 1896. NO. 2.

## BRITISH COLUMBIA MINING RECORD.

Devoted to the Mining Interests of British Columbia.

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ALEXANDER BEGG,
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VOL. 2. FEBRUARY, 1896. NO. 2

## Editorial Notes.

The present issue contains verbatim reports of the valuable lectures, lately delivered in the coast cities by the Provincial Mineralogist, Mr. W. A. Carlyle. In our March number, we propose to publish lectures on chemistry in its application to mining industry, delivered by Mr. H. Carmichael, public assayer for British Columbia, and addresses given in metallurgy by Mr. W. Pellew Harvey, the well known provincial expert on metallurgy and assaying.

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Our object in publishing these lectures is to enable readers who were unable to be present at their delivery to derive the full benefit of the valuable information they contain, and for this purpose we have had a number of the charts used reproduced and published in our reports. We trust that this effort on the part of the British Columbia MINING RECORD will be appreciated by our many readers in the mining districts, and that the lectures will prove to be of substantial service to them.

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Mr. Carlyle is evidently a man of much force of character and practical ability, whence it may be assumed that the giving of lectures—instructive as these are—will be but a minor duty of his office. He will doubtless, be able to diffuse widely and advantageously, much valuable information as to the extent and availability of the vast mineral wealth of our Province of which the world in general, and British investors in particular, are still ignorant. British Columbia greatly needs accurate and authoritative advertisement of its abundant mining opportunities, and in giving this advertisement Mr. Carlyle will render important service to the Province.

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A great need of the metal mining industry of this Province is a public laboratory wherein a good milling test or accurate sampling may be obtained of a representative quantity of ore, say an average amount of one ton or thereabouts. Only by making such a fairly large, and therefore representative test, can the true worth of the ore in a ledge be approximately ascertained. At present no such establishment is to be found within the Province, the only test of ore value now usually made being that given by some assayer of small specimens, too often selected as especially rich in appearance. The fuller test which, we suggest, would furthermore aid in the selection of a proper process of after treatment of the ore in bulk, which is by no means always a simple matter. The same test would also indicate whether the ore sampled would or would not prove unduly and profitlessly expensive to treat, a contingency which now happens very disappointingly, after considerable cost has been fruitlessly incurred in the case of ores, which, when assayed in very small quantities seem rich enough. To such mistakes are due many of the wrecked and idle mills, which are so often found in Western American mine regions. A properly worked laboratory of the capacity which we have broadly indicated would, we repeat, save, as a result of cheap and decisive first tests, much loss of time and money to mining investors in this Province.

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Such a laboratory might perhaps be set up to advantage in connection with the proposed Provincial school of mines, provided only that the latter be itself conveniently located. Mine owners could thus be informed of

the value of sufficiently large samples of their ores, at a cost sufficient to recoup to the Provincial exchequer all expense thus officially incurred. Students in attendance on the school of mines would also thus gain fuller practical knowledge in the various ores of the Province.

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A great need of the Kootenay country is the appointment of a resident County Court Judge who would, with naturally increasing frequency, be required to adjudicate on legal issues affecting the rapidly enlarging mining interests of the district. Enough of such work is gradually accumulating to call for the exclusive service of a resident Judge of a Kootenay County Court district.

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It is satisfactory to note the increasing interest in mining that is being taken by the people of Vernon; as indeed by the inhabitants of the Okanagan country in general. There is no longer doubt as to the extent and value of the mineral deposits of the Vernon district since several promising mine properties have been discovered there and preliminarily opened up.

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The coming spring will certainly witness the influx into the camps of Boundary Creek and the Kettle River of large numbers of mine workers and prospectors. Very likely many of them will prospect northwards, whilst all South Yale will next benefit by the beginning of a period of great mining activity. It is therefore to be hoped that the people of the Province will not in this instance prove as remiss as they were in the case of Kootenay, but instead stand well to the front, and so take advantage of a fair proportion of the eligible opportunities of the Yale country in general. All the mineral region of South Yale now needs is railroad access. With this end in view all the ledges of value should be soon and thoroughly opened up, and when the certainty of a large mineral output is fully demonstrated, the rails will follow without fail.

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Home business houses of good standing should assuredly secure the bulk of the trade of the interior and especially of West Kootenay, whose retail trade requirements are at present in the main supplied from Spokane. One cause of this alienation of trade is the prevailing ignorance of British Columbia business houses and home markets. To dispel this we would suggest a more liberal patronage of the home press, which under trying circumstances and in many cases at pecuniary loss, does duty faithfully and well in advertising the resources of the country.

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Prior to the commencement of the present Provincial session, members of the Legislature almost everywhere, met their constituents and asked them to make known their wants, in order to decide with full local knowledge, questions of public work appropriations. Considerably more has however, very naturally, been asked than it is in the power of the government to grant. Amongst appropriations thus asked were several in respect of increased aid to hospitals, jails and other public institutions.

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Hospitals, old men's homes, orphanages, and jails are all partial necessities in certain places, but trails, roads, and bridges are wholly indispensible to new sections. Many of these new sections possess mineral in plenty, but have no means of getting it out. Hence with all deference to the more settled districts, we think that localities lacking roads and trails should fairly assert a prior claim.

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Another need of the interior sections of the Province—and in this older and younger places are a unit in their outcry for improvement—is a proper mail service. To quote instances of delayed and ineffectual postal deliveries in British Columbia's mining country would unduly engross our limited space And surely a Province which contributes so largely as ours to Dominion revenue, is entitled in common justice to far more liberal treatment and better mail facilities than it possesses.

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We might also remark, that in denying us these advantages, the Dominion authorities adopt a "cent wise, dollar foolish" policy, since nothing so greatly tends to promote business activity in a country as a good mail system, and in a rich mineral land like this, activity encouraged means a large return in revenue to the national exchequer.

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A new era for the Province, and may we not also say for Canada, was inaugurated at Nelson last month with the blowing in of the first copper smelter in the country, which is being followed by one at Trail and another at Rossland. The new industry thus inaugurated will employ many hands, and is, with the large amount of favorable ores available in the Province, capable of great extension. That British Columbia is rapidly forging ahead as a mineral field and smelting country cannot now be denied nor its permanency questioned.

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We notice however, with some surprise, that although the smelter industry grows iron ore is still shipped in from Stevens County, Washington, to the smelters at Pilot Bay and Nelson. That it should be necessary to do this seems strange with so much iron ore ascertained as existent in British Columbia, but it proves when investigated the necessity of further railway transportation. With a railway from Boundary Creek this necessity would not exist, as many thousands of tons of this ore, with richer mineral to boot, would be shipped to Kootenay smelters.

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Some objection has, we understand, been taken to the recent change of the Trout Lake and Ainsworth mining divisions. After careful inquiries, we incline to believe that the change was desirable as affording the greatest good to the greatest number of those concerned.

A very important meeting, the first of its kind, was lately held at Three Forks. At this the whole Slocan country was represented by delegates. Several resolutions, suggesting changes in the mining laws, were then passed, amongst these one to the effect that "Co-owners who do not perform their share of annual assessment work, be compelled to pay up." Another resolution, not relating to laws, but to mining in general, was that, "While the Government should make main trails and roads, small trails for particular mines should be built at the expense of mine owners."

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These motions deserve notice, not only for what they suggest, but as the expressed wish of a deliberative or representative body, and we hope that many such associations in other sections may be formed, or, better still, one large organization for each district, which could thus voice the sentiments of its residents and responsibly make their wants known.

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This leads up to a matter which we have long borne in mind, viz.: The formation of a mining association for British Columbia, rather on the lines of that formed recently in Spokane. Such an organization would be of immense benefit to the country; would make the different sections, (often antagonists without cause) better known to each other, and would promote unity among and add strength to all associated. It would prove potent in bringing about useful legislation and legal amendments; its reports would bear the stamp of responsiblity; its statistics that of accuracy. Indeed so many reasons for the creation of such an organization could be given, which are so patent to every mind, that nothing further need be said by us, save one word, to urge immediate action.

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The great question before the local mining world just now is the amendment of the Mineral Act, and numerous suggestions come from as many quarters. One of the best, or one with which we have most sympathy, favors a reduction of the present size of claims to six hundred feet by fifteen hundred, instead of the fifteen hundred feet square as at present. Claims as now defined are too large and hard to find, and the reduction in size would allow more locations to be made, which means more development, more revenue, more public opportunity.

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We also think that claim boundaries should be better defined, as what is worth having is worth the trouble of showing clearly, and much confusion by re-locations would thus be avoided.

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Vancouver's City Council is calling for offers and suggestions by capitalists in regard to the location of a smelter and refinery plant within the Terminal City. Nothing further has yet been done, but it is said that substantially backed offers are not unlikely to be made very shortly to the city municipality in question. The example of Tacoma's smelter, which receives abundant ore from British Columbia's upper country, encourages the prosecution of the intended effort in Vancouver. The Vancouver Board of Trade is asked to co-operate in the matter, and, it is to be hoped, will do so promptly. The early future development of mining on the coast and in the island districts of the Province, largely depends upon the provisions of such facilities as are now being suggested for Vancouver.

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# MINING LECTURES.

By W. A. Carlyle, Provincial Mineralogist.

## Lecture I.—Geology.

WORD CHARTS USED IN LECTURES Nos. 1 AND 2.

CHART I.—CHIEF CHEMICAL ELEMENTS.

| NON-METALS. | METALS. |
|---|---|
| Oxygen | Iron |
| Silicon | Aluminum |
| Sulphur | Calcium |
| Chlorine | Magnesium |
| Carbon | Sodium |
| Fluorine | Potassium |
| Phosphorus | Barium |
| Hydrogen | Manganese |

CHART II.—PRINCIPAL MINERALS IN ROCKS.

| | |
|---|---|
| Quartz, or Silica | ——— |
| Felspar | Calcite |
| Mica | Dolomite |
| Hornblende | Gypsum |
| Pyroxene | Apatite |
| Garnet | Fluor Spar |
| Chrysolite | Rock Salt |
| Nephelene | ——— |
| Leucite | Magnetite |
| Talc | Hematite |
| Serpentine | Limonite |
| Chlorite | Pyrite |

The first chart to which your attention will be directed will be this list of chief chemical elements, (see chart 1). We know that chemists have discovered that there are many diverse substances in the world, but in analysing these different substances we find there are only some seventy (70) elements, chemical elements being defined as a substance that cannot be subdivided into anything else. Water for ages was thought to be an element, but chemists discovered it was made up of two invisible gases chemically united. When we come to the metals, say iron, one of the most important in the metal group, we find it is a substance which cannot be subdivided, it is iron and cannot be resolved into anything else, though it can be united with other things to form subsances differing entirely from one another.

The first named and the most important is oxygen, an invisible gas, and if we could analyze all our rocks, we would find that nearly fifty-three (53) per cent. of the whole earth's crust was made up of this powerful gas, oxygen; or, in a ton of rock there would be ten hundred and sixty (1,060) pounds of oxygen. Water is formed of nine-tenths ($\frac{9}{10}$) by weight, of this oxygen gas. You can readily see that oxygen thus forms by weight by far the largest part of the earth. Oxygen when it combines with any other substance forms what we call oxides, and these oxides may be minerals we are interested in. In studying ore deposits, we will find the great influence oxygen has in changing the character of minerals combined with the metals. It is found in the air in an uncombined state, and being gathered up by rain and flowing waters, is carried from place to place, and thus in it we find a most potent influence in attacking and weathering ore bodies and wearing away the most solid rocks.

The next element in order is a solid substance—Silicon—never found in nature in an uncombined state, but in the rock quartz we find it forms a large percentage of the rock, being combined with oxygen as silica. Carbon is an element we are all familiar with in the forms of coal, coke, and in its purest form as the diamond, being as it is, a simple element carbon. Carbon com-

bines with oxygen to form an invisible gas, strongly acid, and its combinations with some of the metals have been instrumental in forming vast masses of solid rock. We find that each distinct mineral has a distinctive crystalline form, and by their form we recognize the different sillicates and carbonates of metals, that are so very important in the study of rocks. Sulphur also ranks high in nature, being the third on our list, as it occurs in nearly all the ores of the metals, especially the ores of the precious metals.

Leaving the list of chief chemical elements, we present for passing notice the list of the Principal Minerals in rocks (see chart 2). Topping the list, as the most important is quartz or sillica, of which we have been speaking, then felspar, next mica. If we take a piece of granite, which is a rock familiar to all, we will find these three minerals mentioned, the glassy quartz, the whitish or principal felspar, and the dark spots of mica, thus we find that quartz, felspar and mica combined, compose the rock called granite, and on examining any rock, should we find these three minerals, we would call that rock a granite or a gneiss. Hence the various kinds of rocks are so named according as they form different combinations of these various minerals, and also according to their origin.

Further along in the list in chart 2, is garnet, with which we are all familiar in the form of a gem, but in some rocks it is developed to a large extent and is an important constituent. In working on the Geological Surveys in the Laurentian Mountains, near the height of land, I have seen large areas of gneiss that contained from forty (40) to sixty (60) per cent of garnet. We speak of this as being a matter of interest.

Running down the list of principal minerals, we find that several are combinations of silica with different metals forming silicates, making in different combinations the largest mass of our rocks.

We now come to a little group, the first and one of the most important being calcite, formed of the metal calcium with carbonic acid gas. Calcite is familiar to us in the form of limestone, comprising large areas of great thickness of this sedimentary rock, while dolomite is another of magnesium and carbonic acid gas. Some of the formation of Dolomite occurring in beds of very great thickness, its composition being this carbonate of magnesium, while our limestones are carbonate of calcium. In some of our mining regions the difference between these rocks is of vital importance in the search for ores, which I will exemplify later when we take up the diagram illustrating one of the greatest mining regions in Colorado, in which I was engaged as Mining Engineer for several years. Gypsum is a rock found in beds of great thickness, and is of great economic value, it being mined in Ontario and Nova Scotia, where there are enormous beds. In Gypsum we have sulphur entering in, sulphur, oxygen and calcium forming a compound, or sulphate of calcium, that is prepared and used as land plaster or a fertilizer.

We now come to a list of four, three of which are combinations of the powerful gas, oxygen, with iron, the difference in the percentage of oxygen forming considerable differences in the ores themselves. These ores, Magnetite, Hematite and Limonite, often form beds of great value. Our list ends with Pyrite, or iron pyrites, and you may be surprised to find it included in the list of chief minerals. There is a great deal of igneous rock, also sedimentary rock, as shale or slate, in which iron pyrites are always found, so it is well on finding this mineral, to remember it is not necessarily ore, though it is well to be on guard and to make sure whether you have or not discovered rocks that may prove profitable. We will now end this hurried glance at this list, but these are the chief minerals and all important to the student who should become well acquainted with each one on the list.

We now come to the classification of rocks, which perhaps will be of more interest, and I will run over and describe briefly a few of the commonest rocks met with in mining. To study everything properly we must classify, and in the study of rocks we can classify them in three ways. First, as to texture; second, composition; third, mode of origin.

First, as to texture. Looking at a rock you may find it is made up of fragments of other rocks; for example, it may be made up of quartz grains cemented together, as sandstone. Take a piece of slate or shale and examine it under the microscope and you will find that it is made up of minute particles of rock, hence it is called fragmentary. Many rocks, such as the granites, are called crystalline, as all the mineral constituents are crystallized. Coal is called organic, it being made up of plant, and, to a small extent, animal remains, forming a mineral out of substances that were originally of organic growth.

Second, we have a classification by which we may divide rocks according to their chief chemical ingredients. Here it will be convenient to use big words, which so many people take a delight in doing, and about the only big words I will use myself. We may speak of a rock as being silicious, or one containing a percentage of quartz, or a rock in which quartz is found. As in a limestone we should find more or less quartz we would call it a silicious limestone. An argillaceous rock is one intermixed with slate or shale matter, a calcareous rock being one containing limestone. We thus often find one kind of rock gradually verging into another and have then to give names to show there is a relation between them. A carbonaceous rock is one containing organic matter. In the carboniferous era great deposits of coal were laid down, but in Colorado there are large beds of shale and limestone representing this era, and I understand the same conditions exist in British Columbia. And, while in Pennsylvania enormous measures of coal were being formed the conditions in the West were not favorable for organic growth. Hence we do not find rocks of corresponding geological age in the western coal bearings, but the shales of this era as found here are so impregnated with carboniferous matter as to be of use as fuel in the forge, and such are called carboniferous shales. A ferruginous rock is one containing iron enough to be detected by the reddish or brownish color on weathered surfaces.

Third, and the most important classification of rocks, is according to origin. If we take a piece of rock and study its origin we will find it was formed in one of two ways. It is either igneous, that is, one which in a molten state was pushed up from the molten mass that we know exists under the crust of the earth, and has hardened; or else it is sedimentary, which will generally be seen quickly by examination. A sedimentary rock is one that has been made up by the tearing away and breaking down of other rocks, the particles being washed out and down and carried to other parts, forming in beds, sedimentary rocks being really comprised of sediments hardened into rock. Igneous rocks have two divisions, volcanic and plutonic; the lavas and basalts being representatives of one, and the granites and diorites those of the other. The volcanic rocks have been thrown out of volcanoes or forced up through crevasses and cooled down quickly near the surface. And it is these lavas and well known basalts that have covered up much of our country, especially many of the rich, old, river channels, as we will find when we take up the illustrations of Cariboo and Cassiar sections.

plutonic rock is one that cooled down before reaching the surface, as the diorite which forms a large part of Vancouver Island. Another rock we might mention, one which in reality forms the floor of the crust of the earth, the first rock made when the earth was cooling down from a molten mass, is granite. Other important plutonic rocks are syenite, belsite, etc. We have porphyritic granite and porphyritic diorite; it is not a rock in itself.

Miners all through the West give the term porphyry to many of our igneous rocks not strictly porphyritic, porphyry being a rock of very fined grained matrix in which are well defined crystals of some mineral, it may be diorite, granite, or gabbro.

In examining limestones or shales, we find they have been laid down in beds, and if we understand how these rocks are being laid down at the present time, it will help us to understand the sequence of rocks in geology. As you will note by these maps, we find, perhaps, limestones overlaid with shales, and the shales again overlaid with limestones. As we come to know how these were formed, it will help us to understand many of the changes that have taken place in the earth's crust.

Along the sea shore we find the rounded stones and boulders. We find the water eating its way into the land, grinding up the rocks more or less, and rounding them in form, the finer stuff being carried out to sea. These rounded rocks and coarse pebbles on being pressed into rock form the *conglomerates*. A little further out, in deeper water we would find, if we were able to follow, that the water had been able to carry out the finer pebbles and coarse sands forming what are known as *grits*. Into still deeper water the sea carries out the finer sand, and you will find along all our coasts at the present time enormous areas of sand, which some day may be buried under thousands of feet of sediment, and in turn be hardened into sandstone. Still further out, the finest particles into which the rocks have been broken and ground are carried in the form of mud, and that hardens eventually into what are known as *shales*. Of course this is typical, we find at a large river's mouth, such as the mouth of the Mississippi, hundreds of square miles of sediment laid down in enormous depths, which may be some day hardended into rock. Such illustrations help us to understand some of the formations of enormous depth we meet in the study of geology. Examining the deepest waters of the ocean, we find at the present time there is being laid down to a great thickness what is called "ooze" or material of which have been made our present limestones, and thus we learn that our limestone is always formed in the deepest water. It is interesting to note that the easterly range of our Rocky Mountains has large areas of limestone topping the range, and knowing that limestone is formed in abysmal depths of water, we conclude that from such depths the range has been pushed to its present great height.

Metamorphic rocks—a term often used—are simply areas of sedimentary rocks that have been subjected to enormous pressure, great heat, and chemical changes, so as to quite change many of their characteristics, and rocks so changed we call metamorphic. Of such class is *gneiss*, which is found made up of layers, showing it to have been originally a sediment, but so hardened that the mineral constituents have been rearranged and crystallized until now it is exactly the same rock as granite, though of different origin. *Quartzite*, of which there are enormous areas, is simply hardened and changed sandstone. Slate and marble are interesting metamorphic rocks. Shale is easily recognized by its being in layers that can be pulled apart with the fingers or with a knife. A bed of mud be subjected to tremendous weight from above, it forms into rock that will have a horizontal cleavage; but if the pressure should then come from the sides and the shales be hardened into the harder slates, the cleavage is now directly at right angles to what it was before. Schist is another metamorphic rock formed from mud of which enormous areas exist throughout British Columbia. Much of these schists being the product of changed igneous rock, are rocks often extremely puzzling to the geologist, generally highly crystalized and often mineralized, consisting of very thin laminæ easily split. Another very important metamorphic rock is anthracite coal, of which we will speak more fully when discussing the formation of coal and its change from the beds of peat and lignite to the anthracite or hard coal of the present day.

On the discovery of an ore body or a vein, the first thing learned is its course or direction along the surface, or its "strike." The next inquiry is as to the extent of the "dip," and when we say that a vein has a dip of forty degrees, we know it is the angle it makes with the horizon. In the study of rocks, and especially the study of ore bodies occurring in sedimentary rocks such as limestones, shales, etc., it is very important to become familiar with the "strike" and "dip," as we find the ore bodies so often faulted and broken. (Here was shown and explained an interesting geological section through Eastern Canada, and a view given of the large copper mine at Capleton. The subject of earth movements was also touched upon.)

By the study of geology and by learning the age of rocks that comprise our mountains, we are able to tell the relative ages of our four different mountain ranges in this Province of mountains. We find that the range forming Vancouver Island and the islands north of it was the first, the oldest of all, but after that the next two were forced up; first the Cascade Range, then the Gold Range, while the Rocky Mountains proper appeared last of all, the geological map showing this very plainly. The immense amount of sediment that had been washed out and deposited on the old ocean beds was of great weight, and resting as they were on the great molten mass beneath, the ocean floor gradually settled and in settling so great was the weight of the sinking floor that it shoved laterally on the continent pushing and crumpling its formation into mountain masses. (A diagram of the Appalachian Mountains here served to illustrate how rock strata once lying horizontal had been thrust up into mountain ranges.)

In all ore deposits, or nearly all, are found breaks or faults, few being so fortunate as not to be in some measure faulted. The rocks suffer enormous pressure until the limit is reached and a break or fissure is formed and on one side the rocks may be tilted up or down, or forced horizontally one across the other, as it appears in our diagram of the very complicated system of faulting in the coal measures. Sometimes in some of these coal measures, besides twisting and contorting, the beds have been bent right back on themselves and in exploring with the diamond drill it will appear as if there were several distinct beds when in reality there is but the one bed folded upon itself. When a great fault occurs across it on deposit the miner will suddenly come to a blank wall of rock, then the diamond drill is often used to learn the nature of the fault and to find the ore on the other side of the break.

Before leaving this subject we will glance at this diagram, taken from Mr. O'Connell's survey in the Rocky Mountains at a place called Ghost River, of which this is a section. This shows where rocks of a comparatively late age are overlaid by rocks of a much older formation (see chart 3). This was puzzling and at first rather hard to understand. The rocks that were

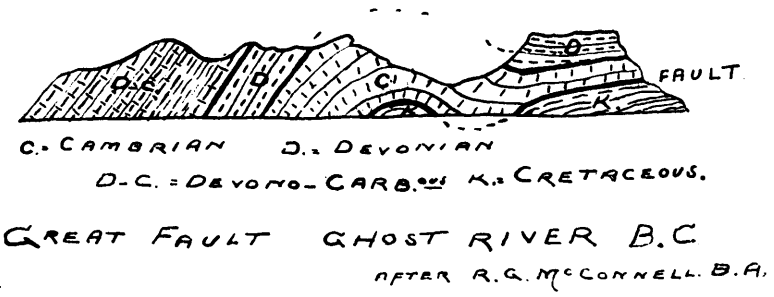



CHART 3.

laid down thousands of feet above the older rocks were now underlying these older rocks, but there had been faulting and the rocks on one side of the break had been lifted fifteen thousand (15,000) feet, by measurement, and pushed over in one place two (2) miles and in another seven (7) miles, and placed upon the younger series of rocks. This will give some idea of the great changes that have taken place in the crust of the earth.

The last diagram we will call your attention to, to-night, will be this section through one of the great iron ore regions of Lake Superior. In looking at this section (see chart 4), you see the rocks in regular sequence

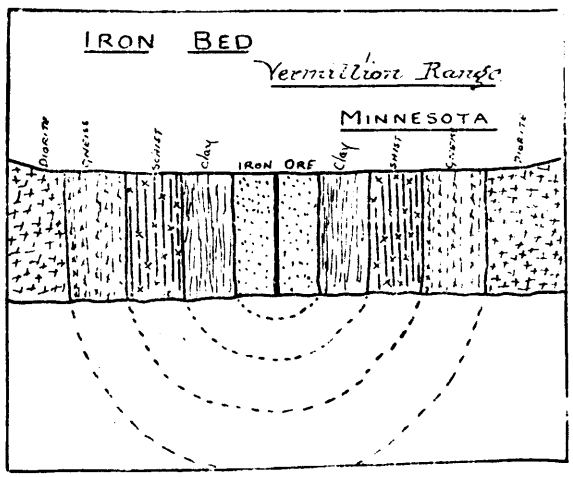



CHART 4.

from without towards the centre; diorite, gneiss, schist, ore, the ore standing nearly on end. These stratified rocks have been bent in horse shoe form, doubling the bed of ore on itself, so that the ore deposit is now double the original thickness as it represents two layers instead of one originally. If this could be divided and folded back you would see the way the formation had been laid down. These two masses of igneous rock, diorite, coming up had bent the strata back upon itself, the result being the ore bed is double in thickness of what it was originally laid down.

I have just given a few practical points in reference to geology, rocks and ores, and I have remaining a number of these rough diagrams, illustrating some of our typical ore bodies.

## Second Lecture.—Mining, Ore, and Ore Deposits.

Before beginning our talk this evening on ores and ore deposits I would like to take upon myself the responsibility of saying a few words in reference to the fees charged for these lectures, as there has been considerable dissatisfaction. In the beginning of the work of this new department we are very anxious to keep down expenses, and in charging this fee of fifty cents, which was the price at all three cities, Victoria, New Westminster, and here, we thought it would be, perhaps, just enough to pay travelling, hotel, advertising, and rent of halls in the different places. The first night at Victoria we had seats brought in for about 50, but to our surprise the attendance was about 150. We had no idea of the amount of interest that would be taken, and it will go a great way in strengthening the hands of the Minister of Mines. Perhaps next year we may be able to give you a second series of lectures, when we shall be able to have the matter better prepared, more succinct, more fully illustrated, and doubtless more acceptable and interesting. This should not be looked on as a money making scheme—such would be too trivial a matter for the new department to undertake along this line — still, we thought it would be better to go slowly and carefully at first. There will be great demands made on this department and we hope to make it of great practical use to our Province.

A definition of ore is, "rock matter with enough metal, or metals, to pay to work—to pay to mine." That is ore. If it is too low grade (not enough metal in it) it is simply rock.

In classifying ores we use a very simple one; nearly 95 per cent. of all the metals found may be classified under three heads. First, a metal may occur in a metallic or native state; second, it may occur as an oxide, combined with oxygen; or, third, and more particularly with precious metals, as a sulphide. Under these three heads we will speak of the leading ores with comments upon them. Everything found in a metallic or native state is an ore, and one of these is platinum. In a district of the Urals, Russia, this metal is found in considerable deposits, and in many of our placers platinum is found. Rarely is platinum found combined with another element as a mineral.

Of course the metal most mined for is gold, which is found almost universally in its metallic or native, or pure state, or may be alloyed with silver or copper, but not combined to make a distinct mineral; it does so occur though, that in Colorado it has been mined as a distinct mineral, being combined with tellurium forming telluride of gold. In Cripple Creek Camp, which in 1891 was nothing more than a cattle ranching country, they have taken out during 1895 $7,300,000 of gold, most of the ore there being gold combined with tellurium and forming a telluride. Tellurium is much like sulphur, and the telluride something like a sulphide. In some of our gold ores containing a great deal of iron pyrites, copper pyrites, etc., it has been a matter of debate as to whether the gold occurs in its metallic state originally, or combined with sulphur as a mineral, the opinion being that it is there in its metallic state, but so closely is it associated with the sulphide ores that when we come to mill it—that is, put it through the stamps—it is impossible to get the gold scoured clean enough to amalgamate.

Another ore, or metal, we find in its metallic state is *silver*, though it is more often mined as a sulphide, but native or wire silver may be found in rich ores, sometimes a considerable quantity being scattered through the mass. I remember in the famous Aspen mine, which was the greatest silver mining camp in America, we had extremely rich ores, and scattered through these ores would be a varying quantity of metallic silver. One day I had just come out of the mine and was sitting in the shaft house when the shift boss came up from the mine holding something in his hat, which he took to the water bucket and soused up and down and then lifted up a great mass of wire silver, which he told us he had found lying next to the shale, and it being very soft

had been able to pick it out with his candle stick. Such ores are more or less difficult to assay, however. Silver is usually found in combination with sulphur, forming a sulphide or argentite.

Another metal of great importance is *copper*. There is only one mining region in which copper is mined in its metallic state, that is on Keewenaw Pt., Michigan. The three greatest copper districts in the world are Rio Tinto, Spain; Butte, Montana; and Lake Superior, the Lake copper commanding the best prices in the market, though the copper separated from the copper pyrites in Montana commands nearly as high a price, it being refined by electrolysis.

Up on the Calumet and Hecla is found a bed of conglomerate made up of fragments of volcanic rocks cemented together. Over a certain area the extent of which is known, there is this sedimentary rock, the bed dipping about 38 degrees from the horizontal, with almost a uniform thickness of 8 feet. At that mine may be seen by far the greatest mining machinery in the world, to see which mining men from all parts of the world come. Aggasiz, son of the great scientist, was one of the first to become interested in the property, and there is considerable romance connected with the first working of this deposit. I believe it was at that mine that a native who had lost a sheep or pig found it in a hole, and in taking the animal out saw the copper. Aggassiz had his attention drawn to it and began exploring, and finally exploiting it. This mine has paid millions of dollars in dividends. The mine is now down over a mile on the slope, or 6,000 feet. In speaking of volcanic rock, we know that ashes are thrown out of volcanoes which falling to the earth, or perhaps into water, may be hardened into a rock stratum. Through this stratum of ash, copper is found in a metallic state, and it has been found in as great a mass as one 120 feet long in a pure state, and it is almost impossible to mine it, as it could not be blasted, the charge firing off like a gun, and it could not be chiselled off to advantage. Metallic copper is found in other deposits but sparingly, and usually is the result of decomposition from the old primary form of yellow ore, or chalcopyrite.

Another native mineral is *graphite*, a mineral of great economic value. Its composition being pure carbon, as is the diamond, and most of you know of the enormous wealth that is being taken out of the diamond fields of South Africa. Graphite has been mined in Canada, and at Ottawa they are now putting in a large mill for concentrating the ore that occurs in certain rocks.

*Sulphur* is mined as a native mineral, in Sicily, and in Mexico, and from it the sulphuric acid of commerce is made, the uses of which are many, it being used largely in the treatment of ores.

*Mercury*, though found in its metallic state, is, like copper, generally the result of decomposition of its primary form, the sulphide or cinnabar. These are the chief metals or elements found in their native state.

In the second classification of ores, the *oxides*, the most important, the most abundant and in fact almost the only ores we find are the oxides of iron. We find iron scattered everywhere through nature, but the iron mined is mostly in the form of oxides, of which there are three, magnetite limonite, and hematite. If we take magnetite and analyize it we find it contains about 71 1-2 per cent. of iron, the rest being oxygen. We sometimes hear of iron being found that is from 90 to 96 per cent. iron, this of course is impossible, as theoretically it cannot be more than 72 1-2 per cent. of iron, the rest being oxygen. The iron industry has become a vast one indeed, the increase during the past year in the production of pig iron and steel being very great. Iron ores are divided into Bessemer and non-Bessemer, the Bessemer being for the production of the better class after Bessemerizing. To determine what is a Bessemer iron, if there is 65 per cent. iron in its ore, divide this per centage by 1000, which would give you .065, that being the limit beyond which phosphorus must not go to rank this ore as Bessemer. It is surprising to see the huge ore barges loaded with iron ores taken from Marquette and sent down the lake and landed, perhaps at Cleveland, for $3, $4, or $5.50 a ton. Up in this mining region where they have such enormous beds of iron, only the richest beds are worked. During the past season there was shipped from Marquette down the lakes over 10,000,000 tons of ores, the shipping industry of the lakes being enormous, in fact one of the largest in the world.

Leaving iron for the present we will next speak of *tin*, wnich is known by different names as tinstone, or stream tin, cassiterite, etc. Unfortunately, for some reason we cannot explain, tin has never been found on this continent in any amount. In Dakota an enormous amount of money has been spent on what was thought to be good tin properties, but it has been almost a total loss. Tin is supplied almost entirely by Cornwall, and the Straits Settlements.

*Manganese*, we will speak of for a moment. It is of great economic importance also, and it may be a mineral of interest in this Province, in which the mineral seems frequently to occur. Manganese acts in every way like iron, and is treated like iron, being of great importance to the smelter. If you have an ore with a good percentage of Manganese you should get from the smelter —that is if the smelter is run on a business basis—a much cheaper smelting charge on account of the Manganese present. In a pure form it is worth from $300 to $400 a ton, the demand is constant and cannot be supplied, it being used commercially in glass making and in dyeing. Deposits of pure manganese can be mined quite profitably and it should contain at least 40 per cent. to be profitable.

As to the manufacture of steel, we are all familiar with the wonderfully different characteristics of wrought iron, cast iron and steel, and if we make a chemical analysis we find that, after leaving out some of the impurities, the vast difference between them is due to a certain amount of carbon being present, in cast iron there being considerable per centage, in steel there is a small per centage, and in wrought iron none at all. The different steels for making the different products, from steel rails down to watch springs is determined, a great deal by the percentage of carbon present. Before Bessemer discovered his way of making steel it was a difficult matter to take pig iron containing from 2 to 7 per cent. of carbon and reduce the carbon from the iron, but in Bessemerizing, the pig or cast iron is put into convertors, and a blast turned on to drive off the carbon and then spiegeleisum, a manganese compound is added to the molten mass to bring the amount of carbon to a certain percentage to produce a certain grade of steel. Steel once worth $400 a ton can be turned out by this precess for $18 to $23 a ton, a wonderful and radical change.

We will speak of one more metal, that is aluminum, one of increasing interest. It is one of the most common metals, being the metallic basis of our clay, shales and slates, though they cannot be treated for its extraction, it being procured from beauxite, corundum or emery by the process of electrolysis.

We find all our precious metals in their primary state or in the state in which they were deposited in the veins or other places where found, and they are all deposited in the first place as sulphides, the original or genetic form.

*Mercury* is of special and growing importance in this

Province, being known as cinnabar or sulphide of mercury. It is being extensively mined in the New Almaden Mines and others in California. We will speak of mercury mining later on.

We have also *Nickel*, which in Ontario is a metal of much importance. Since the year 1894, one mine alone, the Copper Cliff Mine at Sudbury, supplied 70 per cent. of the world's demand, and was quite able to supply the demands of other worlds were it required. Many of the nickel mines have been compelled to close down because there is but little demand for it at present, though there is an increasing demand for nickel steel used for armor plates and in other ways in the commercial world.

*Iron Pyrites* is a common mineral, found in places in very large masses, containing from 40 to 46 per cent. of sulphur from which sulphuric acid and, as a by-product, nitric acid is produced. Arsenic and sulphur are produced from some pyrites with profitable returns.

I have run over the classification of ores and now will give a few examples to show what a vast difference there may be in the value of an ore, which in one district may be profitable and in another of no value. Take iron ore for instance. The amount of iron now being mined is enormous and it is being found in great quantity in many places. It should contain from 50 to 60 per cent., a lower grade rarely being profitable. Pig iron can now be bought so cheap that it no longer pays to attempt to smelt a low grade ore.

A vast amount of copper is also being mined. In such mining districts as Rio Tinto, Spain, and in Montana they have been able to produce copper very cheaply. The price has fallen from 35c. a pound to 8 and 9c., but if you have a large copper deposit, 4, 6, to 10 per cent. may be profitable. If you have it in limited quantities it is useless to think of mining it unless there should be a certain amount of gold or silver present to help raise the value and thus make it profitable.

As to silver, whether the ore can be profitably mined depends on the locality, the amount of ore, and its distance from the smelter and of course the amount of silver itself. The range in which the silver is you will find in large smelting centres has a commercial value, a regular scale of smelting charges being fixed in accordance with the character of the gangue. If the silver is found in a limestone or an iron gangue it then becomes of special value to the smelter, and I can cite cases in point, as at Aspen, Colorado, where limestone containing the silver was so needed by the smelters as a flux that they charged nothing for smelting the ore, even paying a premium so desirous were they to get this limestone bearing ore to mix with the great quantities of silicious ore coming from the other camps. Before the railroads reached Aspen, ore carrying less than 100 ounces to the ton did not pay to mine, as the ore was packed out on the backs of burros or in ore wagons. When the railroads did come, then ores that were before useless, became of great value, and ore having 16 ounces to the ton was profitably mined. Some of the Leadville ores contain 30 to 40 per cent. of iron and only 3 to 4 ounces of silver, but so desirable are these ores to the smelter that they charge nothing for smelting them, hence miners in Leadville and Aspen were making money on extremely low grade ores, but ores needed by the smelter.

In hydraulic mining, gold paying 3 cents per cubic yard is sometimes good pay dirt, it being a question of water and ease of getting at the gravel banks. With a gold ore in rock the question is largely one of whether it is free-milling or non-free-milling. Yet non-milling ore is not the bugbear it was once. Ores that once were very refractory are now treated by the chlorination and cyanide processes, and when one thinks that in extracting $10 worth of gold from the ton of ore, it is but the one sixty thousand part, one can form some idea of the fineness, and the delicacy we might say, of the process that will save so small a percentage from such a mass of rock. It must be remembered that there may be a vast difference between the *assay* value of an ore and the actual yielding value.

I will note an instance. If you take a Gilpin County ore and assay it, after getting as good a sample as you can, you will probably get good assays, but when you mill it you will find the percentage of gold saved much less. In the Treadwell Mine where gold is scattered in small particles through an enormous mass of eruptive granite, where vast masses of ore are crushed, ore yielding $4 or less is mined profitably, because it can be mined and milled in such large quantities. In the Homestake vein, which has paid over $5,000,000 in dividends, the ore yields $3.60 per ton, with 750 stamps at work, some of the mills in the Transvaal being even larger than those of this mine. There is a large mine in California in which the ore yields only $1.65 and yet is yielding a handsome profit, this being a free milling ore. From ores that at one time would not pay for the working, now, by the methods of concentration, or concentrating the volume of metal from 20, 40 or even 100 tons into one, very handsome results have been obtained. The advance in gold milling has been along this line, i. e., the concentration and perfected process. Many of the properties lying dormant for years are now being opened and worked with very good results simply by the use of concentration and the treating of concentrates by cyanide, chlorination, or smelting.

We will now speak for a while on *ore deposits* and will give a few examples. An ore deposit consists of concentrations of metallic minerals, either by chemical or physical means, very often being the localization of certain minerals which are found in smaller quantities desseminated in many of the *common* rocks.

Where do we find ore deposits, in what rocks, in what geological formaiions? I may say that taking the list of the geological formations from the oldest, the archæn, down to the latest in them, we may find ore deposits in some part of the world. There is not a member in this historical list in which ore deposits are not found. In prospecting one must never pooh-hooh or condemn any particular region without positive knowledge. A large area of country near by has been condemned by many prospectors who give it the cold shoulder because they claim the rock is too *cold* (?) to contain mineral of any useful kind. I have seen an excellent ore claimed to come from this region, ore I think any prospector with experience would very quickly prospect to ascertain its true value.

As to classifications of ore deposits, we may divide them into *regular* and *irregular*. In the first, the regular, we have (1) *beds* and (2) *veins*; in the second, the irregular, we have (1) *concentrations*, (2) *impregnations*, and (3) *alluvial* or superficial deposits, the last mentioned being the gold gravels of ancient and modern placers.

It is well to remember in looking at an ore deposit that when it was deposited there were hundreds, yes thousands, of feet of rock above it, above the very place you may be standing., and this may keep you from forming some erroneous ideas. We will define a vein and distinguish it from a dyke. They both fill fissures or cracks made in the rocks, but in the case of a *dyke* the fissure or crack is filled with *igneous* rock forced up from below, while a vein is not filled with igneous rock but with mineral that has been deposited from *aqueous* or watery solutions.

A *true* or *fissure* vein follows the fissure or crevice that cuts across the strata of the enclosing rock. That is a simple definition. In looking at the diagram of a true or fissure vein (see chart 5) we notice some extreme changes in widening and contracting, then widening again, a greater width obtaining in passing through a certain kind of rock and then narrower in passing through another. We will explain this as it is of vital importance in vein mining. As in geology one of the first things to determine on discovering a vein or lead is to find in what direction it runs on the surface; that is, the strike. The next to determine is the dip, pitch, or inclination. A dip or pitch is measured from a horizontal line. The enclosing walls are known as the hanging or upper wall and the foot or lower wall, the vein filling matter being known as the mineral, vein matter or gangue.

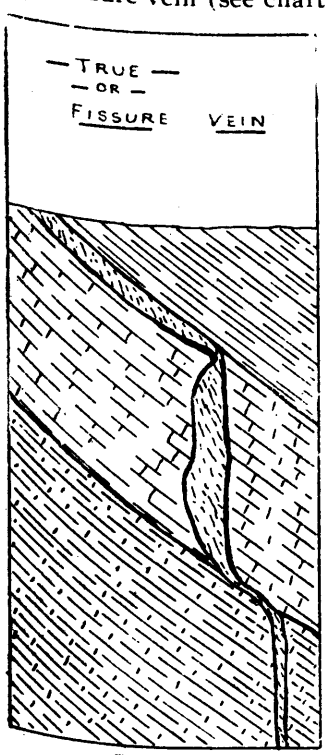
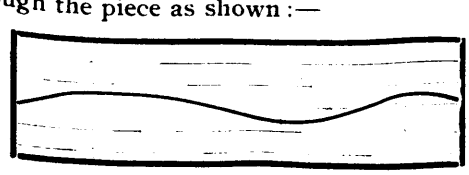
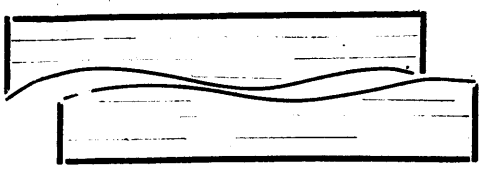


CHART 5.

It may consist of quartz or it may be calcite, or carbonate of lime, dolomite, or one of the ores of iron, or it may be that extremely heavy mineral known as "heavy spar." Besides having a regular gangue, in the fissure is often found much of broken-up rock mass taken from the surrounding walls, forming with the ore a "breccia." We hear of veins or fissures being traced for miles. These breaks, however, are comparatively local, that is the length is never very great, and we have a very long vein if it can be traced for 4 or 5 miles. The great mother lode of California extends for over 100 miles, and in it we have the greatest example of a long fissure vein. As to the depth of veins we do not know. I may say that the influence of depth on veins is nothing. That a vein will get larger or smaller in depth can not be pre-determined without actual exploration, it may or may not, this depends only on circumstances of which we will speak. I will now try with a diagram to illustrate this narrowing and widening of veins, and I have here a paste-board with an irregular cut through the piece as shown:—



Fissures or cracks running across the strata generally are more or less curved and corrugated, and as you sink on the vein it is bound to be quite irregular in shape, hardly ever with a straight, clean-cut break. Generally the shape of the crack depends on the nature of the rock through which it passes. Holding this diagram in its original position you will see that the fissure is curved or corrugated, and if we push one of the pieces along a short distance, allowing them to nearly touch in places, you will find it looking thus:—



By the slipping down of one part of the rocks there can thus be made these lenticular parts, with pinches that afterwards may be filled with vein matter. This is perhaps the best explanation of the irregular shapes common in veins. There may be a movement of the rock containing the vein laterally as well as downwards or upwards, then we would have lenticular-formed ore deposits horizontally as well as vertically, should both movements take place. If a break or crevice is formed in sedimentary rocks, passing from, say, shales into limestone and then into sandstone, we shall find almost invariably as we pass from one kind of rock into another there is a radical change in the vein itself. (See Chart 5.) We present here a diagram illustrating this, and in this particular vein it passed down between shale and limestone, at first as if it were a bedded vein. In passing through the soft, yielding shales a crevice is nearly always closed again, but in passing through limestone, in which we find our largest ore deposits in the sedimentary rocks, when the fissure occurs water may percolate through from the surface carrying with it the powerful acid, carbonic acid gas, which is everywhere prevalent, and as these waters run through these channels they attack the limestone, and the opening is made much greater. This is the explanation of the formation of the great caves, such as the Kentucky cave. In passing through the sandstone the waters have not the same corroding effect they have on the limestones, the change being insignificant. The mineral bearing solution will sometimes pass along the crevice through quartzite or or sandstone, without altering these walls, carrying mineral in solution as water may carry salt or sugar dissolved, but when the solution reaches the limestone it rapidly attacks the walls, there is a chemical change in the solution, its dissolved minerals are precipitated and deposited and thus we may have formed a great ore deposit.

This leads up to another feature, and one that to the miner is of vital importance, one causing every mining superintendent many an anxious hour, and that is the dislocation or faulting of veins and mineral deposits. You may be engaged in mining, drifting on the vein, when suddenly your ore is shut off, cut clean across, but you know that this is not the end of it, but that somewhere beyond this faulty plane the ore continues. In many mines it has been a matter of extreme difficulty to tell where the ore body has gone, as also in sinking on a vein the same trouble has been met with. We will now refer to the diagram of a faulted fissure vein. (See chart No. 6.) Sinking

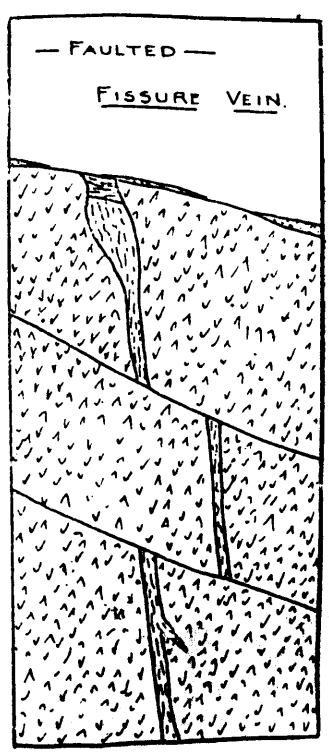
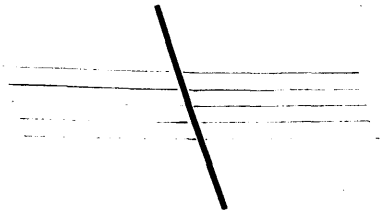


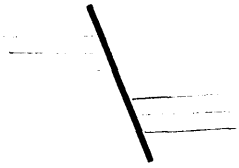
CHART 6.

down on this deposit it began to pinch out, when suddenly it was lost altogether, but they kept sinking into the granite, and when working in igneous rock it is generally more difficult to tell where the faulted part has gone. In the granite they found no trace, but out to the right and left they ran a drift and found the continuation, which in turn ran out, but this time the vein was found round to the left. There had been an earth motion, a crack had been caused and part of the vein had been pushed away. This vein is said to be faulted. In running a horizontal passage or tunnel, to strike a vein I have seen where a fault had so displaced the vein for some yards that the tunnel passed right across through a gap thus made in a vein and was continued some hundrdes of feet farther without the miners being aware of what might be the trouble. Becoming suspicious, they went back, examined carefully, and found direct evidences of a fault, the rock had been split and the vein moved sufficiently for them to miss it.

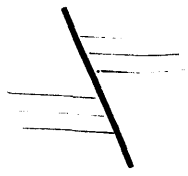
Looking at this diagram which I shall put on the blackboard, let us see how we can know where the faulted part has gone.



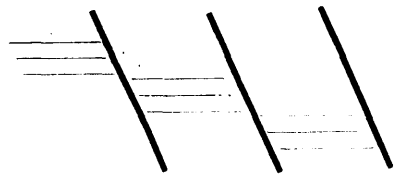
Suppose this to be a stratum with the break or crack running through. Very often there is no movement on either side, though there is a break there being no displacement, generally when a break takes place the rock on one side will move along the line of the break. In this second case we will presume that one wall has slid down, that the lower wall has gone up, there has been a push and one side, the one with less weight, gives way. When this does occur, and it occurs nearly 87 times out of a hundred—when the rock on the *upper* side of the fault wall goes *down*—we have a regular or *normal* fault. The following will illustrate this:



Now we will suppose that instead of the upper rock slipping down it goes in the other direction and slips *up*, then we have a different form of fault. You will note that if you drop a horizontal line through it it would seemingly pass through two ore beds, hence, when the rock on the upper side of the fault moves upward we have then the *reversed* fault, as:



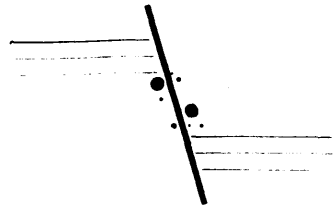
The regular or normal fault is the one that occurs in 85 per cent. of faults. We often find that an ore body that is crossed by one fault will be crossed by another, thus there may be a series of faults as shown, or step faults:



In many mines we find series of faults that have occurred at entirely different times. In that case the ore body becomes so broken with faults that it requires extensive experience and careful study to determine their location. You may ask "How do we determine where the faulted part may be?" We may describe four ways. (1.) Suppose by this diagram that this vein has gone down, as:

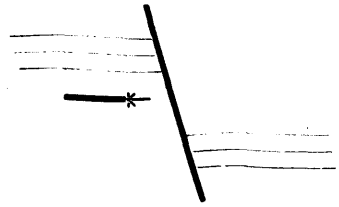
Very often as this part goes down the ore deposit will be dragged down along the fault plane in the direction of the movement showing the course taken by the faulted part. In Leadville deposits this is clearly shown and has been practically utilized. (2.) Another way of locating the faulted vein is by a knowledge of geology, particularly the sedimentary rocks, but in the case of igneous rock it is often extremely difficult to distinguish the different kinds of rock. To refer to Smuggler Mountain, where many thousands of dollars worth of ore had been taken out, when the ore deposit was found to give out. They were working with a dolomitic limestone on the one side and a shale on the other of the deposit, when they suddenly ran into sandstone. Over on another mountain, a mile distant, this sandstone was seen lying geologically below where it was now found, and having it now appearing in the drift, they knew in what direction to crosscut to find the faulted deposit. This is the second way of finding the faulted part, by knowing the position and sequence of strata.

(3.) The third may be illustrated as follows:



When a mineral vein is broken it may break off fragments of the ore and metal, and some of the fragments are drawn along and scattered along the fault plane. This very thing happened in the Smuggler Mountain Mine, for where the deposit had been pushed along 150 feet from the other end of the deposit, they found the ore scattered along the fault line. I know of one instance in which thousands of dollars worth of ore were taken out along such a line of faulting.

The fourth might be illustrated thus:



Suppose a tunnel being driven in the direction of the arrow; a shot is put in and suddenly you may find a smooth face across its dip, and that the shot has broken right through to the fault plane, and the other side

a clean polished wall called a slickenside. If it is sloping downward away from you, you may know that in 85 cases out of every 100 the ore lies below, that is you are on the under side of the fault plane, and you will find the continuance of the ore body below you.

If you find, on the other hand, that this fault plane slopes up and away from you, the chances are much in favor of the ore body being above you.

Many times it is difficult to tell where the fault does lead to, especially when working a vertical fault is met with, then the rule—known as Schmidt's rule—is of no avail; *i. e.*, "explore for the faulted part in the direction towards which the fault plane inclines away from you."

(4.) Where the fault stands vertical there is nothing to guide the miner, and it often takes extensive exploration to find the ore beyond the fault. Such an ore body might have faulted laterally or pushed out sideways. Much money has been spent in looking for faulted parts, but with the present methods, especially with the electric diamond drill to which I may refer later, faulting is not such a bug-bear as it once was.

There are many other details we might mention in speaking of veins. We often find along the vein, and especially along a broken up wall, rocky matter, or it may be clayey stuff that has been ground up along the wall from the enclosing rock.

The upper or decomposed part of an ore deposit is known as the gossan. If there is considerable iron pyrites in the ore deposit the gossan is stained a brown or reddish color, and the prospector should ever be attentive when he finds these colors, as they may be indications of veins underneath.

This leads us to a very important detail in mining, that is the *water-line*.

In working a deposit the mining man must remember that on sinking he will reach a horizon below which there will be a radical change in the ore. Working near the surface the ore may be extremely easy to work and mill, but suddenly he reaches a place where the ore is no longer a carbonate, or an oxide, as it may have been above, but consists of that primary mineral, iron, or copper pyrites. In many mines the appearance of this molten and sulphide ore has meant the end of prosperity for that mine, many instances of this might be given. In speaking of igneous rock in the first lecture I forgot to mention that rock in its molten state contains water. Of course this water in such rock is in the form of super-heated steam under intense pressure and intense heat. In working your ore it may appear to be perfectly dry, not enough water being present in the mine to supply the drills, but on its being shipped to the smelter they take a sample and determine the amount of moisture, and if you are not familiar with the fact you will be surprised to find it contains from eight to fourteen per cent. of moisture. Water from the surface is continually percolating down through the breaks and fissures innumerable, bringing down oxygen to oxydise the ore and also carbonic acid gas washed from the air by the rain water.

These strong acids not only rot away the rocks but attack the ore deposits, and the ores that were sulphides are converted into sulphates, and the sulphates converted into oxides, or sometimes into carbonates. These waters then pass on down filled with sulphuric acid, in some mines the acids are so strong it is almost impossible to pump them as no metal will stand the corrosion, steel and iron being of no avail for pump material, and even gun metal for piston heads and cylinders and wood pipes. The circulation of water continues on to a certain depth and then stops, this depth is the lowest point at which it can again find its way to the surface, perhaps in the form of springs. We might speak of the great ore deposits of Leadville. There they discovered some of the largest deposits of carbonates, sulphates, and oxides of silver and lead, but they have mined down and got below the water level and found the original minerals, the sulphides. In some of their deep mines they have hundreds of thousands of tons of these sulphides blocked out, which will some day be mined. Some are being mined at the present time. We might also instance the Ducktown mine of Tennessee, and the famous Butte mines where 185,000,000 pounds of copper was mined last year. In the Anaconda the upper part of the vein contained oxides of copper assaying from ten to twenty-six per cent. copper. As depth increased they found the beautiful peacock ore, bornite; deeper still, below the water level, they found the original yellow copper pyrites. The lower part has not proved to be so profitable, as the value of the assay has dropped from ten per cent. down to four and five per cent. of copper.

Let us look for a moment at another form of vein, the banded vein, which is greatly developed in Cornwall, and in Germany. We find along the wall a deposit of a certain kind of quartz, chalcedony or milky quartz which at the time before deposit was held in solution. Then there was a change in the nature of the solution, and the result was that the walls were now incrusted with a glassy quartz that crystallized. Then there was still another change, and galena, or bad ore was deposited on each side. In some veins, especially in quartz veins, the ore is sometimes scattered like raisins in a pudding, or it may pass down nearly through the centre, with stringers running out from the sides, or forming pockets in the containing walls quite hid from view, where they may be passed by by the miner as he follows the vein. In staking out an ore chute the good miner always keeps an exploring party ahead and does not sit down and expend all his energy in working out this chute without continuing the search for new chutes.

## Lecture 3.—Ore Deposits.

In our talks to-night on ore deposits, I think perhaps it would not be amiss to define a few mining terms.

A vertical passage, sinking down, is generally known as a shaft, if you have a vein running vertically and you follow down by a passage say 9x5 feet you would call it a shaft. If it is a wide vein running down with a dip you would call the passage driven in thus an incline, but in coal mining they generally speak of such as the "slope." In the West generally only the vertical passage is called a shaft. A tunnel runs in a direction opposite to the shaft, that is horizontally, or nearly so. A tunnel may be driven across barren rock to the vein for drainage purposes, and is then called an adit. After getting underground, a passage made along the deposit is known as a "drift" or level. Sometimes we hear men speak of these as tunnels, but I think that is erroneous, it being seldom used by miners of long experience. A drift or level is driven *along* the vein. Underground a drift or level may be joined to another by a horizontal passage, and we speak of this as a cross cut. Underground, also, we may have a drift or level we want connected with another below for the purpose of chuting down ore or for ventilating purposes, so a small passage is sunk from level to level, known as a "winze," derived from the word "winds."

In opening a regular working passage on the slope, such is called an "incline," the winze being an inferior or smaller incline. Working from below running upwards is called an "uprise," and is the opposite of incline. If we have two long tunnels running into a mine there is little or no natural ventilation after getting in

150 feet, but on making a connection between the two the currents of air will at once circulate through and ventilate both. In removing the ore the excavation is known as a "stope," the derivation of stope being "step." As in working out ore bodies we work down, or what is much better, work up, the ore being often worked out in steps, hence the word stope.

We will now speak of matters in reference to fissures and faults using the illustration on the black-board as:

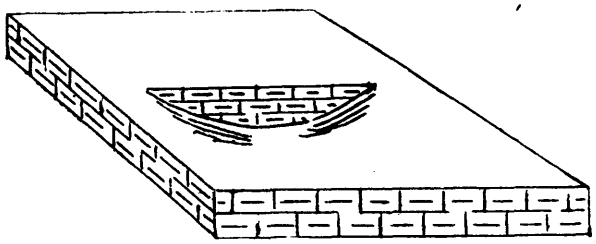


CHART 7.

Imagine a block of country ten miles square were here placed, and this piece of country to be under a strain sufficient to crack it, causing a fissure that may be one or more miles in length. I have said that fissures of three and four miles might be called long. After the forming of the fissure it may be that the rock on one side is not strongly supported as it is resting on the molten mass beneath, and the rock on this side may sink down a varying distance, or "sag" in the middle of the fissure, while at the ends the rocks are found together as formerly. This may help you to understand one feature in the faulting of ore bodies. In looking down this crevice we might find it a wide one, waters coming from below with minerals in solution precipitating along the walls of the crevice, and then, after the mineral has been deposited, erosion may completely change the surface, and on coming to mine this deposit we may find the upper part gone, with a vein along the break petering out at the ends of the gash, and also it may be faulted or broken by a movement of the walls along a subsequent fissure across the ore body.

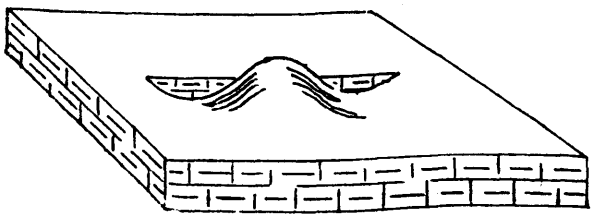


CHART 8.

Again, one side being regular, the centre may be pushed up, the result being that we have two sags, as shown in the sketch above, and in the break or gash below may form a vein. If we study the geology and ascertain the kinds of rock broken through we find a certain rock on one side, following it we find it appears again on the other side, while in the centre the rock that was below has gone up. These sketches will give some explanation of what must occur when rocks are displaced along fissures or fault plains. I refer you to the Comstock lode diagram, that shows a section across this great mine at the foot of Mt. Davidson. The vein was at one time considered to be a contact vein, it is now found to be a true fissure vein, between two kinds of igneous rock, diorite or greenstone, and diabase, the fissure being four miles in length. In the centre of the fissure the vein or ore deposit was of great width, while at the ends of the fissure it petered out to nothing, but the enclosing rocks showed that on one side of the bank, prior to the deposition of ore, had occurred a sag, just as shown in No. 7 above, the amount of sag in the centre, or faulting, being 3,000 feet, decreasing to 2,000 feet at the ends.

From this mine $325,000,000 worth of ore has been taken. It is also noted for the great height of temperature in its lowest working, as at a depth of 3,200 feet miners could not work more than 5 minutes at a time, they would enter the level, strike a few blows, and hurry out to the cooled station, while others took their place. In the Lake Superior district greater depths have been reached without finding the extreme heat experienced here, the regular rise of temperature being one degree for every 60 or 70 feet in depth, so rise of temperature in most mines is of no great importance. In the Comstock there was a chemical change going on in the rocks, with the result that a great amount of heat was given off. On the diagram you will note the great Sutro tunnel running in for 20,000 feet, and tapping the vein 1,200 feet from the surface, to which the water was pumped from below and run out.

Another interesting fissure vein is shown in the diagram of the Great Western or mercury mine of California, of which we show a section. We have here

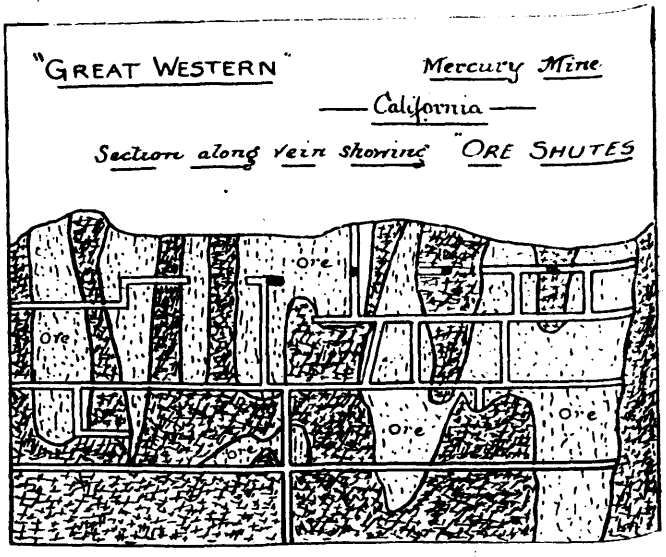



CHART 9.

igneous rocks, and coarse sandstones belonging to the cretacious measures, the same measures from which our coal is mined in this Province. Near where these two classes of rock come together there is a fissure or vein leading down almost parallel to another fissure, which was filled with igneous matter, becoming a dyke, and up through this first fissure the solution arose, carrying mercury as a sulphide, or cinnabar. In the gangue of dolomite, limestone and quartz we find the cinnabar, also metallic mercury from decomposition of the cinnabar, and wherever the mineral bearing solutions found access into the rocks through cracks, ore was found deposited, even in the cracks of the sandstones, and even in the many chinks and seams in the dyke we have the little reticulated veins carrying mercury. I speak of this as a matter of interest and for the reason that they are now mining mercury ores in this Province.

We will speak for a minute of *bedded*, or segregated veins, and refer to a few examples. A fissure vein is where a gash cuts across a formation, it may follow the bedding plane in places, but sometime or another it cuts across the strata, but a bedded vein follows *along* the bedding planes of stratified rocks and in the bedding planes have been formed crevices, and in these crevices has been deposited the mineral. These crevices do not

cut across the formation, but keep along the lines of the bedding planes. In prospecting with the diamond drill, these long, lenticular deposits may be found, but as to the source of the mineral and the filling of these veins it is difficult to explain. Mineral deposits generally occur near igneous rocks or dykes, but it is not yet understood by what means this wonderful influence of igneous rock has affected ore deposits. You may analyze it very carefully and find no mineral in it whatever, yet where we find ore deposits we usually find, in close proximity, large masses of eruptive rock. Another example, of which we show you the diagram, in which the vein follows the formation is the famous "Saddle Reef" of Australia. These rocks have been twisted and bent into horse-shoe form, the bedded vein following the curve and not crossing the strata, thus:

In the quartz veins are found gold. In Nova Scotia a large amount of gold has been taken out from just such veins, and in Australia these reefs have proved very productive.

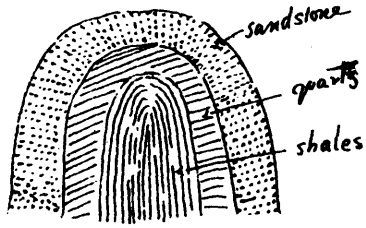



CHART 10.

There is another form of vein, that comes under the classification of regular veins. It is a class of vein that may be of great importance, judging from what is told of the finding of gold at Alberni, Vancouver Island. This class is called reticulating veins, or stockwork. At times there may be one or two leading fissures, but often the rock will be gashed and cut with little stringers, running in every direction, crossing each other with no regularity, thus:

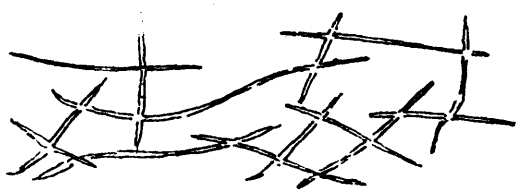


CHART 11.

Sometimes they are so numerous and so well mineralized that it pays to mine the whole mass. One great instance I might mention in this connection is Cripple Creek, Colorado, a deposit that is unique. We learn from day to day that nature scatters her minerals in every imaginable form depository, through rocks of every age. Cripple Creek is determined to be the site of an old volcano from which a large area has been covered by rock matter corresponding in age and character to the basalts that cover our ancient placers and those of California, but at Cripple Creek they find the lavas throughout the different flows are seamed and cracked with a lot of these little veins, sometimes large enough to be mined independently, but in most cases so small that they mine the whole mass of rock, the gold having been deposited as a telluride, for which reason the general way of treating gold by amalgamation in the stamp mill is not a success with the telluride, as it saves only about one-third of the gold. Much of the ore is sold to the smelters and a great deal is now being treated by chlorination and cyanide processes. $7,230,000 were taken out last year. I have been told that in Alberni in a good many rocks the seams and veins are found in this way, and on some properties it may be necessary to mine the whole mass, if examination proves the ore to be payable.

We will speak of *contact* veins, as many veins or ore deposits have been found at the junction or contact of two dissimilar rock formations, and hence in a contact vein the ore is deposited between two rocks of different ages, such as we find very well illustrated in many of the Cornish mines, when there may be a mass of granite butting up against beds of stratified rock, along the point of contact of which the ore may be found. We find this to be the case in many mines in Leadville, when the great ore deposits were found in the limestone lying next to the great masses of porphyry or igneous rock.

BEDDED DEPOSITS.

Our great iron deposits are bedded deposits. Iron is found in nearly all rocks and is easily dissolved out by different solutions and carried down into swamps or ponds and precipitated there by being oxydized, when the iron oxide settles to the bottom of the marsh or pond or lake, forming sometimes a considerable thickness of iron. Radnor Forges, at Lac La Torque, Quebec, an example of this, one of the first iron deposits opened in America, certainly the first in Canada, having been worked for over 160 years, the lake bottom is covered with from four to six inches of "bog" iron ore, which is got by dredging. They found that though the bottom was once dredged the harvest was not done, for on returning after several years they found that another layer of several inches had been formed in the same place. They also find iron in that district in the swamp lands, at varying depths, by driving down a crowbar, after which, on removing the upper dirt, this bog iron ore is mined by the farmers after their farming is done, and brought in to the smelters. From the Lake Superior iron mines they have been shipping yearly from eight to ten million tons during the past few years, from beds of iron ore of great extent, thickness and purity, and many of these deposits have been found as just indicated, although they may in many places have been found in other ways.

We might speak of bedded gold deposits, and I refer you to the diagram of the famous mines in the Transvaal which produced nearly 39,000,000 dollars worth of gold last year, and in December of last year over 175,000 ounces. (Chart 12)

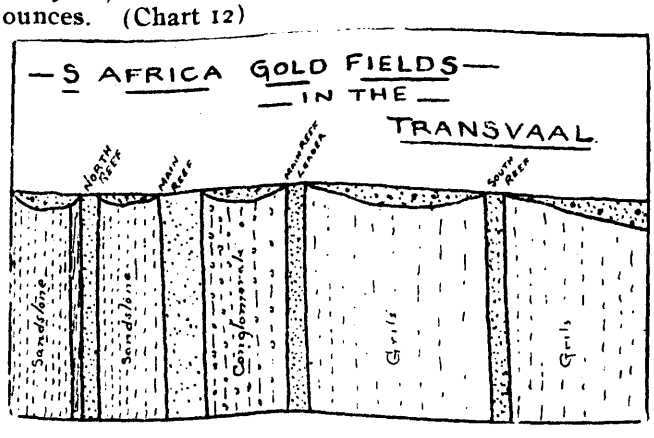



CHART 12.

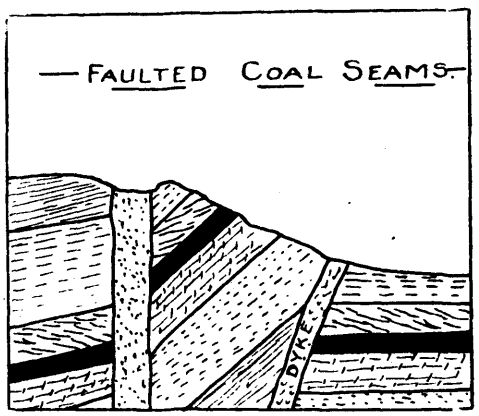
These gold deposits, called locally "reefs," are not in veins or leads but in banks of conglomerate, originally deposited horizontally, but now so tilted up that they are vertical, as shown by the diagram. There are coarse conglomerate rocks in the strata near, but they are not gold bearing, nor is the gold found in the hard grits. We were speaking of the conglomerates being formed along the sea shores, and this section would indicate that after the conglomerate was laid down there had been a subsidence and that the grits were laid down only to rise again to permit another bed of conglomerate

to be formed. There are three beds of this conglomerate that comprise the three gold-bearing reefs, the smallest reef is from one and a half to three feet, and the largest from twelve to fifteen feet in thickness, the main reef is not as rich in gold as the others, but the gold in these sedimentary stratas has been deposited there by circulating solutions after their formation. The tailings from the stamp mills are passed into large vats and allowed to soak in very weak solutions of pot. cyanide, which process has there proved to be a very signal success.

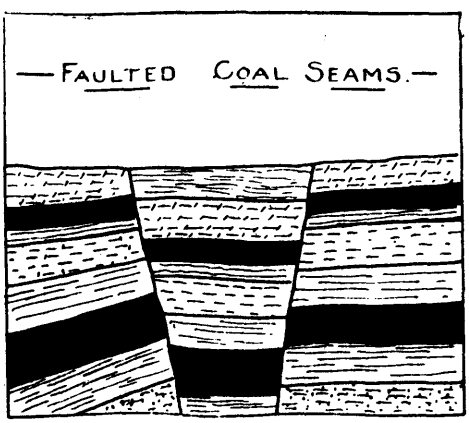
A famous silver mine, one over which there has been a great deal of litigation, was found in a bed of sandstone. There was no indication that the rock was mineralized, but to the surprise of everybody it assayed from $30 to $40 to the ton in silver. It was found that through this sandstone as it was laid down there was more or less of organic matter, twigs and leaves buried in the sandstone, and as the solution carrying silver percolated through the rocks wherever they came in contact with the organic matter the organic matter was replaced by the silver sulphides, and some very beautiful specimens were formed in this way.

The greatest of all bedded deposits are the coal seams. In the study of geology we find but two horizons in which coal is found, in the East we find it in the carbonaceous, in the West in the cretaceous era. On studying these beds of coal we find they are made up of organic remains, and that at the time they were formed the climatic conditions must have been very much different from what we are now experiencing, as in the enormous lagoons or swamps the vegetation must have been very rank, far more luxurious than we find in the tropics to-day, and in these great swamps were laid down enormous thicknesses of organic remains. We find in our swamps to-day trees falling down and being buried, forming masses of woody organic matter, or the vegetable and tree growth forming beds of peat. Originally these beds of coal must have been of very great thickness. We know that they are formed of organic matter, because underneath the bedded coal is the clay and in the clay are the rootlets, and in some places above the coal are stumps of trees that have been buried in the covering sands or silts, and stand as they were buried. After the bed of organic matter had reached to a greater or less thickness there was a great change in the level of the surface—there was a sinking of the beds and they, in turn, were covered beneath a layer of mud hundreds, or perhaps thousands of feet in thickness. It also happened that after a considerable thickness of mud had been deposited that this section of country began again to rise above the waters, so that again existed extensive lagoons, that being also buried, formed a second seam of coal.

Thus may be quickly explained how there are now several successive seams of coal. We cannot, properly, speak of a *vein* of coal, as, strictly, it is a seam or bed, it being a stratum of sedimentary origin. In the change from organic growth into coal the lignite, or a poor quality of coal is first made, with twenty to thirty per cent. water, then soft, or bituminous coal is formed, and from this the anthracite or hard coal. Where the pressure or over-burden has been great we find the mass has become greatly compressed, the water has been driven off, and the result is a better grade of coal, but where the strata is put under great compression horizontally and laterally, contorting and twisting it, we find a still further change and a better grade of coal, the best bituminous, or even anthracite coal, depending on the amount of carbon and volatile matter we find it contains. In the soft or bituminous variety there is a large amount of volatile matter, but where these coal measures have been subjected to very great heat and compression the volatile matter has been driven off and what is left is materially a hard coke, containing from 90 to 95 per cent. pure carbon, this altered coal being classed as the anthracite or hard coal. To exemplify these changes we might cite our coal measures in Western Canada, where, out on the prairies near Winnipeg, the coal seams or lignite are of very poor quality, being buried under a thin layer of rock and soil, but further west is a greater overburden of rock, the measures have been more or less distorted, with the result that we have a better grade of soft coal. But on entering the portals of the Rocky Mountains where the measures have been pushed up with the range at Canmore and Anthracite, the coal beds have been subjected to much greater twisting, heat and presssure, driving off the volatile matter, leaving the anthracite coal, now being mined.



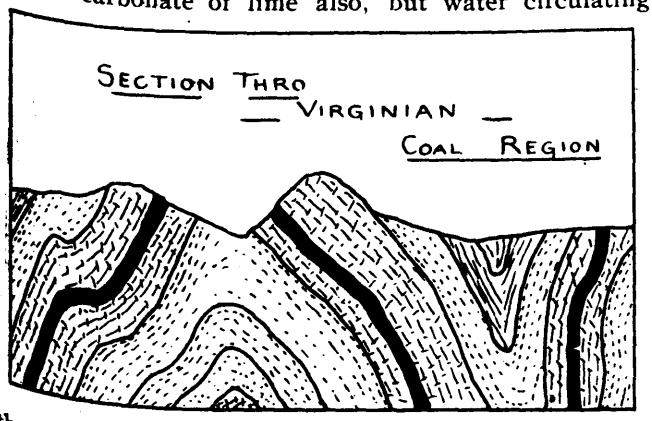

At Mauch Chunk, in Pennsylvania, and in Virginia, the coal has been subjected to much twisting and contortion. Much of the Pennsylvania coal has been metamorphosed into an anthracite, but in Virginia the changes were not sufficient to form the hard coal and its mines are of a very fine, soft coal. We show you diagrams from these famous coal regions, as well as other sections, showing the contortion and disturbance by faulting of coal measures.




IRREGULAR DEPOSITS.

I will speak for a minute about *impregnations*, or ore bodies that may be developed largely some day in this Province. It is found oftentimes that where a break has taken place and a fissure formed the fissure itself contains no mineral, but that the solutions passing up from below, as they pass by certain kinds of rocks that fissured the solutions have attacked these rocks, limestone having been the most susceptible. In the different strata of Smuggler Mountain, of Aspen, Colorado, you will note the sandstone, the dolomitic limestone, the "brown" and "blue" limestones of a different age.

"blue" limestone is the pure limestone, or a carbonate of lime. The rock underlying this had at one time been a pure carbonate of lime also, but water circulating




through, carrying more or less magnesia, converted the lower into magnesian or the "brown" limestone, terms well known in Colorado.

On reaching the blue limestone the solutions attacked the rock, and deposited the silver by replacing the lime with silver and lead sulphides, and in places the ore was extremely rich, while on the other side of the fissure the brown limestone was barren. In one place it had eaten twenty to thirty feet into the blue limestone. This is an example of an impregnation deposit, sometimes the ore being found in the brown limestone, sometimes in the blue. It is now believed that very many veins have been thus formed, not by the filling up with mineral of open fissures, but by the passage of solution along fissures but slightly opened, and the subsequent impregnation of such solutions into the wall rock on one or both sides of the crevice, and the precipitation of the minerals held in solution, these minerals replacing the rock material, which is carried away by the water.

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NOTE.—The March number of the RECORD will contain the fourth lecture by Professor Carlyle and the lectures of Mr. Carmichael and Mr. W. Pellew-Harvey, thus concluding the whole series on mining lately delivered in Vancouver and Victoria. Parties wishing to obtain these lectures should subscribe now to the B. C. MINING RECORD, commencing their subscriptions from January 1st, in order to have a complete volume of the publication at the close of the year. Subscription price, $1.00 per annum.

## Happenings at the Mines.

### ALBERNI.

The Starlight is the only claim located on free milling rock in this section. Naturally it has been the first to secure capital for development and will soon be thoroughly prospected. On Granite and Williams creeks, some nine miles from Alberni and near the Canal, a number of locations have been made. The most promising of these are the Star of the West with six to seven feet of $10 rock, mill tested; the Islander, just now being floated at $100,000, and the Nevada and Lion claims. Further down the canal a number of locations have been made.

At the head of Barclay Sound, from the mouth of the Canal toward the open ocean, is the Copper Island district. Copper Island is some two miles wide by four long. On the east side of the island some good locations have been made. The country rock is a diorite with interbedded bands of quartzite and calcareous matter. The leads are chalcopyritic, and, while strong and wide, are of rather low grade. The Rainbow claim is a good example. There are found about 4 feet of ore between hard and well defined walls. The assay returns run from $8 to $12, according to reports.

### BOUNDARY CREEK.

Messrs. Sheehan and Gwatkin's recent work on the Stemwinder claim at Fairview has disclosed another ledge upon the property, the ore from which is pronounced as being superior to anything taken out of the ledges formerly worked upon.

It has been reported on good authority that eastern capitaliists have offered some of the parties holding claims on the Kruger mountain, near Osoyoos, to put up some kind of reduction or smelting plant at a point near the mines, if a consideration be given in return of a half interest in all the claims held there.

Messrs. Atwood and Wake are engaged developing the Silver King claim in Skylark camp, and the work done has given very satisfactory results. There are four distinct veins of ore upon the claim, each of about six feet.

Messrs Mangot and McEchran are steadily sinking on the Morning Star claim at Fairview, the shaft being now down a depth of some 140 feet, with the ore gradually improving.

A one-fourth interest in the Last Chance claim, located in Smith's camp, has been sold to E. L. Tate, of Spokane, for $2,500. The ore is silver-lead, with a small value in gold, which will have to be concentrated before it can be shipped with profit.

The Montreal company, represented by F. C. Innes, of Vancouver, recently bonded the Gold Drop, and have now taken hold of a sister claim—the Monarch—which lies parallel to the Gold Drop and is a southeast extension of the Rawhide, which in its turn is a south extension of the great Snowshoe claim.

A company to be known as the Indiana Consolidated Mining and Development Co is being formed to work the Indiana group in the Boundary camp. They have a good showing of galena carrying up to 270 ounces silver and several dollars in gold

The development work being carried on upon the Trilby claim in Skylark camp is proving of a very satisfactory character, as one of the veins upon which a shaft is being sunk has widened from a foot to over four feet.

The Stemwinder mine in the Boundary Creek district is said by those who have seen it to be a wonderful property. The ledge is said to be 60 feet between the walls. This was ascertained by sinking a shaft on both walls. This mine is owned by Farrell and Midgeon of the Parrot Mine at Butte.

Another fairly good sale has been made of properties lying in one of our principal camps, as the records show that Mr. J. Keough and his associates have sold to Mr. J. Haney, in trust for Mr. J. E. Banberger, of Salt Lake City, Utah, the four claims in Summit camp, named respectively, the R. Bell, Aspen, Remington and Delamar. The purchase price is stated as $7,500 and the bill of sale is an absolute one.

The impression is gaining ground that a smelter will be built somewhere in the Boundary Creek or Kettle River districts, Midway and Grand Forks being spoken of as the most probable sites.

It seems certain now that the Boundary country will attract much attention this year. Vast ledges of gold and copper ores crop out of the mountain side, and yet the country has hardly been scratched over, much less prospected. That the richness of its ores and the greatness of its ledges will surprise the world is the general opinion of the most conservative mining men. These ores are similar in appearance to the Trail creek ores, but carry more copper and less iron, considerable of which is free milling and running high in gold. Lack

of transportation has kept this country in the background for many years, but stimulated by the rich strikes made in the Trail Creek country, railroad men are paying special attention to Boundary Creek, especially the Canadian Pacific, who have a line surveyed through the country, and who have had numerous experts in here of late in their interest.

## CARIBOO.

Two carloads of hydraulic pipe arrived recently at Ashcroft destined for Cariboo. One carload of 38,000 pounds was for the Ward Horsefly Hydraulic Gold Mining Company, on the Horsefly River. Twenty kegs of rivets also accompany the pipe. The rivets are expected to go north to rivet the Ward pipe some time this month. The other carload of pipe, 20,000 pounds, is for Hobson's Cariboo mine on Quesnelle River, and is to be used in extending the system of pipes and connections in that mine. A twenty horse-power engine destined for the Cariboo mine is on the warehouse platform and will replace the engine in the sawmill which was badly wrecked last fall.

Gus Lange has organized a company with $10,000 capital to carry on mining on Dragon Creek, where at one time three ounces to the set of timbers was taken out by drifting. When water is brought in Mr. Lange expects to wash 2,500 yards per day.

The Victoria Hydraulic Company will operate their ground on a large scale this year. A well known Californian will have charge of the work.

Large pieces of float cinnibar ore have been found on the west bank of the Fraser River opposite Big Bar. Someone will yet find a valuable ledge there.

A letter received from Mr. R. G. Ward, secretary and general agent of the Horsefly Gold Mining Company, says that all the pipe for his company has now been shipped, also two large giants, two elevators, gates, pumps, ete.

Work was resumed on the Slough Creek drain tunnel about the first of the month. It is expected to have the drain across the head of the Nelson Creek by April 1st.

During the past few months Mr. Helgerson has organized a company with a capitalization of $10,000, known as the Elk Mining Company, which has taken over a lease held by Mr. Helgerson on Goose Creek, a stream emptying into Cariboo Lake about opposite Keithly Creek.

On January 15th, at half past four Col. Underwood's dredger was launched.

The Quesnelle River Hydraulic Gold Mining Company will resume operations in the early spring. With a permanent water supply this company has a valuable property.

A contract for 20,000 lagging has been awarded to A. McLeod & Co., by the C. G. F. Co.

The Tenderfoot Company claim on the northeast bank of William's Creek is progressing favorably. The company has sunk a shaft through a bank of gravel nearly 50 feet thick that carries gold all the way through.

## EAST KOOTENAY.

The Upper Kootenay Navigation Co. is constructing a steamboat at Jennings, Montana. It will be used on the Kootenay river, between Fort Steele and Jennings. The new boat will be larger than the Annerly, and of much greater capacity.

Messrs. Watson and Usher are busily engaged in running the tunnel on the Midnight. They are in eighty feet.

The bond given by R. L. T. Galbraith, on the Cariboo placer ground, to the International Company, of Bozeman, Mont., was taken up and paid for by them. The company are running a tunnel for the old channel.

Some time last fall a shaft was sunk to a depth of forty feet on the property of the International Placer Mining Co., on Wild Horse Creek, finding gravel that paid as high as 75 cents to the pan, but as considerable water was encountered the company resolved to run a tunnel and are now in 212 feet, having run through a bed of gravel 90 feet in width and some 70 feet in depth. This gravel would pay well worked by hydraulic mining. The tunnel is now in what is thought to be the rim rock and will be continued until the abandoned shaft is reached.

The Banks Bros. are at work on the Dardanelles, and will continue until spring, or future development shows what the prospect contains. At present the lead is four feet in width, and is a gold proposition, the tunnel is in some eighty feet.

Messrs. Wharton & Usher are busily engaged in running the tunnel on the Midnight, they are in 80 feet and have struck ore.

The St. Eugene mine is working about ten men, they will have several thousand tons of ore ready for shipment in the spring.

The showing on the Sullivan Group is excellent, it is now patent to all that in a short time this property will prove another monument to the mining industries of this district.

Wire silver going 17,000 ounces to the ton has been found in the North Star.

Work is progressing rapidly on the lower tunnel of the St. Eugene, it is now in 136 feet, and in about 50 feet more it is expected to strike the main ore shute. The upper tunnel is in 100 feet and for the entire distance runs through solid ore. There are 1,100 tons of first class ore, and 600 tons of concentrating ore on the dump. The company are working ten men during the winter.

The contractors engaged in running a tunnel on the Dibble are now in 98 feet, under the contract they have run 72 feet. They are working two shifts, averaging two feet to the shift, at this rate it will take about 35 days to complete the 200 feet. The shipment of ore from this property realized $103 to the ton.

The Neosha property, situated on the head of Wallinger Creek, is surrounded by timber suitable for all mining purposes. The lead is a large one, it is 24 feet between walls, covered by a heavy iron cap. The foot wall has considerable galena attached to it, assay returns give 91 ounces in silver and $5 in gold.

A communication from Capt. B. W. Jones states that his tender for the transportation of 3,000 tons of ore has been accepted by the executive committee of the North Star mine. Mr. Jones also stated that he would at once commence the construction of a large steamboat and have it completed by the spring. Mr. Jones' contract is for the transportation of 3,000 tons of ore from Fort Steele to Jennings, Montana.

## KASLO-SLOCAN.

For the week ending January 22nd 699,650 pounds of ore were shipped from Kaslo to Everett and Great Falls and the value of the output was $33,248.

The ore shipped from Kaslo to Great Falls and Everett, between Jan. 22nd and Feb. 1st, amounted to 1,126,502 pounds, valued at $62,446.

The Idaho Mine, which is adjacent to the Alamo and belongs practically to the same parties, has shipped 1,400 tons during last year, valued at $100 a ton.

During the year 1895 the Alamo shipped 95 carloads of concentrates. Returns from 84 of these have been received. They amount to $185,322. Taking a carload at twenty tons, this gives a value of between $104 and $105 to the ton. The cost of the mine, with flumes, concentrator, tramway, roads, etc., amounted to $125,000. A dividend of $35,000 was declared last fall, and another, of which the amount is not fixed, will be declared either during this or next month.

The Slocan Star has shipped about 1,500 tons of ore so far this season.

Chas. L. Arnold has sold his one-sixth in the Lucky Jim to E. J. Matthews, who represents the Omaha and Grant smelter. The sale was negotiated three months ago the price being $5,000. The first payment of 25 per cent, was made a short time ago. The balance of purchase money is to be paid in six and twelve months.

The smelter returns on the first four shipments from the Wellington Mine near Kaslo, which aggregated 119,672 pounds in weight, were $7,042.76. One carload went 320 ounces silver and 15 per cent. lead.

The Noble Five and several other properties are suffering from an ore blockade, and have reduced their forces until the railroads catch up to the output.

The Enterprise, on Ten Mile, which is being worked under a bond by J. A. Finch, is looking well. Two tunnels are in 100 feet and ore is found all the way.

The Exchange paid $20 a ton to have ore packed to Slocan City a distance of three miles.

The first shipment from Springer Creek was a twelve ton lot sent by the Howard Fraction and Exchange to Pilot Bay. The returns were 163 ounces of silver and $17.50 in gold to the ton. The Exchange will ship again in March.

The Washington and Slocan Boy are shipping ore.

The owners of the Slocan Star own fifteen claims and they will develop them all this summer.

It costs $40 a ton to pack ore from the Howard Fraction to Slocan City.

The Eureka and Whitewater are busily engaged in rawhiding to the railroad.

Work will be resumed on the Antoine. W. J. Trethewray recently sold his interest in this mine to George Alexander for $1,500.

Mr. Robert J. Kirkwood, one of the proprietors of the Enterprise and Slocan Queen claims on Ten Mile Creek, Slocan Lake, says these claims are under bond to Mr. J. A. Finch, for $25,000. About twelve men are at present employed in stripping the vein which is reached by a tunnel 175 feet long. The ledge is a true fissure vein with a pay streak of from six to fifteen inches of extremely rich ore. Assays of it average about 400 ounces in silver with some lead, but it is almost a dry ore.

The Arlington No. 2 and Burlington No. 2, owned and located by C. E. Fielding and Robt. Cooper, were bonded by John A. Finch, last week for the sum of $50,000.

The K. & S. has put in spurs at the Lucky Jim and the Iron Hand, for convenience in loading ore.

The ore shipped from Kaslo for the week ending Feb. 7th, amounted to 1,023,985 pounds, valued at $46,022.

The Ruth employs about twenty men, the largest number they have ever had, and their manager says they are shipping 100 tons a week.

The R. E. Lee has changed hands, Mr. Alexander having desposed of it to Messrs. J. Stewart, P. Welch, and P. Larsen, for $35,000.

The Reco Mine is pushing ahead as usual. Between 30 and 40 men are employed. They have a large quantity of ore ready for shipment.

## TRAIL CREEK.

Messrs. Conway and Fraser are making good progress in putting up the new 20-drill compressor for the War Eagle company. The machinery is all on the ground, and will be in place by March 1.

The face of the drift being run east on the 100 foot level of the Nickel Plate is now in solid ore. It is the largest body of ore ever found in this mine and is of good grade.

The Trail Creek smelter started up on Monday, Feb. 23rd, with one furnace in operation.

It is stated definitely that the War Eagle company will erect a smelter of its own this spring.

The Le Roi, as a result of recent development work, and more especially as a result of prospecting with a diamond drill, has been found to have an ore body which in extent and richness almost passes belief. The ore body at the bottom of the shaft is now opened to a width of fifteen feet, with no walls. There is good reason to believe that it exceeds 25 feet, from what their diamond drill discovered. Last year the mine shipped 12,000 tons of ore, the smelter returns showing a value varying from $40 to $60 per ton. Since then 5,000 tons more have been shipped, of which the grade was much higher, while ore recently obtained from the bottom of the shaft has given average returns in carload lots ranging from $250 per ton up to nearly twice that value. The output of the Le Roi since the first of January has exceeded 100 tons a day and now it is averaging over 125. The miners on the pay roll number 125 and 30 men are also employed in getting out cordwood, etc. A week or two ago, a second dividend of $50,000 had been declared, and it is confidently predicted bp the management that they will have no difficulty in meeting monthly dividends in the same amount from now on. The new smelter, which is expected to blow in next month, has 45,000 tons of $30 Le Roi rock on hand. From 100,000 to 150,000 tons of ore, 10,000 cords of wood and $50,000 worth of coke, is the stock to be kept on hand continually. The smelter will have a capacity of 250 tons daily to start with.

Work is being pushed steadily on the Centre Star with a force of 20 men and three machines. Crosscuts are being run both ways from the main tunnel, which is now in about 600 feet. The crosscuts have proved the ledge to be over 70 feet wide, with an average grade of ore exceeding $15 per ton in value.

It is reported that the War Eagle Company will erect a reduction plant during the current year. The site has not yet been selected, and it may be either at Rossland or Northport.

A five foot vein of ore in the shaft on the Iron Mask has been struck. It averages $312 in gold.

The representative of a Vancouver syndicate offered $3,000 spot cash for the Little Floe. The offer was rejected.

The reliable War Eagle mine is producing at present at the rate of 50 tons a day. From 70 to 75 men are employed. The heavy machinery for the War Eagle, which has been held at the Waneta Customs House, has been released by order of Collector Johnson, of Nelson. Having been made in Canada there is no duty on it.

A contract is about to be let to drive 100 feet in the lower tunnel of the St. Elmo.

The Homestake mine began shipping ore early this month. About 20 tons will be shipped daily from now on, as long as the roads last.

J. L. Warner, manager of the O. K. mine, announces that the development of the mine is so satisfactory that the company will put in a heavy ten stamp mill this spring. The quartz which is run through the stamp mill yields about $20 to the ton in free gold. The concentrates run all the way from $50 to $100 per ton. The sulphide or smelting ore runs from $80 to $250 per ton.

## WEST KOOTENAY.

### NELSON.

The Hall Mines smelter was blown in on Jan. 21st., and the first pot of matter was drawn at 8 o'clock that evening. Superintendent Johnson expected to run through about 80 tons of ore a day, exclusive of fluxes, but the ore smelts so readily that he is now running through 110 tons of ore every 24 hours, and that, too, with lime rock as the only flux. By February 1st, shipments of matter will have commenced, and the shareholders of the Hall Mines, Limited, will be making close on to $2,500 a day clear profit.

The Hall Mines of Nelson have in sight, blocked out in their mines, 132,400 tons of ore and about 8,000 tons on the dump and in bins that will average 40 ounces in silver and 5 per cent. copper.

The mill on the Fern, a gold mine on Hall Creek, twelve miles south of Nelson, is nearly ready to start up. All the machinery is in place.

Four hundred and three locations and 110 assessments were recorded at Nelson in 1895.

The Silver King smelter at Nelson will receive three car loads of iron ore a week from Colville, Wash.

### AINSWORTH.

The Skyline is shipping to Great Falls and Helena over 400 tons a month. The ore nets, after paying all expenses, a profit of about $17 a ton.

The combined smelting capacity of the smelters at Pilot Bay, Nelson and Trail, for this year is placed at 255,000 tons.

H. S. Earnest, superintendent of the Clugston Creek iron claims, has just closed a contract to furnish the Pilot Bay smelter 60 tons per week of iron ore. The Nelson smelter has also placed a trial order, which, if satisfactory, will lead to a large increase in business.

### LARDEAU AND TROUT LAKE.

The development work on the Abbott group, which has been suspended since J. H. Hoar and W. Breckenridge were killed by a snowslide there a few weeks ago, was resumed recently. O. D. Hoar, the superintendent, having returned to Trout Lake this week for that purpose.

The rawhide trail to the Silver Cup is now in full swing, a large staff of men being employed thereon. Shipments will commence as soon as the trail is completed.

The Great Northern has four feet six inches clean ore —silver and copper—which will average $90 per ton.

### BIG BEND.

Active operations on the Last Chance, McCulloch Creek, have been suspended until, probably, March next. This suspension has been occasioned by the delay in receiving the large pump built in Vancouver last fall.

### PILOT BAY.

The smelter at Pilot Bay commenced treating ore in March, 1895. From that date until December 30th last, 3,220 tons of bullion were sent to Aurora, Illinois, for refining. During the year 1895 the smelter company transported 52,000 tons of ore and lime rock from the Blue Bell mine, and purchased 2,500 tons of ore, of the value of $156,464, from outside mines. Since July 10th, 1894, the company has expended in cash for machinery, labor and the purchase of ores something over $650,000. During 1895 the company employed over 200 men daily, and paid out for labor $170,000. It also paid out during the same time over $85,000 for supplies, $70,000 for duties, and $92,500 for freights.

### GENERAL.

M. S. Davys, superintendent of the Silver King mine, has located a lime rock deposit at a point on the west shore of Kootenay Lake, nine miles north of Kaslo. The rock contains only about 1 per cent. silica, and is "sugar" for smelter flux. The Hall Mines smelter will use about 10,000 tons of the rock a year with its present capacity.

The Skyline, near Ainsworth, is producing 12 tons of 60 ounce ore daily.

Senator Ramsdell, of Montana, will put 60 pack animals into the White Grouse Country next spring.

## YALE.

A. Morden has brought to Vernon samples of free milling quartz, from the west side of Okanagan Lake, which assayed $9.20 in gold. The ledge starts near the lake and is very large, so that perhaps 100 claims could be staked on it. The find is considered a valuable one.

Robert Stevenson, of Chilliwack, and a number of Ottawa people and Montrealers have been incorporated as the Granite Creek Mining Company, to assume the properties of the Stevenson Gold and Platinum Mining Company.

Development work has been carried on by S. D. Ord and partners on the mineral claims on the commonage, near Vernon, with good resnlts. The ore, which is free milling, runs about $7 in gold, and there is a large body of it.

Mining in this vicinity for the past year has been very favorable. The gold bought by the merchants of Lytton in the year 1895 amounted to about $17,000, and no doubt a great deal was taken from the bars which was not sold at Lytton.

Mining on the bars at Lytton has received a check owing to the cold weather. The Fraser River Mining and Dredging Company's dredger got fairly started but had to discontinue as the deck became so coated with ice that it was difficult to work.

There is strong probability of some of the Tranquille hydraulic leases being worked during the coming summer on a much larger scale than before. A man with large experience in California will be employed as manger, and sufficient water will be brought in to work efficiently. H. J. Russel is calling for tenders for 100 feet of tunnel on the placer claim on the Tranquille. He intends prospecting the grouud thoroughly with a view to ground sluicing.

The Cariboo mine, Camp McKinney, is one whose stamp mill has been running continuously for a long time, and it is supposed, on good pay all the time, but the proprietors are not in the habit of saying much about what returns they get. Clean-ups are made fortnightly and the last one is said to have yielded 700 oz.

enough is in sight now to keep the mill running for two years, and even then is not likely to pinch out. the Lillooet, Fraser River & Cariboo Gold Fields have had H. Munroe, formerly of Lytton, down in Boundary Creek obtaining information about some of the mines, and has secured options on a few. He left the other day to lay these propositions before his employers.

Word comes from Savonas that about twenty men are employed on the Cinnibar property, developing it in such a way as to make it possible to take out a larger quantity of ore when retorting begins.

### A CORRECTION.

EDITOR MINING RECORD:— In my article in your journal of December, I said "Boundary Creek ores, etc., are not suited to smelting." This is contrary to my opinion and should have been rectified earlier, but absence from home has prevented my paying due attention to it. Will you kindly amend this by stating that Boundary Creek ores are strictly adapted to smelting.

Yours truly,

W. PELLEW-HARVEY.

### Black Sand.

The British Columbia MINING RECORD is anxious to make some tests of the black sand of the country, and will be glad to receive from anyone interested in the matter, samples of black sand, properly tied and labelled with the address of the sender, and name of the district from where taken.

### Book Notices.

The first number of the new monthly, *Mining*, the journal of the recently formed North West Mining Association, and published in Spokane, reached us some days ago. It is very welcome to our exchange list. It is bound in good covers, book size, and the contents are of particular interest and careful selection. *Mining*, we hope, will be well patronized in B. C. as well as on the other side. Mr. L. K. Armstrong, favorably known as a journalist of ability, is the editor.

The *Province* calendar for 1896 is one of particular beauty and does credit to their taste. It is also worthy of note that it was every bit produced "at home."

A copy of *Hidden Mines and How to Find Them*, (Thos. W. Newman,) now a well known book, recently reached this office. After a close perusal of the work, we feel glad to be able to recommend it to all or any desirous of knowledge on Mines, Metals, or Ores. The prospector's kit, however, as given, is one hardly suitable to B. C. mountains.

The holiday number of the Trail Creek *News* (Messrs. Thompson and Blackmer publishers) is a very excellent production and does the publishers credit. The several cuts are well executed and the letter press is good.

### West Slocan Mining Division.

One of the latest, if not, indeed, the latest, mining districts of West Kootenay to make itself heard is that of the West Slocan division, which is that portion of the country bounding both shores of the Arrow Lakes, and lying between the mining divisions of Lardeau on the north and Nelson on the south.

The most central point in this very accessible division is Nakusp, and here a record office, with F. G. Fauquier in charge, was opened on July 12th, 1894. In that year there were 43 quartz and 56 placer locations made. In 1895 the number of locations had increased to 210, all quartz, certificates of work numbered 25, about 80 men were counted as engaged in mining, while the total revenue from mining receipts and miner's certificates came to the respectable sum of $1,611.50, not bad for an office but one year and a half old.

The principal fields in the division are those of Cariboo Creek, on the east side of Arrow Lake narrows, 22 miles below Nakusp; the east shore country of upper end of lower Arrow Lake and the same shore at lower end of lake; also on west shore of lower Arrow Lake. With the exception of Cariboo Creek and, perhaps, Van Houten Creek, the camps are all silver ones.

In the Cariboo Creek camp the principal claims are the Promestora, War Eagle, B. C., Eureka, Arctic, Hail Storm, Leola, Dalton and Eclipse. On the Promestora, owned by Bourne, Demars & Rodd, over a thousand dollars worth of work has been expended, a tunnel 60 feet deep has been run on the property and four feet of gold bearing shipping ore is now exposed. On the War Eagle, owned by Madden, Hyland, McNeill, Alexander and Fauquier, a 28 foot tunnel and 16 foot shaft shows up a very promising ledge of gold bearing rock. The B. C., on same ledge as War Eagle, owned by Milne, McDonald & Sherrin, also shows well. These properties are all on Mineral Creek, a tributary to Cariboo Creek. The Eureka and Arctic on the head of Cariboo Creek are good silver properties. The Hail Storm, Leola, Dalton and Eclipse (Matthews & Jamieson) are located on Snow Creek and are also silver bearing.

Amongst the east shore claims at upper end of lake are the Chicomen, Golden Clime, Star, O. K., Excelsior No. 2, and Brooklyn Silver Blend, all silver bearing properties. On the Brooklyn some work has been done, showing very good ore. Vallance & Moore, of the Three Forks concentrator, are interested here. Lower down on east shore of lower Arrow Lake lie the Cape Horn, Wild Cat, Grey Eagle, Lucky Jack, Half Moon, Kate Hayes, and other silver properties. Here, too, on Van Houten's Creek, lies the very promising Hendee group, composed of the Crown Point, Arrow Lake, Look-Out and Stem-Winder claims. On the Marion a tunnel 50 feet long has been run, and the rock which is gold bearing assays from $8 to $72. On the west shore of Lower Arrow Lake lie the White Elephant No. 2, West Shore, and Saint Marie claims.

Enough has been said to show the importance of this new mining country and to ask for it that recognition which its residence requires in the creation of it as a mining division of itself. As it is at present but a subdivision, reporting its records weekly to the office for the Slocan at New Denver, the greatest confusion has often occurred, and leads to duplication and omission.

Nakusp should be made the seat of a record office from, say, Arrow Head, to the boundary of the Nelson division. The creation of this office would occasion no extra expense to the government and afford considerable benefit to those engaged in mining on Arrow Lakes.

### The Lardeau Division of West Kootenay.

Most of the mining properties in this division are situated on Fish Creek and its tributaries, and on one of the latter (Poole Creek) the very first—the Black Bear and Kangaroo—discovered in the division, were recorded on July 19th, 1892, by T. Downing and B. Ramey. In the same year, but later, three other claims known as the Gladstone Group were located on the same stream by T. Livingstone, B. Ramey, and W. B. Pool. The Lexington group on the creek of that name, was also located in 1892 by E. Crockett, T. Livingstone and J. Robertson.

The principal finds located in 1893 were the Sable

Creek claims, situated on Sable Creek, a tributary of Fish Creek, and were found by three colored men named Alex. Clark, Jackson Radcliff, and D. Washington. Eight claims are now staked on this lead. Also in 1893 were filed the notices of the well known claims "Silver Bow," and "Seattle," situated on Lexington Creek and located by A. E. Kincard and T. Mitchell; "Trapper and Hunter" claims situated on Pool Creek, located by Bros. and Paterson; the "Black Bear," Fish Creek, by L. Arthur; and the famous Glengarry group on Boyd Creek by J. McDonald, (Lardeau Jack.) Seven claims are now staked on Glengarry lead.

In 1894, owing to the low and unsettled price of silver and the extremely high water and severe storms in the month of June, very little prospecting was done in the division. Bridges having been washed away and trails filled with fallen timber, the claim holders were unable to get to their claims to do assessment work and permission was granted them by the Gold Commissioner to restake, so that mining matters in this division, as had been said, were practically at a standstill in 1894.

The year 1895 has seen a more active state of operations begun, and the numbers of claims recorded that year were 33, some of which have good surface showings and will, no doubt, be heard from next year. Development, however, is backward in the division, consequent upon the absence of proper roads and trails, which are sadly needed, as the assessments of 1895 showed some of the claims to be number one properties.

The Gladstone, Hunter and Black Bear groups on Poole Creek all show good bodies of ore (galena), and when further developed, will no doubt become better. The Lexington group, though rather low grade, has one of the largest surface showings in the country and is particularly easy of access. With a wagon road up Fish Creek, this group would be a very large producer. Again, the Glengarry group is pronounced by all who have seen it, to be one of the best prospects in West Kootenay. The assessment work on this group shows the lode to average two feet of solid ore of very high grade, but unfortunately, as in the other cases there is no road or trail to the mine, else it would 'ere this have been a "shipper" or producer.

Two claims of the Sable Creek group, now owned by the Kootenay Gold, Silver and Copper Mining Company show some splendid ore, the richness of which may be told by noting the results of three recent assays.

| Assay No. | Gold. | | | Silver. | Copper. |
|---|---|---|---|---|---|
| | oz. | dwts. | grs. | oz. | oz. |
| No. 1. | — | 12 | 3. | 59 14-16 | Did not try. |
| " 2. | 1 | 7. | 19. | 94 1-16 | 15-4. |
| " 3. | 1 | 6. | 10. | 65 5-9 | 18. |

Other claims on this ledge have good showings and will be worked extensively in the spring of 1896.

The Silver Bow group are showing up some very high class ore, recent assays going over 1,000 ounces to the ton, while ore taken from the Black Bear, on Fish Creek, goes 760 ounces to the ton.

The most recent "finds" (discoveries) in the Lardeau division are the Enterprise group, situated about five miles from Lardeau, and some fine iron ore carrying gold, on Fish Creek. The Mammoth and some other claims situated on Upper Arrow Lake are other good prospects lately located.

In conclusion, it may be said that prospects for the year 1896 are most encouraging, and if the Government will only appropriate some money to be used in building roads, and some of the claims secured by men with capital, the Lardeau mining division will come to the front as one of the richest divisions of West Kootenay.

B. K. Atkins.

## Province of British Columbia.

Minister of Mines.—Hon. Col. James Baker.
Provincial Mineralogist.—W. A. Carlyle.
Public Assayer.—H. Carmichael.

## Gold Commissioners.

For the Province.—W. S. Gore.
Alberni.—Thos. Fletcher, Alberni.
Cariboo.—John Bowren, Richfield.
Cassiar District.—James Porter, Laketon, Cassiar.
Lillooet District.—Frederick Soues, Clinton.
East Kootenay District.—J. F. Armstrong, Donald.
West Kootenay District.—N. Fitzstubbs, Nelson.
West Kootenay District.—J. D. Graham, Revelstoke.
Yale District.—Chas. Lambly, Osoyoos; G. C. Tunstall, Kamloops.

## Mining Recorders.

| District. | Office. |
|---|---|
| Nanaimo.—M. Bray | Nanaimo |
| New Westminster.—C. Warwick | New Westminster |
| East Kootenay.—J. Stirret | Donald |
| F. C. Lang | Golden |
| G. Goldie | Windermere |
| C. M. Edwards | Fort Steele |
| M. Phillips | Tobacco Plains |
| West Kootenay.—J. D. Graham | Revelstoke |
| Corry Minhennick | Lardeau |
| A. Sproat | New Denver |
| John Keen | Kaslo |
| W. J. Goepel | Nelson |
| J. Kirkup | Rossland |
| J. C. Rykert | Rykert's |
| T. Taylor | Trout Lake |
| R. J. Scott | Illecillewaet |
| Cariboo.—W. Stephenson | Quesnelle |
| Yale—W. Dodd | Yale |
| L. Norris | Vernon |
| C. A. R. Lambly | Osoyoos |
| W. McMyn | Rock Creek |
| H. Hunter | Granite Creek |
| Lillooet.—C. A. Phair | Lillooet |
| Cassiar.—Ezra Evans | Manson Creek Ominec |

## British Columbia Mining Papers.

*Inland Sentinel.*—Kamloops, B. C.; weekly; 7 col., 8 pages; publishes Friday. Circulates in Cariboo, Lillooet, Yale, Kootenay; also in Victoria, Vancouver, and New Westminster cities. Subscription, $2 per year. Also Semi-weekly.

*The Golden Era.*—Golden, B. C.; published by the Golden Era Publishing Co. Covers the entire East Kootenay District. Subscription price, $2 per annum.

*The Prospector.*—Rossland, B. C.; published by W. D. Pratt. Covers West Kootenay generally. Subscription price, $2 per annum.

*The Ledge.*—New Denver, B. C.; published by R. T. Lowery. Covers the Slocan District, and circulates generally in West Kootenay. Subscription price, $2 per annum.

*The Claim.*—Kaslo, B. C.; published every Saturday by R. T. Lowry. Circulates generally in Kaslo-Slocan country. Subscription price, $2 per year.

*B. C. Mining Journal.*—Ashcroft, B. C.; published Saturday by Messrs. Reynolds & Sroufe. Circulation covers Cariboo and Lillooet. Subscription price, $2 per year.

*The Advance.*—Midway, B.C.; published Mondays, by Norris & Co. Covers Osoyoos and South Yale. Subscription price, $2 per year.

*The Miner.*—Nelson, B. C.; published Saturdays, by the Miner Publishing Co., Charles St. Barbe, managing editor. Four pages, 6 cols. Covers the entire West Kootenay District. Subscription price, $2 per year.

*The News.*—Vernon, B. C.; published Thursdays by News Publishing Co., J. A. McKelvie, editor. Covers Okanagan. Subscription price, $2 per annum.

*Rossland Miner.*—Rossland, B. C.; published on Saturdays, J. R. Reavis, editor. Covers Trail Creek district. Subscription price, $2 per year.

*The Record.*—Rossland, B. C.; published Saturdays, by Kirk C. Smith. Covers Trail Creek district. Subscription price, $2 per year.

*The Prospector.*—Fort Steele, B. C.; published every Thursday by Pratt & Northey. Covers West Kootenay. Price, $2 per year.

# MINING CENTRES IN BRITISH COLUMBIA

—AND—

# HOW TO REACH THEM.

## ALBERNI.

*Alberni.*—Steamboat communication with Victoria and by stage with Nanaimo.

*Barclay Sound.*—Forty miles from Alberni; communication by steamer with Victoria.

## CARIBOO.

*Barkerville.* — Two hundred and eighty-five miles from Ashcroft; stage from Ashcroft. See stage lines.

*Bonaparte.* — Twenty miles from Ashcroft; stage from Ashcroft.

*Big Bar.*—Stage from Ashcroft.

*Clinton.*—Thirty-two miles from Ashcroft station; stage from Ashcroft.

*Fort George.*—Nearest post office, Quesnelle, where stage to and from Ashcroft changes.

*Horsefly.*—Nearest post office, 150-Mile House; stage from Ashcroft; change at 150-Mile House.

*Lac La Hache.*—One hundred miles from Ashcroft; stage from Ashcroft and Barkerville.

*Lillooet.*—Weekly stage from Clinton, where connection is made with stage for Ashcroft.

*Lightning Creek.*—Between Quesnelle and Barkerville, by stage.

*One Hundred Mile House.*—Stage from Ashcroft.

*One Hundred and Fifty Mile House.*—Stage from Ashcroft.

*Quesnelle.* — Two hundred and twenty-five miles from Ashcroft; stage from Ashcroft.

*Quesnelle Forks.*—Stage and pack trail from Ashcroft.

*Soda Creek.*—Stage from Ashcroft.

*Slough Creek.*—From Barkerville, twelve miles.

*Tatla Lake.*—Stage from Ashcroft, changing at Soda Creek.

*Willow River.*—Stage to Barkerville or Stanley, thence rail.

*Williams Creek.*—From Barkerville, seven miles.

## CASSIAR.

*Dease Creek.*—

*McDame Creek.*—

## COAL CENTRES.

*Crow's Nest Pass.*—

*Nanaimo.*—From Victoria, all rail, 73 miles. Steamer from Vancouver.

*Union.*—

*Wellington.*—From Victoria, all rail, 83 miles. Steamer and rail from Vancouver.

## EAST KOOTENAY.

*Cranbrook.*—Nearest railway station, Golden. Communication by steamer from Golden to Windermere, thence by stage.

*Fairmont Springs.*—Nearest railway station, Golden. Steamer to Windermere, thence by stage.

*Fort Steele.*—Steamer and road from Golden. Steamer from Jennings, Montana, G.N.R.R.

*Galbraith Ferry.*—Steamer from Golden. Stage in winter.

*Galena.*—Nearest railway station, Golden; thence by steamer. Stage in winter.

*Golden.*—On the main line C.P.R., 475 miles from Vancouver.

*Moyie River.*—From Fort Steele, 25 miles.

*McMurdo District.*—Steamer and trail from from Golden, 35 miles.

*Perry Creek.*—Steamer from Golden to Fort Steele, thence by road.

*St. Mary's.*—From Fort Steele, 20 miles, trail.

*Thunder Hill.*—One hundred and fifteen miles from Golden. Steamer in summer, stage in winter.

*Windermere.*—Steamer from Golden. Stage in winter.

*Wild Horse Creek.*—From Fort Steele, two miles trail to Kootenay river.

## WEST KOOTENAY.

*Ainsworth.* — Twenty-eight miles from Nelson and twelve from Kaslo. Steamer communication.

*Albert Canyon.*—A station on the C. P. R., 400 miles from Vancouver.

*Big Bend District.*—Fifty miles from Revelstoke by trail and boat.

*Cariboo Creek.*—Steamer from Nakusp, ten miles.

*Fort Shepherd.*—Nearest post office, Trail Creek; communication by rail and steamer from Revelstoke.

*Illecillewaet.* — On the main line C. P. R., 407 miles from Vancouver.

*Kaslo City.*—Thirty-five miles from Nelson; communication by steamer.

*Lardeau City.* —Forty miles from Revelstoke; communication by steamer.

*Lardo-Duncan.*—Steamer from Kaslo to head of lake, thence river trail 40 miles.

*Nakusp.*—North-west terminus of Nakusp & Slocan Railway, 50 miles from Revelstoke. Steamer communication from Revelstoke tri-weekly.

*Nelson.*—Thirty miles from Robson; is the eastern terminus of the Columbia & Kootenay Railway, and also on the Spokane & Northern Railroad. Steamer from Revelstoke.

*New Denver.* — Steamer from Revelstoke and rail from Nakusp; all rail from Kaslo. Distant from Revelstoke, 78 miles, from Kaslo, 28 miles.

*Pilot Bay.*—Eighteen miles from Kaslo, thence by steamer.

*Revelstoke.*—On main line C.P.R., 379 miles from Vancouver.

*Rossland.*—Seven miles from Trail Creek by road or stage.

*Sproat's Landing.* — One hundred and sixty miles from Revelstoke, and one and a half miles from Robson.

*Springer Creek and South Slocan Camps.*—From New Denver by steamer, twenty miles.

*Sandon and Cody Creek.*—All rail from Kaslo, 29 miles. Steamer and rail from Revelstoke *via* Nakusp and Three Forks. Distant from Three Forks, four and a half miles.

*St. Mary's Country.*—Steamer from Kaslo or Nelson to Davie Townsite, thence trail.

*Three Forks.*—Steamer from Revelstoke to Nakusp, thence rail; from Kaslo, all rail. Distant from Revelstoke, 82 miles; from Kaslo, 24 miles.

*Trail.*—Rail from Spokane to Northport, thence steamer. All steamer from Revelstoke, or steamer and rail *via* Nelson. Distant from Spokane, miles; from Revelstoke, 150 miles; from Nelson, 50 miles.

*Trout Lake City* —Steamer and stage from Revelstoke.

## LILLOOET.

*Bridge River, Cayoosh Creek, Fraser River.*

## YALE.

*Boundary Creek.*—Nearest railway station on the S. and O. R., Okanagan Landing, thence by steamer to Penticton and on by stage to Midway.

*Fairview Camp.*—Communication by boat from Okanagan Landing to Penticton, thence by stage.

*Kettle River.*—Steamer from Okanagan Landing to Penticton, thence by stage.

*Midway.* — Rail from Sicamous to Okanagan Landing, steamer Penticton and on by stage.

*Okanagan Mission.*—Rail from Sicamous to Vernon, thence by stage, or by steamer from Okanagan Landing to Kelowna, thence by livery.

*Osoyoos.*—Rail to Okanagan Landing, steamer to Penticton, and thence by stage.

*Rock Creek.* — Rail to Okanagan Landing, steamer to Penticton, and thence by stage.

*Yale.*—Nicola Lake Stage from Spence Bridge and Kamloops, 50 miles.

Any of these points may be reached by rail from Spokane to Marcus, and thence by stage, twice a week.

Mail stage leaves Penticton for Midway every Thursday morning.

## Assayers.

Public Assayer.—H. Carmichael. Victoria.
W. Pellew Harvey, Vancouver.
R. C. Campbell-Johnston, Vancouver.
Mahon & Twigg, Vancouver.
G. F. Monckton, Vancouver.
Albert Strolberg, Ainsworth.
Ed. A. Martin, Barkerville.
W. W. Gibbs, Boundary Creek.
W. V. Bowrow, Richfield, Cariboo.
Crowells & Wallinger, Fort Steele.
W. J. Thretheway, Kaslo.
Harry A. Guess, Midway
Wm. F. McCulloch, Nelson.
Frank Dick, New Denver.
Howard West, New Denver.
A. H. Holdich, Revelstoke.
C. W. Cluett, Rossland.
Frank J. Davey, Rossland.
Chas. M. Wilson, Three Forks.
M. A. Bucke, Sandon.
F. H. Latimer, Vernon.
A. L. McKillop, Nelson.