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The Canadian Mining Review

Established 1882

Vol. XIII.—No 11 | 1894—OTTAWA, NOVEMBER—1894. | Vol. XIII.—No. 11.

SCHOOL OF MINING,

KINGSTON, ONTARIO.

Faculty:

WM. L. GOODWIN, B.Sc. (Lond.) D.Sc. (Edin.) F.R.S.C.
Director and Professor of Chemistry.

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WM. HAMILTON MERRITT, M.E., F.G.S., Associate Royal School of Mines, England,
Lecturer on Mining Engineering, The Economic Geology of Ontario, and The Discovery and Winning of Minerals.

WILLIAM MASON, Lecturer on Freehand, Mechanical and Office Drawing, Topography and Surveying.

JOSEHH BAWDEN, Lecturer on Mining Laws.

T. L. WALKER, M.A., DR. ISAAC WOOD, M.A., Laboratory Demonstrators.

THE SCHOOL PROVIDES THE FOLLOWING COURSES OF STUDY:

1. *A Course of four years leading to the Degree of MINING ENGINEER, (M.E.)*
2. *A Course of three years, for which a Certificate in ANALYTICAL CHEMISTRY and ASSAYING is given.*
3. *A COURSE OF EIGHT WEEKS, (January and February), for Prospectors, Mine Foremen and others interested in Mines and Minerals.*

Lecturers are sent to any mining centre where a sufficient number of students is guaranteed, to conduct SHORT COURSES in Blowpipe Analysis, Chemistry, Mineralogy, Geology, Prospecting and Mining.

The different courses are made thoroughly practical by work in the well-equipped Chemical, Assay, Mineralogical and Petrographical Laboratories. A Mining Laboratory, furnished with Mills, Separators, Concentrators, etc., is in course of construction. It will be open for work in Session 1894-5. Surveying is practised in the field during the warmer months of the Session.

FOR CALENDAR OF THE SCHOOL AND FURTHER INFORMATION APPLY TO

WM. MASON, Bursar,

SCHOOL OF MINING, - KINGSTON, ONTARIO.

The Canadian Mining Review

Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Victoria Chambers, Ottawa.

VOL. XIII., No. 11 NOVEMBER, 1894. VOL. XIII,, No. 11

Federation.

The Mining Society of Nova Scotia held its regular meeting in Halifax on the 6th instant. The principal business of the day session was the consideration of a scheme for federation reported by committees of the Ontario Mining Institute and the General Mining Association of the Province of Quebec. As will be seen from the detailed account of the meeting published on another page, the report was much amended, and in some of its most vital and characteristic points. It remains to be seen whether Quebec and Ontario will approve of the views held by their brethren of Nova Scotia.

The limitation of the action of the Council in Dominion matters is of no importance, and the enlargement of the Council to a body of nine or ten instead of six is a good point. But the insistance on a uniform annual fee strikes us as not only in very bad taste, but as likely to be a permanent stumbling block. A representation based on the annual income of each Society will have an objection in Ontario, where the annual dues are but $2.00 per year, as against $10.00 per year each for Quebec and Nova Scotia.

Likewise, a per capita contribution of $3.00 towards the publishing fund is impossible in Ontario.

Our friends in Nova Scotia evidently believe in working for love, as they have made the onerous position of Editor and Secretary Treasurer an honorary one *without salary*. They may do work without pay in Nova Scotia, but we have never seen anything of that sort in our peregrinations in that Province. The idea is farcical, and simply means that a clerk or other competent person must be employed by the Council or Secretary-Treasurer.

We do not care to express any opinion as to how the proposed constitution will be received by the Ontario and Quebec associations, which each have a meeting in January, but that important changes will be made goes without saying. It seems to the REVIEW that this idea of Federation is capable of great good for Canada if appreciated and understood correctly, and if carried out in a broad and comprehensive sense. Its inception may properly be due to an idea of economy in getting out the transactions of the various societies, but its enlargement into a body that would be representative of the mineral interests of the whole Dominion, and which would be regarded and honored as such, would make of it an instrument for the advancement of mining throughout the Dominion. The scheme as reported on by the Society is as follows:—

NAME.

The organization shall be named THE MINING INSTITUTE OF CANADA.

CONSTITUTION.

The Institute shall be a Federation of all or any of the Canadian Societies interested in the advancement of mining, metallurgy, engineering and their allied industries. It shall have for its objects:—

(*a.*) The publication in one volume of the papers and proceedings of the several organizations in the Federation.

(*b.*) Action upon all matters affecting or relating to the Mineral Industries of Canada, provided that nothing in this clause shall be construed as conferring jurisdiction, or power to act, with reference to any matter or thing affecting the said mineral industries or any of them unless thereto requested by a majority of the members of one or more of the Societies associated in said Federation.

MEMBERSHIP.

The original founders are as follows, viz.:

The Mining Society of Nova Scotia.
The General Mining Association of the Province of Quebec.
The Ontario Mining Institute.

Written applications from Societies desiring to enter the Institute shall be made to the Council by the President of the applying Society, who shall furnish such information as may be desired by the Council.

GOVERNING BOARD.

(*a.*) The affairs and business of the Institute shall be managed and controlled by a Council consisting of the President of each Society in the Federation, and one member for every forty and fraction thereof full members of each federated Society—to be elected annually. The qualification for full membership as specified above shall be an annual fee of Ten Dollars.

Nothing in this clause shall prevent the various Societies from having other classes of members, paying other rates or fees.

(*b.*) The Council shall elect a Chairman each year. The office of Secretary-Treasury shall be an honorary one, and this officer shall be elected by the individual votes of the members of each of the Societies in the Federation.

(*c.*) The Secretary-Treasurer shall act under the direction and control of the Council.

(*d*) The Secretary-Treasurer shall attend all meetings of the Council and shall record the proceedings in the minute book. He shall have charge of, and conduct all correspondence relative to the business and proceedings of the Institute and of all committees where necessary, and he shall be responsible under direction of the Council, for the editing and publication of an annual volume of proceedings. The income of the Institute shall be received by him and be deposited in its name at a bank approved by the Council.

(*e.*) All payments on behalf of the Institute shall be made by cheques signed by the Chairman of Council and the Secretary-Treasurer.

(*f.*) The accounts of the Treasurer and the financial statement for the year shall be audited by two members of the Institute. The auditors shall be elected at the Annual General Meeting.

SUBSCRIPTIONS.

The Societies in the Federation shall each pay an annual subscription of such an amount as may from time to time be deemed necessary by the Council to conduct the affairs of the Institute: but the contribution from each such Society shall at no time exceed in amount the sum of Three Dollars per capita.

MEETINGS.

The Annual General Meeting of the Institute shall be a United Meeting of the members of the various Societies in the Federation. It shall be held in the month of July at such time and place in said month as the Council may determine.

PUBLICATIONS.

(*a.*) Publications of the Institute shall be supplied only to members in good standing in their respective Societies, one copy to each member, twenty copies to the authors of papers, and the balance shall be sold by the Council at such prices as it may determine. Copies of the Transactions sent for exchanges shall be accompanied with a request for a copy of such exchange for each Society in the Federation.

(*b.*) The Institute as a body shall not be responsible for the statements and opinions advanced in the papers which may be read or in the discussions which may take place at the meetings of the Institute or of the federated Societies.

(*c.*) The Council may accept communications from persons who are not members of the Institute and allow them to be published.

"Progressite" the New Non-Nitro-Glycerine Explosive.—For some time past it has been rumored that a counterstroke by those interested in the nitro-glycerine explosives was contemplated against that class of explosives termed "safety." The new explosive, "Progressite," it is said, is shortly to be introduced into the country by one of the firms connected with the Dynamite Trust Company. It contains two constituents, namely nitrate of ammonia and hydrochlorate of analine, the proportions being 94 per cent. of the first and 6 per cent. of the second. The process of manufacture is described as extremely simple and cheap, the two ingredients being combined chemically by water. The manufactured explosive is, we understand, perfectly homogeneous, and may contain a considerable percentage of water without the nitrate being physically affected thereby. This constitutes an important advance in the class of explosive under consideration. Another improvement claimed is that it is less hygroscopic than others of its class.

January Meetings.

Arrangements for the next quarterly meeting of the Ontario Mining Institute are rapidly nearing completion. So far, we are able to announce papers by Dr. A. P. Coleman, Prof. Nichol, Prof. Goodwin, Mr. Peter McKellar, F.G.S.A., and others. The meetings will be held in the Lecture room of the new School of Mining, Kingston, in the first week of the new year.

The General Mining Association of the Province of Quebec will inaugurate its fourth year with a series of meetings in Montreal in the second week in January. Contributions have been promised by Capt. R. C. Adams, Mr. J. Burley Smith, M.E., Dr. R. W. Ells, Mr. Dwight Brainerd, Mr. John Hardman, S.B., Mr. R. G. McConnell, Ba. Sc., Mr. John J. Penhale, and others. Hopes are also entertained that Sir William Dawson, the venerable ex-Principal of McGill, will be able to deliver an address on the occasion.

Nova Scotia Gold Output.

The returns of the gold yield of Nova Scotia for the year ended 30th Sept. 1894, which we publish below, are instructive reading. The totals are hardly to be compared with those of last year, owing to the change of the departmental fiscal year, which now ends Sept. 30th instead of December 31st as formerly. Last year the Government blue book contained the returns for only nine months, this year it will contain twelve. The only comparison that can be made is with the totals of years previous to 1893, and from this point the returns show a marked falling off. It is, however, but fair to say that the returns, as supplied the REVIEW by courtesy of the Mines office, are incomplete. Of the 39 mills reporting, only 9 have reports for each of the twelve months, the period covered by the remaining reports varying from eleven months down to one. It is therefore possible that the aggregate may be increased by from 500 to 700 ozs.

There are only three mines reporting yields above 1,000 ozs.; these are the Antigonish Gold Mining Company, of Stormont, with 2,111 oz., 10 dwts.; the West Waverley Gold Co., Ltd., with 1,860 ozs., and the Richardson Gold Mining Co., with 1,564 ozs. It is noteworthy in this connection that each of these companies is working low grade ore, the average of the Antigonish Co. being 6.7 dwts., of the West Waverley 4 dwts., of the Richardson 5.2 dwts. Of the total number of tons milled (47,330), West Waverley milled 9,312, or 20 per cent. of the whole; these three companies milled 21,575 tons, or 45½ per cent. of the whole, and produced 5,535 ozs., or 32½ per cent., practically one-third of the whole production of gold. The average value of the rock milled by these companies was 5.14 dwts., and the width of vein extracted varied from 12 inches at the West Waverley mine to 9 feet at the Antigonish and nearly 20 feet at the Richardson. These figures are certainly instructive, and bear out the words of the Inspector of Mines, Dr. Gilpin, at the united meeting of the Canadian mining societies in July last, as follows:—"The prospect of an increased output from the small, rich "leads is not encouraging, In the future the greatest returns must be "sought for in the mining and milling of low grade ores." The figures quoted certainly confirm Dr. Gilpin's views, as the average of the 47,330 tons milled is but 7 dwts.

The prospects for the coming year are, however, very encouraging. The Richardson Company have completed extensive improvements in their plant, enabling them to handle much larger quantities of ore, and are also opening a large vein 1,500 feet west of their workings. New mills of large capacity are being erected at Caribou and Mooseland upon large deposits of quartz that mills from $4 to $8 per ton. The continuation of the rich pay chute of the Thompson-Quick property has been cut by the Golden Lode Co. at South Uniacke and is now being vigorously worked, returns showing that the high grade character af the roll (from 6 to 10 ozs. per ton) is well maintained. A large mill has been erected at Cochrane Hill, but has not yet been started. The once famous Salmon River mine shows a return of 271 oz. for eight months. The Oldham mine, which had a production of over 3,000 ozs. in 1893, shows only 536 ozs., having been practically idle since February, 1894. The small, fabulously rich lode discovered in Sherbrooke has brought that district up somewhat. Guysboro' County, this year as last, shows the largest production.

OFFICIAL RETURNS FURNISHED "REVIEW" FOR THE TWELVE MONTHS ENDED 30TH SEPTEMBER.

Name of Company or Mine.	District or Address of Mine.	Rock Crushed.		Gold Milled.		
		Tons.	Cwt.	Ozs.	Dwt.	Grs.
	For 12 Months:					
Oldham Gold Co.....	Oldham.....	918	2	536	18	10
West Waverley Gold Co	Waverley.....	9312	16	1860	1	0
Damas Touquoy.....	Moose R, Caribou	4131	—	342	12	17
Moose River G. M'g Co	" "	2501	9	551	6	21
Oxford Mill.....	Lake Catcha.....	1643	15	944	18	0
John H. Anderson.....	"	661	15	642	4	0
Richardson G. M'g Co..	Stormont.....	5963	4	1564	11	10
Antigonish G. M'g Co.	Stormont.....	6299	—	2111	10	—
N. Scotia G. Mines Ltd	Montagu.....	1484	10	814	1	0
	For 7 Months:					
Herbert Dixon.....	Caribou.....	673	—	972	—	—
	For 11 Months:					
C.P.F. Mining Ass'n. .	Uniacke.....	1311	—	237	7	0
Symon Kaye Syn. Ltd .	Montagu.....	334	—	336	—	—
Neptune Mill.....	Gold River	299	5	196	12	18
	For 10 Months:					
W. A. Sanders.....	Caribou.....	2297	—	618	14	—
Mooseland G. M'g Co..	Mooseland.....	1355	—	434	1	0
	For 9 Months:					
Goldenville Mill.....	Sherbrooke	407	—	163	16	—
Thompson & Quirke....	South Uniacke...	129	10	790	3	2
James A. Macdonald...	Stormont..... ..	686	—	472	9	—
Picton Dev. Co	Renfrew.....	889	—	683	5	—
	For 8 Months:					
Dufferin G. M'g Co....	Salmon River....	1467	—	271	5	—
Eureka Mill	Ecum Secum.....	108	—	51	—	16
Kempt " ..	Kemptville	188	—	187	14	—
	For 6 Months:					
Miners Mill.....	Sherbrooke... ..	194	—	89	8	—
Old Provin'l G. M'g Co	Killag.	199	11	119	16	7
	For 5 Months:					
Columbia Milling and Reducing Co.....	Oldham.....	74	—	10	19	6
A. C. Cogswell.....	Lake Catcha.....	90	10	172	8	—
K. F. Crocker.....	Whiteburn.....	478	—	236	16	—
	For 4 Months:					
New Egerton G. M'g Co	15 Mile Stream ..	613	—	193	—	—
	For 3 Months:					
Stanley "	15 Mile Stream ..	560	—	359	—	—
Country Harbour "	Stormont.....	1025	—	420	—	—
S. R. Giffen	"	131	—	79	11	12
	For 2 Months:					
Cochrane Hill G. M'g Co	Sherbrooke.....	136	—	69	17	12
Wentworth Mine.....	"	3	2	226	—	—
Phœnix Land & Dev. Co	Uniacke..... ...	50	—	10	19	9
McNaughton's Mill....	Wine Harbor	71	—	83	15	—
Central Rawdon M'g Co	Central Rawdon..	85	—	44	10	—
J. J. Withrow *et al* ...	Uniacke.....	54	6	32	7	12
	For 1 Month:					
Truro Gold Mining Co.	Caribou.....	60	—	8	16	4
Boston " "	Malaga.....	456	6	92	—	—

J. M. REID,

Oxford Gold Mining Co., Musquodoboit Harbour, N. S.

EN PASSANT.

Although an extra issue of two thousand copies were printed, our August number has been completely sold out. September and October issues are also out of print.

Our next issue will contain a complete review of the features of this year's Nova Scotia coal trade.

Mr. J. S. Drew, of the Royal Engineers, has, we learn, invented and patented an ingenious and promising device in connection with safety mechanism for mining cages, lifts, elevators and like appliances. Seeing the number of serious accidents which annually occur through overwinding or the breaking of the hoisting ropes used with such apparatus, we hope that Mr. Drew's invention may be speedily introduced The contrivance in question is simplicity itself, and can be readily applied to existing cages or lifts with but little structural alteration or expense. It consists in the employment of powerful spring bolts, which are liberated on the travelling structure should the rope become ruptured and whereupon the bolts are instantly caused to engage with the vertical or inclined controlling guides and thus arrest the descent of cage or car.

We are authorized by Mr. John F. Caldwell, Winnipeg, the owner of the Sultana gold mine, Lake of the Woods, to say that the reported sale of the mine to an English syndicate is not confirmed.

A new method of raising water from deep borings has been devised by Mr. Thomas Matthews, Manchester, Eng., and has been put in operation at the breweries belonging to Messrs. Gartsides, Ashton-under-Lyne. At these breweries, it is stated, there was already a bore-hole about 300 feet deep, and in it was a pump driven by strong wheels, cranks, and levers, the full capacity of which was about 3,000 gallons per hour. Mr. Matthews undertook to double this quantity without altering the bores in any way. After taking out the old pump, Mr. Matthews applied his patented system, and in place of the old cranks wheels, levers, &c., put down a neat but strong steam engine, working at thirty-six strokes per minute, driving up to a height of over 200 feet from the bucket a column of water equal to 7,000 gallons per hour, and this without shock, noise, or trouble of any kind. The work done by the engine is very considerable when we take into consideration that 7,000 gallons per hour equals 14,000,000 foot-lb. per hour, or upwards of 30 tons of water, 200 feet in one hour. The manager of the brewery, who has had an opportunity of inspecting the pump put down by Mr. Matthews, states that, with the new management and with no increased cost as regards fuel or steam power, they could now raise in six hours quite as much water as the old set of pumps could do in twenty-four hours, and whereas previously they had been subjected to scarcity of supplies of water from the well they had now ample supplies without running the pumps at full pressure.

In his report recently presented the Ohio Inspector of Mines gives the following statistics relative to coal mining by machinery in that state. He says that 2,553,074 tons were produced by this method, an increase of 313,994 tons as compared with the preceding year and the largest by the above amount of any year of which a record has been kept by the department. The returns indicate that during the year, machine mining has been confined to 10 of the coal producing counties of the State as compared with 8 during 1892 and 11 during 1891. Part of this variation was caused by Guernsey county, which dropped from the list in 1892, but entered again in 1893.

"The largest production returned was from Hocking county, followed by Athens and Perry. These 3 counties embrace the Hocking Valley region, in which the returns indicate that the production from this source amounted to 2,429,512 tons, which equals 95 1/6 per cent. of the year's production of machine mined coal as compared with 93 4-10 per cent. during 1892; of this Hocking county produced 55 1-10 per cent. There were 379 hands employed in operating the mining machines, which indicates a gain of 35 as compared with the year of 1892. In preparing the coal for market, after it has been undermined by the machines, another set of men called followers, drill the holes, blast it down and load it into mine cars. Of this class the returns show that there were 2,587, which is a gain of 286 as compared with the preceding year. In the time worked the greatest was in Jackson county, the least in Guernsey, while the average in the nine counties was 32 weeks, a gain of 3 weeks, as compared with the average time worked in the mines throughout the state."

In the 10 counties referred to 379 machine operatives and 2,587 day hands were employed 30 weeks. The output of lump coal was 2,263,362 tons; nut coal, 156,331 tons, and 133,381 tons of pea and slack.

Natural gas pumped from under the Detroit river is to be supplied to Detroit consumers from the Canadian wells at Kingsville, Ont.

ST. LAWRENCE COAL DELIVERIES, 1893-94.

As customary, on the close of St. Lawrence navigation, we are able, by courtesy of the Customs' officers and agents of the companies, to provide our readers with an authentic comparative statement of the coal deliveries for the past season. The total quantity received is the largest in the history of the trade, the figures for previous years, since 1885, being 1885, 360,000 tons, 1886, 377,500 tons, 1887, 482,103 tons, 1888, 517,539 tons; 1889, 467,525 tons; 1890, 543,656 tons; 1891, 602,323 tons; 1892, 626,087 tons; 1893, 737,891 tons, and in 1894, 796,282 tons. In comparing the returns of the companies we find the Dominion Coal Co., Ltd., with an increase over last year of 54,839 tons, while the General Mining Association and the Intercolonial Coal Co. show a decrease of 02,056 tons and 2,928 tons respectively.

Company.	Montreal.		Sorel.		Three Rivers.		Quebec.		Totals.	
	1893	1894	1893	1894	1893	1894	1893	1894	1893	1894
General Mining Association, Ltd.....	75,195	74,359	11,494	8,485	9,218	3,952	33,500	22,555	129,407	109,351
Dominion Coal Co., Ltd	466,005	512,269	5,191	3,151	.....	5,529	18,087	23,173	489,283	544,122
Intercolonial Coal Co, Ltd.....	72,079	69,151	.....	.....	.....	.....	.....	.....	72,079	60,151
Scotch, English, Welsh and American bituminous	36,074	55,849	1,528	1,932	.....	.....	9,520	15,877	47,122	73,658
	649,353	711,628	18,213	13,568	9,218	9,481	61,107	61,605	737,891	796,282

The wells belong to the Ontario Natural Gas Company. It is said this company has an output of 50,000 feet of gas a day at present, and can easily supply Detroit without assistance from the Ohio fields. An 8-inch pipe is to be laid under the river at an estimated cost of $50,000.

"A steel cable one and a half inch in diameter, travelling at the rate of 12 miles per hour, can transmit nearly 2,000-horse power," says the *Electrical Age*. "But by taking a copper wire one square inch in section and applying to it a potential equal to that which is in use to-day in at least one place in this country, viz, 10,000 volts at 1,000 amperes per square inch, we find we are transmitting in an invisible form over that wire more than 13,000 horse power, which is enough to rupture instantly six such cables as are ordinarily used in operating a cable railway."

An American journal describes a shot-firing appliance, which can be attached to any form of safety lamp, and is known as the "Roberts Shot-firing Lamp." The following are the essential features of this apparatus:—A brass tube 5-16in. in diameter is inserted through the oil cistern and its top is terminated in a brass box covered with gauze. A hole is made in the tube opposite the flame, and is normally closed by a "sleeve" pushed up by a spring. The lower end of the tube is also closed by a plate pushed over it by a spring A blow-pipe also passes through the oil cistern, and is closed like the lower end of the tube. To fire the fuse it is pushed through the tube, and the sleeve being drawn down, the flame directed on to the end by the blow-pipe. When it is certain that sparks will not be thrown from the end of the fuse it may be withdrawn from the tube.

A new kind of elevator for use in mines is mentioned by the English mining journals. It is constructed so that one side exactly balances the other. On one side is a large cage on which a loaded car is run, to be hoisted to the top of the mill, and on the other is a huge iron tank capable of holding sufficient water to raise the car, load and carman to the top. The carman, from his station at the bottom, pulls a rope which opens a stop cock and fills the tank with water, at which the tank descends, and the cage, containing car, carman and all, rises to the top of the bin, when the car is dumped. The carman then pulls another rope, which opens a valve at the bottom of the tank and lets the water out; thus the cage and car, now being the heaviest, descends, its movement, of course, being always under the control of the operator or carman. The cage is provided with strong brakes, capable of holding it and the contents stationery at any point, either in going up or coming down, and the whole is hung on an 8-foot wheel by a 1½-inch wire rope of great holding capacity.

Not long since at Springbank colliery, Airdrie, Scotland, a trial took place of a Rigg and Meiklejohn coal cutting machine. The machine was one of the usual size, 7¾-inch diameter cylinders, and was worked by compressed air at a pressure of 40 pounds per square inch. It was worked by 4 men, 1 to attend to the machine, 2 laying rails and setting props, and another followed the machine clearing out the cut to let the coal drop. The cut was 3 feet under in a seam of coal 2 feet 8 inches thick, and the wall to be cut was 70 yards long. This whole length was cut in 1 hour and 30 minutes, which at this rate would mean a cut of considerably over 300 yards per shift of 8 hours. The whole was done in a very satisfactory manner. Mr. William Cassels, the manager, says: "We can cut easily 300 yards per shift. The machine is 7 feet 10 inches long over all, 2 feet 10 inches wide, exclusive of cutter, and 1 foot 10 inches high on the rails, and the air pressure at the machine is 35 to 40 pounds, and this is quite enough. The grip cut by this machine is only 2¾ inches to 3 inches deep, and this results in a large saving of hand coal as against hand labor."

As we go to press we are advised that in the suit against the Dominion Coal Co., referred to elsewhere in this issue, the Supreme Court of Nova Scotia, on the 24th inst., reversed the decision of Judge Townshend and ordered a new trial.

Is there anything new under the sun? asks the *Railway Review*, and here adds: Soloman was right. The more the past is explored the more evident this becomes. A pre-historic blast furnace is the latest discovery. Professor E. Petrie, in 1890, convinced himself that in a remarkable mound called Tel-el-Hesy, in South Palestine, would be found the remains of what was one of the strongest places in the country down to the invasions of Sennacherib and Nebuchadnezzar. The explorations, said Mr. Bliss at the recent Palestine exploration fund meeting, have fully verified this forecast. Amid all the evidence discovered by Mr. Bliss of the civilization of that remote age—wine presses, treacle presses, alkali burnings and innumerable others—by far the most curious is the disclosure of an iron blast furnace, arranged to give strong evidence of being intended to heat, in its descent, a blast of outside air forced through passages before entering the chamber at the level where tuyeres are usually found. "If this theory be correct," says Mr. Bliss, "we find 1,400 years before Christ, the use of the hot air blast instead of cold air, which is called a modern improvement in iron manufacture due to Neilson, and patented in 1828."

A small light "pocket" blasting battery has been brought out by the Nassau Electrical Company, of New York. The battery is made up of chloride of silver cells, each being securely and hermetically sealed; these cells have an E. M. F. of 1.10 volts, with a maximum current of 2.00 amperes, weigh less than 1 oz., are less than 2¾ in. long, and under ¾ in. in diameter.

At the last meeting of the North Staffordshire Institute of Mining Engineers, Mr. J. J. Priest contributed a paper on "Colliery Cost Sheets," which he illustrated by drawings. He observed that there were greater difficulties in carrying out an elaborate system of cost keeping in North Staffordshire than in almost any other district, owing to some extent, to the mode of working, and partly owing to the fact that in many instances ironstone and coal were drawn not only from the same shaft but from the same seam. It would generally be admitted that some system of ascertaining in detail the cost of labor per ton of minerals produced or paid for was of the first importance to a manager, and unless these accounts were carefully and minutely kept, the management of any mining enterprise was not likely to be economical or successful, as would otherwise be the case. Labor costs were very generally based on the tons produced or paid for at the pit, and were therefore only useful as a means of comparison with the labor cost of previous pays. It was a common custom in some districts a few years ago for the subordinate heads of departments to make out their own wages and cost sheets. This system had the advantage of impressing on the memory of those officials the cost per ton of each class of labor working under their immediate authority, but that system in late years had become more or less obsolete. The services of such persons were generally thought to be better utilized in the active superintendence of their particular departments, while the work of making out the wage sheets and cost sheets was now generally performed by clerks. The cost sheet would in all probability be made out on the "tons accounted for," otherwise "disposed of," and these would in nearly all cases show a greater or less—generally less—quantity than the tons paid for at the pit, the discrepancy arising from refuse and dirt picked out of coal, allowance to customers, variation in the tare weight of trucks, &c., all adding to the probability that less tons would be "accounted for" than the colliers were paid for "getting." In some instances the cost was worked out on the production—that was the coal paid for at the pit—but he maintained that the most accurate plan was to work out the statement entirely on

the "tons accounted for," all fuel consumed on the works being charged for as materials, at market prices, while coal put to stock on the ground was valued at much less than current market prices, on account of the deterioration which naturally took place; coal in wagons or on the pit bank might or might not be taken into consideration in the "general cost sheet," his experience being adverse to its inclusion, as the quantity of coal paid for and not yet accounted for in this direction usually balanced itself month by month. He made suggestions respecting dealing with rents, rates and taxes, and spoke of the advantage of the slide system.

Coal Outcrops.

This was the subject of a paper read by Sir William Dawson before the Society of Students of Mining Engineering of McGill University, at the opening of the session of the Society on the 26th ulto.

A typical coal-bed was defined to be a fossil bog or swamp, with an underclay or ancient soil beneath, full of carbonized roots, and a roof of shale or sandstone above, often containing fossil leaves or trunks of trees. Some of the latter are occasionally found to stand erect as they grew; and being replaced by stony matter, they form what have been called "coal-pipes," which when the coal beneath has been removed by mining, sometimes fall into the workings, causing accidents to the miners. The coal itself is shown by the microscope to consist of layers of compressed and carbonized vegetable matter. In some exceptional beds, chiefly of cannel coal, there is no true underclay, and the coal in this case seems to have been produced by the bursting or discharge of bogs pouring vegetable debris over submerged flats. By continuous or intermittent subsidence and renewed deposition, it usually happens that several beds of coal are found to occur, separated by intervening shales and sandstones, in the same locality.

The coal-bed formed in either of these ways is at first horizontal and covered up with earthy beds of greater or less thickness, deposited upon it, and whose pressure has contributed to its condensation and preservation. It has thus no outcrop except where it has been cut across by the channels of streams, or by the action of the sea on coasts, when the edge of the bed may appear in the banks of ravines or canyons or on coast cliffs. Coals of cretaceous and tertiary age in a horizontal or nearly horizontal attitude crop out in the banks of rivers in many places in the Canadian North-west, and may be mined by levels run in from the river valleys. Even coals of the true carboniferous period sometimes retain their horizontality, as in parts of the Ohio coal-field Usually, however, the movements of the earth's crust have thrown the beds into synclinal valleys and anticlinal ridges, and when the crowns of the anticlinals have been removed by denudation the edges of the beds appear at the surface or covered only by soil and loose material, and the outcrops of the several beds of the same series run in lines more or less parallel to each other. In this case the beds may be seen to dip in different directions and at different angles with the surface. Such an outcrop when exposed and examined, enables the explorer to ascertain the thickness and quality of the bed, the character of its floor and roof, its horizontal course or strike, its direction and angle of dip; and in connection with these facts, the directions along the surface in which it can be traced, the depth at which it can be reached at any given point, and the area under which it can be profitably mined. All these facts and inferences can be learned from a very small opening, provided it exposes the whole breadth of the outcrop. Additional information may be obtained from the outcrops of the beds associated with the coal, wherever these are exposed.

But since the beds of coal are not unlimited in extent, and since the crowns of anticlinals and the bottoms of synclinals are not always parallel to the surface, we may expect the reverse dips on the opposite sides of synclinals not to run parallel to each other, but to curve round and join each other at the ends of the troughs or basins. We must also make allowance for the manner in which the outcrops bend backwards in crossing transverse ridges or forwards in crossing transverse alleys. These points were illustrated by the arrangement of coal-beds in Eastern Cape Breton, which have been said to run up on the land like a series of stranded boats. These outcrops also show the manner in which anticlinals bringing up hard rocks sometimes form ridges, and when they bring up softer rocks which have been denuded away, appear as hollows. The various appearances presented in this way were shown by a map, and also the curving and widening out of the series of outcrops when the angle of dip of the measures diminishes.

The effects of faults were then explained and illustrated, and the manner in which they may repeat the outcrops of beds of coal, or may render them discontinuous. Special illustrations were given of these disturbances from the great faults in the Pictou coal-field, which were at one time so perplexing to explorers.

Cape Breton was then taken as an example of the submergence and erosion by the sea of the outcrops of coal-seams. Limited portions of the outcrops of coal-seams dipping more or less toward the sea appear in many places around the older rocks which form the nucleus of Cape Breton. Only a small part of many of these coal areas remains on the land, while there is reason to believe that they extend widely over the sea bottom both east and west, and that they are continuous under the sea with the coal-fields of Nova Scotia proper and Newfoundland. Thus a large part of the mineral fuel of Cape Breton as well as of Nova Scotia lies under the sea, and it was shown to what extent these submerged coal districts may be made available. It was also shown that the amount of accessible coal not yet mined is enormous, and that the mining of coal in the maritime provinces of the Dominion admits of a great expansion, if a profitable market can be found either in Canada or elsewhere.

COMPANIES.

New Glasgow Iron, Coal and Railway Co., Ltd.—The following is an excerpt from the Directors' Report submitted to the shareholders at the last annual meeting:—"Your Directors are pleased to advise the continuous operation of the furnace during the entire year, resulting in an increased production of iron. The various services of the Company have been well maintained throughout the year. A good deal of difficulty was experienced and some expense incurred in keeping the railway and other outdoor operations going during the excessive cold of the past winter. A subsidy was voted by Parliament at its last session for the extension of the railway five miles, but your Directors have decided that under existing circumstances it would not be prudent to proceed with the work at present. As all are aware, the year has been one of great depression in all lines of trade, but possibly none have felt it so keenly as the iron business in its every department. That we have been able to do even as well as we have, is, in the opinion of your Directors, a matter for congratulation. The amount of the profits after two years' operations have been $110,814.59."

Nova Scotia Steel and Forge Co., Ltd.—Owing to extreme commercial stagnation, covering a large portion of the year, neither the volume of business nor the prices realized by this company were as large as the previous year. Notwithstanding the earnings of the company have been fairly satisfactory. The profits of the year (ended 30th June, '94) were $61,281.52, to which is added the balance at credit of profit and loss carried forward from last statement, $2,943.68; or a total profit of $64,225.20. On recommendation the amount w s distributed as follows:—Reserve for insurance against bad debts, $4,000; reserve for depreciation of plant, $11,500; 8 per cent. dividend on preference stock, payable 5th Sept., $18,174.45; 8 per cent. on ordinary stock, payable on 10th October, $26,664.00; leaving balance forward of $3,886.75.

Drury Nickel Co., Ltd.—A special meeting of the stockholders was held at the office of the Company in the Township of Drury, Ont., on 26th instant, for the following purposes:—

1st. To authorize the proper officers of the Company to place a mortgage on all of the Company's property for the purpose of paying the debts of the Company.

2nd. To authorize a sale or transfer of all the property of the Company for the purpose of paying the debts of the Company.

3rd. To authorize an order to wind up the affairs of the Company.

4th. To do any and all things necessary to a proper transfer of all of the property of the Company, for the purpose of paying the debts of the Company.

5th. To transact any other business that may legally come before the meeting.

Broad Cove Coal Co., Ltd.—The officers of this Company, incorporated at the last session of the Legislature of Nova Scotia, are:—John M. Raymond, *President;* Alpheus P. Alger, *Vice-President;* William Penn Hussey, *Treasurer and General Manager;* Edgar S. Buffum, *Secretary;* Warren D. King, Electrical Engineer; Directors, Wm. H. Munroe, of Martha's Vineyard; George W. Gale, Boston; John Y. Pazant, Halifax; Hon. John M. Raymond, Salem; Warren D. King, Peabody; Hon. Alpheus B. Alger, Cambridge; Edgar S. Buffum, Salem; J. R. Naegeli, Zurich, Switzerland; William Penn Hussey, Danversport. The American Loan and Trust Company, of Boston, of which S. Endicott Peabody, of Salem, is president, is trustee of the company, holding a deed of trust for $1,000,000 as a guarantee of payment of principal and interest of bonds. The areas controlled by the company cover

two square miles, and are located in Inverness County, Cape Breton. The company is preparing to build a shipping pier off Melsade's I ce; tenders for the dredging of which have been given out.

Nova Scotia Steel Co., Ltd.—The proposed amalgamation of the New Glasgow Iron, Coal and Railway Co., Ltd., and the Nova Scotia Steel and Forge Company, Ltd., will be discussed by the shareholders at a meeting to be held in New Glasgow on 12th proximo.

The Maud Hydraulic Mining Co., Ltd., has been registered at Victoria, B.C., to acquire the placer mining claims, leases and property held by J. M. Buxton on Four-Mile Creek, near Quesnelle River, in the Province of British Columbia. Authorized capital, $25,000, in shares of $5. Directors: J. M. Browning, J. M. Buxton and Charles Wilson. The head office is at Vancouver, B.C.

Alberta Railway and Coal Co., Ltd.—Subjoined is an excerpt from the report of the directors submitted to the shareholders on 31st ultimo:—"The accounts show a profit on working of the railway and colliery of £17,969, while house rents and water privileges brought in £844, making a total of £18,813; on the other side managerial expenses, insurance, and taxes absorbed £6,391, and interest on debentures and loans, if paid in full, would have required £62,591, leaving a deficit for the year of £50,168, and increasing the debit balance to profit and loss to £101,316. Interest on first mortgage debentures, however, requiring in full £53,400, was only paid to a small extent in cash. Sundry creditors in Canada and London, and bills payable, totalled on June 30th last £212,429, of which £188,203 was secured on mortgage; and there were in addition sundry creditors for debenture interest for £75,687, and the cash balance amounted to £3,462:—

The balance-sheet and accounts for the twelve months ending June 30th, 1894, are herewith submitted. In judging the result of the working for that period, the shareholders will bear in mind that the condition of business generally in Canada and in the United States was very unsatisfactory. In face of the severe commercial depression, however, it is gratifying to observe that the quantity of coal which the Company disposed of was 139,308 tons, against 133,924 tons in the previous year, or an increase of 5,384 tons. The shareholders are aware that during the year 1893 the Lethbridge-Dunmore Railway was widened to the standard gauge under arrangement with the Canadian Pacific Railway Company. The work was completed on November 28th, 1893, and since that date the railway has been operated by that Company with a result, it is believed, alike satisfactory to both Companies."

Canada Coals and Railway Co. Ltd.—The shareholders of the Canada Coals and Railway Company, of Joggins, N.S., held their annual meeting in Montreal on 20th instant. The following board of directors was elected:—Messrs. S. Finley, R. L. Gault, A. F. Gault, S. H. Ewing, E. Hanson, E. W. Wilson and R. Wilson Smith. At a subsequent meeting of the board Mr. S. Finley was re-elected president; Mr. A. F. Gault, vice-president, and Mr. A. G. Watson, secretary treasurer.

The Canadian Anthracite and Coal Co., Ltd.—The annual general meeting of the shareholders was held at Ottawa on 14th inst. There was a large attendance. The output from the colliery (at present operated by the H. W. McNeill Co., Ltd., under lease), for the month of October was the smallest for some months, being 6,000 tons. It is intended to largely increase the output in 1895. The C. P. R. are taking large quantities of the coal, which is giving great satisfaction, and an increasing market is being found for it in Manitoba, notably at Winnipeg, where it is gradually superseding Pennsylvania anthracite. The officers of the Company are:—Hon. J. G. Thorpe, Cambridge, Mass., President; O. H. Ingram, Eau Claire, Wis., Treasurer; W. K. Coffin, Eau Claire, Assistant Treasurer; L. Crannell, Ottawa, Secretary. The quantity, quality and value of the coal is now assured beyond any doubt, and great credit is due to the lessee, Mr. H. W. McNeill, for the vigorous and successful manner he has prosecuted the development of the trade of the colliery.

Creighton Gold Mining Co.—Several experts have reported on this Company's property and the works have been closed down. Mr. J. Burley Smith, M.E., has, we believe, taken a contract to do some prospecting with the diamond drill, and this work is proceeding.

The Eureka Oil Developing Co., of Lambton.—This Company seeks incorporation with the object of taking over the petroleum and power producing business at present carried on by James E. Austin, of Enniskillen, in the County of Lambton, including real estate, oil wells, machinery, buildings, pipe lines, tanks and all the plant connected with said wells and business, and to carry on and extend the same. Head office: Petrolia, Ont. Authorized capital, $5,000. Directors: J. E. Austin, London; R. M. Morgan and J. W. Morgan, of the town of Adelaide; David Barr, Petrolia, and George Burness, London.

Compagnie Francaise des Phosphates du Canada.—The lands of this Company, in liquidation, will be sold by public auction at Bordeaux, France, on 4th proximo. The property is in the Townships of Portland East and West, and Templeton, Ottawa County, Que. The upset price is 10,000 francs, and the purchaser will have to pay over and above a sum of 5,800 francs for government costs in France and the costs of liquidation. The price is payable five months after sale.

Nelson Hydraulic Mining Co., Ltd.—The first annual meeting of the Nelson Hydraulic Mining Co. was held last month. The directors presented a report of the progress of the company, which has been so frequently noted in our columns that there is no necessity to repeat it. Mr. John Elliot was elected a director in the place of Mr. J. F. Hume, resigned, and the other members of the board were all re-elected. Some important alterations of the by-laws were discussed and left to the board to carry out.

Rapid Tunnel Work.—The record for fast tunnel driving is believed to be held by the East River Gas company in the construction of its tunnel under the East river, New York. In one week the day shift made 48 feet 6 inches—a total of 101 feet. The heading is 10 feet 6 inches by 8 feet 6 inches and was advanced in full section. The rock is very hard hornblende gneiss. This is very remarkable work, considering the peculiarly difficult conditions of the locality; and is claimed to be the quickest tunnel-driving of the kind. Four three-and-one-half-inch drills were used in the heading, mounted on tunnel columns with arms, two drills on each column. About fifteen holes, nine to ten feet deep, were drilled by each shift, consisting of five machine runners and their helpers.

GOLD MINING.

Nova Scotia.

Caribou.—Messrs. Dixon & Co. have completed the transfer of their property to the Caribou Gold Mining Co., Ltd.

The work of unwatering and retimbering the shaft on the Macdonald property has been completed, and levels started from the shaft. Capt. Mackintosh reports good ore showing in the faces.

Mr. Damas Tonquay continues to work steadily his Moose River surface gravel. Last year he crushed 4,131 tons, which gave an average of 1⅛ dwts., making this the lowest grade ore worked in Nova Scotia.

Gold River.—Negotiations are afoot for the transfer of the Victor Co's property to New York people.

An expert has also visited the property of the Lincoln Mining and Milling Co., and is making a mill test of the ore from the "Picayune" and "Captain" lodes.

Mr. T. N. Baker has opened a second lode upon his property, 200 feet south of the large lode. It is small in size, from two to nine inches, but the ton and a half in the dump is valued at 10 ozs. to the ton.

Killag.—This district is practically deserted, and no returns have been made for some time.

Stormont.—The October return of the Richardson mine was 300 ozs. from about 900 tons. The new plant is now running smoothly and the faces in the mine workings are showing a higher grade of ore. The "McMillan" lode has been cut on the western end of the property and is about 18 inches wide, showing gold freely.

The Country Harbor (or Saint John) Co., at Johnson's Brook, have cut the streak worked on the adjoining Antigonish property and are now in good ore. October's yield is reported at 175 ozs.

Uniacke.—The C. P. F. Mining Association are successfully working a 3 to 4 dwt. ore here. The mining is done by open cut or quarry, a Miller cable hoist being in use for hoisting and conveying from the pit. This system is likely to find favor in other portions of the Province where large belts of auriferous material occur.

South Uniacke.—The new mill of the Golden Lode Co. is reported ready for running. The quartz taken out of the roll cut by the shaft has been milled at the Thompson Quirk mill and yielded a brick of 272 ozs., an average of over 7 ozs. to the ton. This property will be a very large producer in 1895.

Renfrew.—The mill of the Pictou Development Co., which has been several months idle from lack of water, has started up and is now crushing the large accumulation of quartz mined during the summer months. The lode is reported as looking fully as well as hitherto.

Ontario.

The Sultana Gold Mine has not been sold to English capitalists as reported.

The Ophir Gold Mine is being worked by a strong force. The 30-stamp mill is also running double and a respectable brick is reported periodically. Mr. F. D. Taylor, M.E., is superintendent.

During the month, Sheriff Carpenter, Rat Portage, sold all the moveable property of the Black Jack Mining Co, and the Gold and Silver Reduction Co. under executions in his hands. The whole cost originally $6,000 or $7,000, and was bought by Mr. W. G. Motley for $1,050 and will be moved to White Fish Bay for the purpose of operating the Regina mining location recently purchased by an English syndicate.

The Rainy Lake *Journal* states that Capt. Dent, of the Syndicate Mining Co., reports that his Company is working night and day on the Luella property, and as the shaft goes down on the mine the ore becomes richer and the vein is getting wider. In fact the ore is so rich that a 20-stamp mill has been ordered and the work of construction of the building is to begin inside of two weeks, or as soon as the necessary plans and specifications can be secured from Duluth.

Last Monday morning Mr. Wm. Caldwell and a gang of men went out to the Regina mine with an outfit to erect camps, shaft house, and other necessary buildings to accommodate a mining staff of twenty men for the winter to carry on the development of the property. A 20-stamp mill will be put on the property as soon as the state of development will warrant it.—*Rat Portage Herald.*

British Columbia.

The Cariboo Mining Company, Camp McKinney, are considering the idea of putting twenty additional stamps onto the Cariboo in the spring and working their mill by water power by bringing the water in pipes from Rice creek from a distance of a mile and a half. In this case some of the stamps—ten or fifteen—could be utilized for custom work. There is no doubt that a custom mill at either McKinney or Fairview would be kept busy the year round and pay a handsome dividend.

The negotiations which have been under way for some time past for the purchase of the Victoria Hydraulic company's claims on the North and South Forks of Quesnelle river, have been closed, and the property transferred to the new syndicate. This is composed of Messrs. Geo. A. Cox, president of the Canadian Bank of Commerce, and Wm. McKenzie, president of the Street Railway, Toronto, D. D. Mann and T. G. Holt, contractors of Montreal, also representing other eastern capitalists, and F. S. Barnard, M.P., of Victoria, the original owners also retaining a considerable interest. The amount paid to the latter in cash and paid up stock is understood to be in the neighborhood of $70,000. The purchasers, to whom the proposition was introduced by Mr. Barnard, secured the services of Mr. Ross Brown, a well known mining engineer of California, on the properties. Mr. Ross Brown was not only well satisfied with the prospects for developing a profitable mine, but also expressed himself very favorably of the whole of that section of the province, believing that there are numerous auriferous channels of ancient rivers, which will pay largely by hydraulicing.

About 40 men are placer mining at Rock creek, South Okanagan, and 30 of these will stay in all winter. The average is $6 per day.

In all 22 car loads of machinery have been shipped to Lytton for the new pumping and dredging plant.

Prospects for Trail creek are very good. The Le Roi is expected to turn out 30 tons of ore a day, averaging $40 a ton.

The gold output of Kootenay will this year approximate a total of $200,000, made up as follows:—

Mining Division.	*Gravel.*	*Quartz.*
Trail Creek		$150,000
Nelson	$ 8,000	20,000
Trout Lake	2,000	
Revelstoke	10,000	
Fort Steele	10,000	
Total	$30,000	$170,000

The O. K. stamp mill is running on ore that has been culled over three times and yet is found very profitable working.

On December 6th, 1890, Charles Hussey, who owned a five-eighths interest in the Poorman mine and mill, six miles west of Nelson, mortgaged his interest to the Spokane National Bank for $14,000. The bank shortly afterwards suspended and was placed in charge of a receiver. The mortgage was one of the assets the receiver hoped to realize enough on to enable him to pay off the bank's indebtedness in full. Last month A. L. Davenport, who owned the other three-eighths of the mine and mill, bought the mortgage and the transfer is now on record in the record office at Nelson. By this deal Mr. Davenport secures title to the Poorman mine and mill, and he is now in a position to work the property to the best advantage. At present the mill is running day and night, the water supply being ample. The ore worked is so soft that from twenty to twenty four tons are crushed daily. About 1,000 tons have been run through this year, the returns being satisfactory. The stoping ground, however, is pretty well worked out, for if the drifts were continued much farther they would both come out on the surface, owing to the incline from which the drifts run starting in a ridge or hogback. It is more than likely that a hoist, to be run by a Pelton wheel, will be put on the mine in the spring. If this is done, the mill will be run continuously, as it is the intention to sink on the ore body.—*Tribune.*

The Golden Era Mining Co. is hydraulicing with good results on the North Thompson. The machinery is very simple and comprises two wheels 14 ft. in diam. and of 9 ft. face, driven by the current of the river and set upon either end of a scow. These drive the pump for hydraulicing. It is proposed to build a larger scow than the one at present in use, and employ a single wheel, say 16 feet diameter by 18 feet wide, instead of the two smaller sized ones now used, and this single wheel will give them sufficient hydraulic power for any purpose whatever. The power from the river is so great that one pump will put in 400 miners' inches at an elevation of 150 feet.

Work has been begun on the claims on Granite Creek in the Similkameen district owned by the Stevenson Gold and Platinum Hydraulic Mining Co. Tests on these upper benches have run as high as $1.50 to the cubic yard, and the whole bank is estimated to average 25 to 35 cents. The gold is coarse. Platinum has also been found and is expected to yield about one-third as much in value as the gold.

The Victoria Placer Mining Co., represented by J. D. Sherwood and J. F. Warner, will spend $55,000 on developing its claims on the left bank of the Pend d'Orielle. Water will be brought from four miles up the Salmon River in a flume, which will be carried across the Pend d' Orielle on a cable.

A recent dispatch says: "Up to this year British Columbia has owed its reputation as a mining country to the gold output of the Cariboo district; but this year will prove that Kootenay is not only the silver and lead-producing district in British Columbia, but is the greatest gold-producing district of the province as well. The gold output of Cariboo comes from gravel mines, while the Kootenay output is from the quartz mines, and these only meagerly developed. Quartz necessarily gives employment to a large number of men and the industry is a lasting one. The gold output of Kootenay this year will aggregate $200,000.

The War Eagle is now working about 20 men, sinking two shafts and running a tunnel. The owners will began ore on 4th instant. The ore yields $600 in gold and 12½ per cent. copper. Steam power will be obtained from the Le Roi mine and Burleigh drills put in next week. The new shaft will join the tunnel and will be completed in about a week when the bond on the property will be taken up. On the north side the ledge is opening well and is now 6 feet 10 inches wide. The ore chute is 900 feet long by 9 feet broad and all in sight is ore. Once stoping is started 100 tons a day can be taken out as easily as one ton, and when opened out another 200 feet she will put out 250 tons a day. This property gives every promise of becoming a mine sooner than any other in camp. Everything is being done in a miner-like manner to develop the property to the best and fullest advantage. Mr. Kingsbury, part owner of this property and also of the Poorman mine in the Cour d' Alene, states that he prefers this camp to any other in this province.

A personal visit to the O. K. says the *Miner*, shows the work to be in active progress. The tunnel is in 300 feet and the quartz vein matter cuts it in several places and shows up well at the end of the tunnel. A five stamp mill is in full swing and gives concentrates worth $500 per ton. The tailings also will be rehandled as considerable gold passes out with them. A jigging machine with copper table has just been put in and will start work next week.

In the I. X. L., adjoining the O. K., stoping is going on in two or three places and ore of the same quality as the O. K. is being taken out, but no plant has yet been put in. The recent survey of these claims by Mr. F. Ritchie throws the line of the I. X. L. over on to the O. K., covering the tunnel for some 40 feet; the two mines are therefore using the same tunnel and the I. X. L. is taking out ore which was thought to have been located by the O. K. people.

At the Le Roi is still going on in the 300 foot level and the ore comes up richer than ever. Burleigh drills will be put in at once and they will ship some 30 tons a day as they have a clear face of 300 to 400 feet of ore to work on and will probably put out between 3,000 and 4,000 tons this winter. It is understood that all this shipment will be made from Trail landing.

Mr. Chas. F. Law, late Commissioner to the World's Fair, contributes the following to that excellently gotten up provincial magazine *The Province*:

"The development now in progress in the district of Cariboo promises to open up a new field for placer miners in the old river channels which are now buried beneath the enormous masses of lava which cover the upper country for many miles. These channels are usually at a much higher elevation than the beds of the modern streams, and whenever cut into and worked have served to supply the present river beds with their auriferous deposits. In many instances the older channels are so completely obscured that it has not been possible to discover their location. Mr. Ross T. Browne, who recently exploited the Victoria Hydraulic properties at Quesnolle Forks, Cariboo district, has developed a system in California for tracing these old channels, which is known as the Forest Hill Divide System, because of the principle first having been successfully applied to the opening of that great property. A late report of the state mining bureau of California refers in detail to the work inaugurated by Mr. Browne as a very remarkable piece of engineering skill, and explains the means by which he was enabled to trace the bed of a phocene river between two mines, five miles apart, and where the veins of the channel were 8,000 feet distant from each other. The earlier drift mining on the great blue leads of California was attended by many costly mistakes which modern engineering science has shown us a way to void; and it is to the accumulated knowledge and ripe experience of such authorities as Mr. Browne and others, that we are enabled to reap all the advantages of such experience in opening up ground in Cariboo district of like character and conditions. It is apparent from observations made in the field during the last season, that we are about to enter on an era of drift mining which will carry us into localities hitherto unexplored. There is a vast district lying west of the Fraser, opposite the mouth of Quesnelle, which is covered by basalt for 100 miles square; and it is to this particular field that I wish to call attention with a view to investigation. The old system of drainage of the Quesnelle river country appears to have crossed the Fraser where the two now meet, and proceeded in a westerly direction towards the coast. It is possible that at that time the upper Fraser river did not then exist, and proof of this appears to have been furnished by the discovery of a great auriferous channel passing to the westward under a cap of basalt 100 feet thick, at an elevation of several hundred feet above the present Fraser system, and crossing the latter at right angles. This channel was found by Dr. Selwyn, director of the Geological Survey many years ago; and the conditions being exactly the same as in California add Australia, he has always been of the opinion that it should be investigated. Mr. Hobson, the well known hydraulic engineer, has exploited much of the ground about Quesnelle, and his California experience has forced him to conclusions which bear out the theory of a westerly drainage of the Quesnelle river system. If it should be proven that this channel continues westward and does not return again to the Fraser river, we will have proved the important fact that the vast broken plains between the Fraser river and the sea coast, which are now covered with lava, have at one time been traversed by a river system containing auriferous gravels, but now hidden from view. The opening up of such a field may lead to prodigious results, as the lateral branches of the greater streams may extend over an immense area. The methods employed in California to trace out these channels and their tributaries can be directly applied to this new field; and it is possible that we may be able to prove a new gold field of greater value than old Cariboo. It will be possible in many instances to trace the older auriferous deposits to quartz veins of a permanent character, and thereby place the mining of gold quartz on a solid bases. When it is considered that the Witwatersrand district in South Africa is only 12 miles in length and is producing thirty millions sterling of gold per annum, it is not unreasonable to assume that our gold oelds will prove equally as rich in an area so extensive as that which we posses. The righest gold fields in Australia and California were proven to exist in old channels buried under basalt and other debris, and we may expect similar results from like conditions in this country."

SILVER LEAD MINING IN BRITISH COLUMBIA.

An extraordinary showing of clean ore is to be seen in one of the stopes in the Slocan Star. Byron White measured eight feet across of clean high-grade galena, without a trace of country rock or zinc or other base metal in it. It is not anywhere near the surface, either.

Since the railway reached Three Forks, the Slocan Star has been shipping ore at the rate of 50 tons per day and this record will be kept up for fully two weeks to come. The ore, like all previous shipments from here is consigned to the Grant-Omaha smelter at Omaha. There are 800 tons to come down from the store-house, with 1,000 tons more from the mine during the winter. At the end of the week the Mountain Chief will resume its 500 ton shipment. Other properties are preparing to ship, including the Alamo, Idaho, Noble Five, Cumberland and Surprise. About 250 tons in all have been forwarded from here during the week, valued at $25,000. Besides this the Trail creek mines shipped—Le Roi, 30 tons to Everett; Josie, 14 tons to Tacoma; and the Gold Hill 5½ tons, also to Tacoma. These latter shipments were valued at $2,475. The approximate value of the ores of the district shipped during October was in the neighborhood of $48,000. The local list stands thus:

Sept. 13,	from the Alpha mine	120,000 lbs.,	valued at	$6,000
Sept. 17,	" "	180,000	"	9,000
Sept. 19,	" "	220,000	"	11,000
Sept. 20,	" "	78,130	"	3,900
Sept. 21,	" "	178,375	"	9,000
Sept. 24,	" "	181,000	"	9,100
Sept. 25,	" "	180,000	"	9,000
Oct. 1,	" "	90,000	"	4,500
Oct. 9,	" "	150,000	"	7,500
Oct. 15,	" "	75,000	"	3,750
Oct. 25,	Mountain Chief	122,450	"	6,150
Nov. 3,	Slocan Star	200,000	"	10,000
Nov. 5,	" "	40,000	"	2,000
Nov. 7,	" "	260,000	"	13,000

The value is reckoned on the basis of the release manifest of $100 per ton, but this will be found to be below rather than above the actual worth of the ore.

There are four mines in the Slocan to-day putting out ore that goes over 1,000 ounces to the ton. They are the Antoine, the Nonpareil, the Goodenough and the Reucau. On the Antoine, Jack Thompson and two men have been at work for eight weeks putting out 1,000 ounce ore, and they reckon that they have $15,000 to $20,000 worth on the bank. From the Nonpareil thirty sacks of ore, about one ton in all have been brought down to Kaslo for shipment. The ore assayed over four thousand ounces to the ton.—*Continued on page 229.*

CORRESPONDENCE.

(With Pleasure.)

The Editor :—

Your personal note concerning me in the October REVIEW contains a grain of truth, but several measures of error.

As you are well aware I have all along been connected in a dual capacity with both the American and Canadian Rand Drill Cos. My duties in connection with the American company have of l te largely increased, while the business here has reached a stage of development where it does not require my personal attention to the extent that it formerly did. Under these circumstances I expect to make New York my headquarters for the future, but I have no intention of severing my connection with the Canadian Rand Drill Co. On the contrary I expect to continue as engineer of that company and direct its operations as heretofore. I hope to continue to meet my Canadian friends on their own soil in both a business and social capacity, and beg to say to them that when in New York they will always find the latch-string out at 23 Park Place.

Yours faithfully,

F. A. HALSEY.

SHERBROOKE, Que., 12th Nov., 1894.

Mining in British Columbia.

The Editor :—

One of the best evidences of the inexhaustible richness of the mines of this province is that much of the world's experience is gravitating here and settling down to the work of steady and systematic development. And not only is this experience amongst the arrivals, but the numbers and the capital are coming to make their stand in the gulches and on those mountain tops on which nature has bestowed her richest mineral treasures. The days of placer mining, though limited, have not yet passed away in this country of mountain ranges, deep gulches and golden sands; but modern methods have begun to deal with refractory ore and with the rocks which nature in her convulsions has burned and made obdurate.

The pan has been superseded by the rocker, and the wooden aqueduct has given way to the hydraulic pipe, and the machinery of our boyhood has been superseded by the stamp mill with its great power to pulverize the hardest quartz and thus release the golden treasure from its rock-bound bed. One effect of the superabundance of rich mineral ore is that it sooner or later attracts capital, and this becomes a staying power in the production of wealth. The old complaint that the miners are mere prospectors and do not represent fixed or systematic effort is rapidly disappearing before the steady influx of miners and capitalists who have come to stay, but the work of the prospector has by no means ceased. The field here is yet a large one and the encouragement, compared with that offered by other countries, is by no means small or variable.

After many years of labor in the field Dr. Dawson has concluded this year's work with the deepest conviction that the mineral prospects in the province are very encouraging. As an authority on British Columbia mining matters he is, perhaps, one of the select, because he has given the province most careful attention. He is not given to superlatives, but the summary of his report of the year's work does not admit of any other conclusion than the one that the mining industry of the province has already marked an activity not exceeded in previous years, and that the production, especially of silver, is going to add millions to the wealth of the Dominion.

The ordinary reader is very apt to put down what he hears of mineral development now-a-days to be the dream of an enthusiast, who, tired of the oppression, is inclined to draw fancy pictures in order to encourage the desponding.

He is, however, assured on authority which men have everywhere learned to respect, that the mining activity of the province is by no means a vision of the dreamer, but a reality, and that the recent shutting down of the Kootenay mines has only been a pause for breath, during which smelter and concentrating works have been erected for reducing the ore on the spot.

One of the pleasing features in this respect is to note the way in which Canadians themselves are taking hold. In the past the Canadian yielded too readily to others. He gave way to the Englishman or the American, as though these always possessed more experience than himself. He has since learned to use better judgment, to give way only when fairly over-matched.

I have in memory a picture that was presented to me a short time ago by a man who was working a rocker on the Fraser near Yale. Said he: "Do you see those pieces of plant lying around loose on the banks of the Fraser? They are the remains of a plant sent out by an English company. The plant cost about $40,000. There was an Englishman in charge and he was so important a person that he stood all day with an umbrella over his head and superintended the locating, or rather the *dis*locating of this plant. He would listen to no one. A suggestion from a practical man was out of the question. Even when offered by an old timer with a fund of experience on the Fraser, and given with the best of intentions, it was unheeded and went the wrong way, because it was gratuitous and well meant. The result may be seen any day, and the uninformed traveler wonders what kind of water works came to grief when this plant was distributed promiscuously along the river banks."

It is a feature in New Zealand mining that English capital is best conducted under Scotch management, though it is by no means to be inferred that all English management of gold mines is capricious and extravagant. The inference to be drawn is rather that Canadians are finding that they have been more or less underrated in the mining field.

The advance which Ottawa has made in this western province indicates the potent and progressive power of the Dominion Government. In the explorations which have been found necessary to secure the introduction of capital and also to secure development, the educated gentlemen of the Geological Survey have done very much to make the resources of the country known.

They have also exercised a beneficial influence in lighting the way for the accomplishment of two great measures which will, doubtless, be sooner or later adopted by the Dominion Government, viz:—the sub-division of freshet-occuring streams and a general system of irrigating dry lands.

So far it has been deemed advisable to begin this series with a brief introductory article. In those that follow the attention of the reader will be called to certain facts which bear intimately on the mining resources as they present themselves in a general way to the observer.

It is not a little astonishing to find that numerous misconceptions prevailed in the early days with regard to the mineral resources of this province. The limit at one time embraced only gold and coal. The rich silver deposits of Kootenay were then unknown, as also were the iron and copper deposits which are now found to exist in large quantities. In the race for gold the prospector has laid bare other treasures which are both rich and inexhaustible and new areas are constantly entering the domain of his mineral treasure.

It is this constant prospect of new areas which adds interest and value to the mining industries and gives additional interest to the province.

There is an expectation in mining circles which is commensurate with the mining possibilities of the province. It is the reasonableness of these possibilities which gives life, strength and hope to the mining industries of the country. The grazing lands of the province may possess some extent—the agricultural lands may be limited, but the mineral areas are constantly expanding, and as the case is in Cariboo there is a decided tendency to revive a one time activity.

The Canadian geologist regards the province as a great exception from the general rule. He is astonished but not confounded. The prospector camped in the gulch will hail you as you pass, invite you to partake of his grub, hand you some specimens of the latest find and then tell you that, at one time, Nature has furiously kicked up her heels and fairly howled. There never was, he will tell you, before or since, such a fine old jumble as when these mountains "bucked" forth and then stood perfectly still.

Camped, not far from North Bend I met, some weeks ago, a man who was an old timer. He was an Englishman named Louis Johnson. Like most of his countrymen in this country he is warm hearted and would share his last piece of bread with the hungry traveler. After partaking of his frugal fare this veteran handed me some specimens of gold-bearing quartz which he found in the mountains adjacent to North Bend. These specimens were exceedingly rich, but the depth and extent of the lead was yet to be determined. This prospector who has been 25 years in the business in the province was quite sanguine. A great deal of confidence is really necessary if the prospector must succeed. He is undoubtedly a fortune seeker and it does not square with his calling to give way to gloomy reflections even though he never found bed rock or made the "riffle."

To the omnipresent gold, silver and coal in the province, must be added gypsum and mica as articles of commerce possessing considerable commercial value.

In the early days of the maritime provinces during the existence of the Reciprocity Treaty, gypsum from the provinces found a ready market in Portland, Boston and New York. Not a few farmers realized handsomely, from this gypsum trade. Its reduction by burning to expel the water and thus make plaster of paris was an easy process. The American people import not a little of our gypsum now-a-days but its demand in the Dominion is constantly increasing—something close to a hundred thousand dollars being the quantity used in Canada. But of this gypsum more particulars will be given hereafter.

Of mica there are known to be four promising mines, two near the Tete Jeune Cache and two on the Canoe River. These mines are the property of Mr. Louis Victor Bennett, of Kamloops. Mr. Bennett, though quite a young man possesses much of the ability, enterprise and perseverance which are so necessary to achieve success in the mining world. This gentleman has already expended a large amount of money in holding the fort. As mica comes within the mining regulations the duties which have to be performed on its possession in the mines place it beyond the reach of the ordinary speculator.

The property on Canoe River is known as white mica. It is founed in gneiss rock. It is also found in diminutive quantities in quartz about ten miles west of Canoe River.

It is found in no less then ten distinct veins heavily laden with the mica. The veins are parallel and they run in a south-easterly to a north-westerly course with a dip to the south at an angle of about 55° and covering a distance of from one mile to one mile and a half in width visible in a north-westerly direction until they again seek refuge in the cragged glacier mountains to the west, a distance of about one mile and a half. The veins measure from 7 to 16 feet in thickness. Writing of this mine on Oct. 22, 1894, Mr. Jno. F. Smith, who has the mine in charge says: That all the work that had been done was centered on this vein which is about 12 feet thick where it is opened, but immediately below a shale of rock of about 12 feet in thickness is another vein 10 feet in thickness, but I think these will be found to be *the same vein on further development.* "*Nevertheless we continued operations in the* open cut previously started from which we took out some fine blocks of mica. As I judge the formation of mica in large blocks is little understood I brought out several pieces of especial interest showing how the mica is formed in the quartz and the class of rock in which mica is found. In our operations, continues Mr. Smith, we found a small piece of very hard and brittle bluish-white stone which may prove to be beryl, some formation of which is precious stone. A few days later a large piece was found. I broke this in two with the intention of bringing it out, but unfortunately I laid it down on a stone and came out forgetting it. Nevertheless I have the small piece first found which will cut glass as easily as a glazier's diamond. We also picked out small pieces of fluor spar blue in caste. Several deposits of black mica were found, all of which can be seen by anyone who may desire.

"Mica is found in as well defined a ledge set in quartz as any other mineral but in wedge shaped blocks from four to ten inches thick at one end, squaring various dimensions. Mr. Smith says each block of the mica found will weigh from 15 to 20 pounds. There are several distinct veins running parallel in these mountains which are strictly the Cariboo range of mountains. These deposits can be traced for several miles in length and about a mile and a half in breadth. There is, he says, equally as much mica here as there is at the Tete Jeune Cache. It does not show so well because there has not been so much work done. We started in the centre location and ran a drift 14 feet from which we unearthed considerable mica of a little *different quality*, not quite so clear as that from Tete Jeune Cache, but a little rougher and more flexible."

Passing gold, coal and iron mines, Mr. Smith has directed his practical attention to a neglected field.

The demand for mica is constantly increasing and as we have no reason to doubt that our protective policy will give way to a suicidal one of handing over the natural productions of the country to strangers, the interest of Canadian capitalists must center more than ever in the natural resources of the country, especially in this portion of the Dominion. Canadians have been too ready to hand over their mineral treasures to outside capitalists who have often been in no better circumstances than themselves. Mistakes like these will not be made in the future, though the inference is not to be drawn that in these pages any attempt is made to create a prejudice against outside capital. This capital is very much needed, but it is not to be preferred to the home-made article which it has been the practice in mining circles to regard as inferior to the importation.

The constantly widening demand for mica in this conntry is an incentive to the development of this mineral, and as the proof of the richness of a place may be best determined by the actual field, so the readers of the journal may best realize what the value of this mica is by a sample which will be shortly sent to the REVIEW office.

H. J. E.

KAMLOOPS, B. C., 21st Nov., 1894.

The Coleraine Mining Co.

To the Editor :—

For the benefit of investors whose attention may be directed to the chromic iron industry of this section, a few lines respecting the remarkable business methods of this company may be of interest. The Coleraine Mining Co., in which Lieut.-Governor Chapleau and Senators Desjardins and Lacoste are directors, owns a large block of land in the township of Coleraine, Que., and on the discovery of deposits of chromic iron upon its property, the Secretary, Mr. Papineau, granted working leases of areas to a number of operators. These leases, it is worthy of remark, were signed only by Mr Papineau as Secretary of the Company, and were accepted in good faith as a *bona fide* and binding agreement with the Company. A considerable amount of development followed and large quantities of chromic iron, commanding a good market, were raised. But the Company, finding the value of its land greatly enhanced by these operations, cooly repudiates the leases of its Secretary, and claims that they are invalid, inasmuch as they have not been ratified by the Company. A nice state of things this for the unfortunate operator who has been allowed to spend considerable money on his area and who seeks a recompense from the sale of his ore. And now, forsooth, he is compelled to accept new terms or lose his all. The new agreement provides for the lease of small areas, some twenty-eight acres in extent, at *a royalty of one-half the selling price of the ore.* Out of the remainder (say nine dollars), he has to provide his working expenses and costs and recoup himself as best he may. This sharp practice will not commend itself as worthy of the eminent and Honourable gentlemen who preside over the affairs of the Company, neither will it conduce to the speedy development of their lands, which they so earnestly desire. The goose will lay one golden egg and then die. I may say that Dr. Reed, who owns probably the best chromic iron property in this section, is quite content with five dollars per ton, a royalty, by the way, in itself high enough in all conscience.

Thanking you for the space.

R. S.

BLACK LAKE, 22nd Nov., 1894.

Prospecting on the Rainy River.

The Editor:

A few notes respecting a prospecting trip to the Rainy River country may be of interest to your readers. We arrived at Rat Portage on 19th June and purchased our provisions and camp outfit. It had been our purpose to go direct to Rainy Lake, but on hearing of the discoveries of gold in the vicinity, we determined to spend a few days in and around Rat Portage. We examined a great many islands and found many promising leads, but on learning of the rich finds being made on Rainy Lake, we left for this point on 25th June, and arrived at Fort Francis three days later. Fort Francis is an old Hudson Bay fort at the head of Rainy River, about 190 miles from Rat Portage. Between these points there is a very fair steamer service, the boat making the round trip once a week. Leaving Fort Francis on the 29th with two canoes we went to the North-West Bay, about 26 miles away, and here our party divided—my brother and a half-breed going farther north-east, while I went south-east, or towards the Seine river. On reaching Shoal Lake, some 42 miles from Fort Francis, I found the surrounding country promising enough to warrant the establishment of a permanent camp. We discovered some very promising leads, some of them showing free gold and all panning very well. About this time a great many prospectors were coming into this region from the Manitou district. By the 15th October we had taken up about 1,000 acres of promising country. All the land round Shoal Lake has been taken up by the numerous parties in the field and development is being rapidly pushed ahead. Five stamp mills of various sizes have been contracted for to be in running order by the 1st of June next year, and altogether the outlook for practical results next season is very promising. The only thing necessary to make this a great gold producing region is confidence, capital and enterprise, as there is no doubt of the existence of gold in paying quantity.

Yours etc.

BUSH WINNING.

PLANTAGANET, Ont., 21st Nov., 1894.

Drilling for Oil at Gaspe Que.

The Editor :—

Can you give any particulars respecting the operations of a company reported to be drilling for oil in the Province of Quebec? If any such work is being done what results are being obtained? Any information you can give through the medium of your columns will be esteemed.

J. T. PLATT.

New York, 21st. Nov., 1894.

[An English syndicate named the Petroleum Oil Trust, Ltd. has, we believe, a large force at work near Gaspe. A number of wells, each equipped with an expensive plant, have been drilled, some of them to a considerable depth, and oil found in very small quantities. The head office of the company is at 22 Henrietta Street, London. The authorized capital is £430,000 sterling, in ordinary shares of £1., and £100,000 in preference shares of £10. Of the ordinary capital £345,940 has been allotted and paid, £314,988 having been issued to the vendors, and of the preference capital £39,490 has been subscribed and called up. The outlay on the equipment and drilling of the wells must have been very large and the prospects of finding oil in any quantity are generally regarded to be visionary by those geologists who have visited the field. Althogether the concern is regarded as a very doubtful enterprise—EDITOR.]

LEGAL.

Tobin vs. The New Glasgow Iron, Coal and Railway Co. Ltd.—This is an action to recover $5,000 damages for the death of an employee named Peter Tobin. The deceased, whose duties were to attend the ore washing machinery, was found dead, jammed in the machine, the first night he was on duty. No one saw the accident nor can it be explained. It is claimed that the ore when washed came out through spouts projecting from the front of an iron tank filled with lumps of ore and water in which ponderous cylinders revolved. The size of these spouts was 9 x 11 inches. The lumps of ore were sometimes larger than the opening, and consequently would not pass through. If the spouts clogged the tank would soon fill with ore and the cylinders in their turn would clog, and if not cleared out some part of the machinery would break. Among other things it was Tobin's duty to keep these spouts clear. The only platform was the one above the tank, but this platform was on a higher level than the spouts, being 3 feet 9 inches above them. When a lump of ore was forced down by the revolving cylinders to the front end of the iron tank too large to pass through the spouts, it had to be lifted by hand out of the mouth of the spout and over the front of the iron tank which projected above the spouts, by a person standing on the upper platform. This could not be done by a straight iron bar 3 to 4 feet long, the only tool provided by the company to do the work. The spouts could not be reached by hand from the upper platform. The only standing place from which Tobin could reach the spouts was the end of a beam which formed part of the trestle work. This beam extended out from the end of the frame work or butment on which the ore washer rested 2 feet 2 inches, and projected over a pit ten feet deep. This beam was near enough to the cylinders to be covered with mud from the asher and was slippery. Standing on this projecting end of a beam Tobin could only reach the mouth of the nearest spout by bending over a revolving shaft connected at that particular place by a coupling with bolts. A line drawn from the beam on which his feet rested up over the revolving shaft and down to the spout would be over four feet in length. The revolving shaft with the coupling bolts was uncovered. The work was carried on at night. There was no building over washer, simply a trestle work erected, no railing around it, no light in front where the spouts were; only one dim light above on the platform. No means of signalling the engineer who was on duty at his engine; was fifty feet away in the engine house and on a lower level, and could not be seen or heard from the place where Tobin stood. No one saw Tobin at the time he was killed, but it is conceded from the position in which his body was found, "his head jammed between the coupling on the shaft and the screen, his coat wound round the coupling and his legs hanging down below the shaft," that he was standing on the projecting beam endeavoring to clean out the spouts, and by losing his footing on the slippery beam his clothing was caught in the machinery. The defendants deny that the ways, works, machinery and plant were negligently constructed, defective or dangerous, or that they were operated in a negligent or dangerous manner. They also claim contributory negligence on the part of the deceased. The case was first tried before Mr. Justice Ritchie and a jury and dismissed, but this judgment was reversed and a new trial ordered by the Supreme Court *in banco.* On appeal to the Supreme Court of Canada this verdict was confirmed a few days ago and a new trial ordered in the court below.

George W. Stuart vs. Charles F. Mott—Stuart, who is a well known gold miner in Nova Scotia, brought a suit for the performance of an alleged verbal agreement by Mott to give him one-eighth of an interest of Mott's interest in the Dufferin gold mine, but failed to recover, as the court held the alleged agreement to be within the Statute of Frauds. On the hearing Mott swore that he had agreed to give Stuart one-eighth of the proceeds of the mine when sold, and after the sale Stuart brought another action for payment of such share of the proceeds. In an appeal to the Supreme Court of Canada judgment has been given in favor of Stuart, with costs, reversing the decision of the Supreme Court of Nova Scotia. In rendering judgment Mr. Justice Gywnne said: I am of opinion that this appeal should be allowed with costs, and that the judgment of the court of first instance in favor of plaintiff be restored. The only real defence to the action urged before us was that the plaintiff's cause of action was estopped and barred by a judgment rendered in favor of the defendant in a former action at suit of the plaintiff which, as was intended, operated as *res judicata* upon the matter of the present action; but concurring herein with the learned judge of first instance, I am of opinion that there is nothing in the former action which operates as a bar or estoppel in the present.

Tilley vs. Walker—Several years ago Mr. W. H. Walker, Ottawa, induced plaintiff to invest in his plumbago mine at Graphite City, near Buckingham, and there was an agreement by which Tilley was to furnish more capital if necessary. The plaintiff believing that he would be throwing his money away did not complete his engagement and Walker sued him. This suit was settled by Tilley forfeiting the greater portion of what he had put in and abandoning his claim against Walker. Walker on the other hand entered into an agreement whereby he acknowledged himself indebted to Tilley to the extent of $5,500, which he promised to pay in five years with interest at six per cent., giving Tilley a mortgage upon his mine, which, however, had been previously mortgaged to the extent of over $50,000. This was on the 12th January, 1892. In May last, having received nothing on account, although there was two year's interest overdue, Tilley entered the present action for $752.50, the amount of interest due at that time and also for $5,500 of principal, which was not due, but alleging that Walker was insolvent and the security worthless by reason of the prior mortgages, and that on this account the principal was now exigible. Walker contests the suit and claims that he has spent a great deal of money on the mine recently and that it is worth $300,000. The suit will be tried in Hull on or about the 20th inst.

The Bank of Ottawa (plaintiff in court below), appellant, and **A. Lomer** (defendant in court below), respondent in the Court of Queens Bench in appeal.

The appeal is from a judgment of the Court of Review which reversed a judgment of the Superior court. The judgment of the Superior court condemned the respondent to pay the bank appellant the sum of $911.56 being the amount of two sterling bills of exchange drawn by respondent upon the Kingston Phosphate company, and accepted by that company. The judgment of the Court of Review reversed this judgment and dismissed the appellant's action. The Bank of Ottawa, appellant, sued the respondent on two bills of exchange drawn by Lomer, Rohr & Co., on the Kingston Phosphate company. Appended to the signature of the drawers were the words "Mg. Agts." The appellant alleged in its declaration that the abreviation "Mg. Agts." stood for mining agents, and that the respondent bound himself personally as drawer of the bills. The contention of the respondent was that the abreviation "Mg. Agts" did not stand for "mining agents," but for "managing agents" viz., managing agents of the Kingston Phosphate company, on which the bills were drawn and by which they were accepted. The respondent pleaded that he did not sign the bills of exchange in his individual capacity and never intended to become personally liable upon them, but that he drew the bills in his representative capacity of managing agent of the Kingston Phosphate company, which alone was liable on the bills. The Court of Review, reversing the judgment of the Superior court, held that appellant was well aware of the meaning of the words "Mg. Agts." underneath the signature of the firm of Lomer Rohr & Co., and that it discounted the bills with full knowlege that the firm was only binding itself as agent of the company on which the bills were drawn.

Judgment was reserved.

Lauchlin Mclean vs. Dominion Coal Co., (Ltd.) Appeal to the Supreme Court of Nova Scotia. Plaintiff, a farmer, claims $2,014 damages for value of

property destroyed or damaged by a forest fire, which, it is claimed, originated on the defendant company's railway. At the trial in the court below the jury returned a verdict for the plaintiff, but the judge, (Townsend) ordered judgment to be entered in favor of the company, for the reason that the burning of the brushwood that occasioned the fire, was done by a contractor of the company, whom he considered liable. A similar appeal by another farmer named John McDonald, who sustained loss on the same occasion is also down for hearing in the same court.

Phosphate Milling Co. vs Montreal Warehousing Co.—At the Superior court, Montreal the defendants moved for leave to re-open their enquete. The court was of opinion that they had not shown proper diligence; the enquete had previously been re-opened by their request and closed. Motion dismissed.

The Canadian Copper Co's Suits—J. B. McMullen and G. B. McMullen, vs. S. J. Ritchie. Judgment in this celebrated case has been given in the United States Circuit Court as follows:

"In January, 1886, Samuel J. Ritchie contracted to purchase from James B. McMullen and George W. McMullen, the plaintiffs, 210 first mortgage bonds of the Central Ontario Railway Co. Ritchie was to pay them $210,000 cash and $40,000 in stock of the Canadian Copper Co. The delivery of the bonds and coupons and the payment of the consideration were to be simultaneous. Ritchie failed to make such payment and was sued in the Canadian Court for breach of contract. Judgment was rendered against him in February, 1888, for the sum of $238,000. Afterwards suit was brought on the judgment in the United States court in the northern district of Ohio, in September, 1888. The result was that judgment was rendered at the November term, 1890, upon the Canadian judgment for $265,370. The case was taken upon a writ of error to the supreme court of the United States where it is still pending. Execution was issued from this court. The failure of Ritchie to set up the defence which he now by an amended cross bill seeks to arrest is fatal to his application. He seeks to attack the judgment, but shows no reason why he did not earlier acquire the same information upon which the attack is based. Mr. Ritchie was himself president of the railroad company at the time the bonds were issued and at the time the contract of 1886 was made and has continued to be president to a very late date. The McMullens had jointly with Ritchie been the owners of the road. It was his right to have examined those bonds and coupons and it is impossible for him to escape the charge of very gross negligence in this matter." The decree goes on at length into the debts of Ritchie to Judge Burke, Senator Payne and the Cornell estate. For the amounts due Judge Burke a decree was given. "There is a controversy as to the debt claimed to be due the Cornell estate on a note for $8,000," continues the decree. "The only controversy as to the indebtedness claimed by Senator Payne against Ritchie is as to a note for $6,000, dated in 1887, payable in three months after date. The note was worthless at the time it was executed, as the railway company had no means of payment and there was no practical way of coercing payment. Ritchie is entitled to have this note sold or collected and the proceeds applied to the payment of Senator Payne's debt. The other debts or claims of Senator Payne are allowed. The aggregate amount of compensation claimed by Mr. Ritchie for services of one kind or another for the running of one or both companies, exceeds $1,000,000." Judge Lurton held that when Ritchie was engaged in the matter for which he claims compensation he was officially connected with the companies and that neither company had by any resolution provided for any salary or compensation to any president or director. He says: "His services have been voluntarily rendered without expectation on his part that he would be paid for them. Lands were bought by Ritchie some times in his own name, and others in either of the copper companies. He gave his services with no expectation of compensation other than as the stocks owned by him would increase in value. He was a man of great ability, energy, and a towering ambition for great enterprises. As a promotor or boomer he seems to be unrivaled. His ambition was to make millions. He believed that these mines were of fabulous wealth. Difficulties did not seem to deter him, nor danger affright him. The company's caution in his judgment was timidity and cowardice. He appears to have been an overbearing and imperious man, and the court is not particularly impressed with the scruplousness of his methods or reliability as to details of fact. The conservatism of Messrs. Payne, Cornell and Burke was never a barrier to his exertions or an obstacle to his plans. To those ends he devoted himself with the zeal of a crusader. He had most exaggerated ideas as to the value of these properties."

The document then devotes some space to the discussion to Mrs. Ritchie's stock, the judge holding that a decree will be drawn, directing that the collaterals held by Mr. Cornell's executors, other than those belonging to Mr. Ritchie, be first sold and then the coupons levied upon by the McMullens to pay any further sum be next sold and if any surplus remains after satisfying the Cornell debt the McMullens will be entitled to such surplus, and if there be a deficiency enough of Mr. Ritchie's securities will be sold to make good such deficiency.

Summing up, Judge Lurton said that the McMullens will deliver the bonds and coupons sold to Ritchie and for which they have obtained judgment to Clerk Belford, who is oppointed special commissioner, and take his receipt. Each of the defendants will do the same. The commissioner will, after advertising, sell at public sale each lot of collaterals. The sales will in each case be for cash unless the council for all parties agree upon a different mode of sale. The sale is not to be made earlier than ninety days from date to give Ritchie an opportunity to pay off the several amounts due to complaintants Burke, Payne and Cornell and all the costs of the cause.

The claims of the different parties to the suit are set off by the court as follows: H. B. Payne, $600,000; Judge Burke, $230,000; Cornell estate, $200,000; McMullens, $270,000.

The Coolgardie Gold Fields—Rich, Perhaps, but Costly.

(From the Investors Review.)

Coolgardie! Who has not heard the name? Its praises have been sung incessantly of late, and by all the members of the band, from the Agent-General down to promoters, punters, and touts. The song has been ever the same—gold, gold, until the whole city is sick to death with the thing. It is impossible to take up a paper without one's eyes falling on further marvellous gold discoveries at Coolgardie, or at the Murchison or Yilgarn fields. Crowds are rushing here, crowds are rushing there; two or three men in as many days simply by a hand machine have obtained so many hundred ounces of gold; water has been found in plenty, and so forth. We quite expected all this, for preparations have been for some time in progress to introduce to the London market companies to work the gold fields of Western Australia, even down to the Agent-General hiring a shop window in Gracechurch street in order to display some samples of the metal. Gold has long been known to exist in Westralia, as it is now the fashion to call the colony, and since 1885 various fields have been "proclaimed;" but former attempts to "boom" the place were not successful, mining operations being too heavily handicapped by difficulties and cost of transit and the lack of water. Since that time the Government of Western Australia has expended some money on roads and railways and in making experiments for the storage of water. It also adopted the pretty sure way of getting the country developed by selling immense tracts of land to enterprising speculators for very little money, in spite of the known or suspected riches. We have no desire to disparage gold mining in Western Australia; but the public must be told the truth. Gold is there in large quantities, at and near the surface. Whether it takes the form of proper and well defined lodes which continue to any depth, has yet to be proved; but the extraordinary richness of the finds suggests that the lodes are "pockety," and not permanent. The country is little better than an arid desert, whereas timber will be largely wanted if any real mining is to be done. Railways are being slowly constructed, but are still many miles from the seat of operations. Of water there is none, beyond the sea water, between 100 and 200 miles away, though this, of course, can be condensed at considerable trouble and expense. Even the optimistic Agent-General admits that the lack of water is a very urgent question. "There is," he says, "a skeleton in every cupboard, and with them it is the question of water." The Government have spent a fair amount in water conservation, but the average yearly rainfall does not exceed twelve inches, and is immediately sucked in by the parched soil. Artesian wells are spoken of, but good authorities think little of the idea. The drawback to the industry is therefore plain enough—the great cost of working, and unfortunately it is "writ large." It is almost a repetition of the Queensland "boom" of some seven or eight years ago, when over two dozen companies were formed with an approximate capital of about 5 millions, of which four-fifths were taken by vendors and promoters. How many of these companies are still at work? All but very few have been wound up and the money lost. So it will be with these latest creations, and the public will have to use great caution in having anything to do with such traps. If the remaining companies to be brought out—and we understand that a great number of ventures are waiting to be issued—are not started upon a more solid basis, Coolgardie will stand no chance whatever. If it had ever stood much chance it would have been developed years ago. Shareholders are face to face with their usual privileges—reconstruction and calls, or the swift death of all their hopes.

The Status of the Nickel Industry.

(From the Engineering Magazine.)

The large increase in the production of nickel during the past few years is mainly due to the introduction of the metal into material designed for war purposes, the toughness of nickel-steel having been found of considerable value in the manufacture of objects which are to be subjected to sudden and excessive stresses. It has been found that steel alloyed with a small percentage of nickel (3 to 4 per cent.) possesses great tensile strength with a corresponding elastic limit. The percentage of nickel used in the alloy has a marked effect upon its physical characteristics, the advantage of steels containing a low percentage of nickel not being found in richer mixtures. For instance, a gun manufactured of steel carrying 27 per cent. nickel did not give satisfactory results, treatment after forging reducing its physical qualities below simple steel.

Up to the present time nickel-steel has met with an extended use only on the part of national governments, such being the inertia of custom that it has not been introduced openly into the arts and manufactures. This is partially due to expense attending its manufacture, partly to a conservative spirit which hesitates to employ a new material, engineers not caring to call for it in their specifications and manufacturers hesitating to advocate its introduction. It is very important for the nickel industry that this nickeliferous iron alloy should meet with a general introduction because in that case nickel would find a ready and ever increasing market. That such a desideratum can be reasonably looked forward to is foreshadowed in the opinion recently expressed by one of our best authorities on steel subjects who stated in a letter to the writer that the qualities of nickel-steel are simply marvellous and if properly pushed it should have a great future. On this account the future of the metal seems closely bound up with that of nickel-steel and the limited extent to which this material has already been employed has given the nickel industry a considerable stimulus, the remarkable results obtained from physical tests of this material affording much hope for its ultimate extended use. Although the results obtained in the cases of certain Harveyized plates recently submitted to the Government for testing purposes caused some doubts to be cast upon their effectiveness, still the many tests of a similar nature which preceded the ones referred to and which turned out successfully, and others which have subsequently been made, render it more than likely that in these particular cases failure cannot be charged up against the alloy. As is the case with every new industry, perfection has not been attained at once, and some failures must naturally be expected; but it has not been by any means demonstrated that the disasters which overtook the particular plates mentioned are to be ascribed to any inherent weakness in the nickel-steel itself. An accumulation of evidence obtained at Krupp's works in Germany, at the Ochata trials in Russia and at the many tests made at Indian Head and other places in this country and in France has been obtained, which goes to show conclusively that nickel-steel plates, when placed side by side with those of ordinary steel, and subjected to severe tests, are capable of withstanding greater punishment than the latter. As stated, this fact has been established upon American and foreign proving grounds again and again so as not to admit of any reasonable doubt remaining upon the subject. However our naval authorities were not satisfied with the resisting powers of nickel-steel plates but wished to carry the matter still further, and to provide for the new war vessels building a material of great surface hardness in addition to toughness so that the projectiles should be broken up on their surfaces, they still possessing the quality of not cracking. If in thus attempting to produce in ideal plate, one possessing the toughness of nickel-steel at the same time with an extremely hard outward surface, it has been found that further experience in the methods of manipulation is necessary before attaining perfection, it is hardly logical to ascribe a casual failure to any inherent weakness in the nickel-steel itself. When it is considered that the presence of 0·1 per cent. of carbon, more or less, in a plate constitutes the difference between a material which will resist cracking, or one which will fly to pieces under the impact of projectiles, the extreme caution necessary in proportioning the ingredients is apparent. Furthermore, the effects upon steel of the various processes of annealing, tempering, etc., are factors which demand serious consideration, especially in the case of heavy armor plate subjected to severe test shortly after manufacture.

Apart from the mechanical and chemical processes to which the plates are subjected, the incorporation of the nickel into the alloy during the process of manufacturing the steel may also have a considerable bearing upon the results produced. In France, which was the birth-place of nickel-steel, the method of incorporating the

nickel into the bath was for a time through the medium of ferro nickel. The material, which corresponds in a measure to the compound of iron and manganese known as ferro-manganese used extensively in the manufacture of steel, was prepared from ores of the two metals and subsequently introduced into the steel bath. This process of manufacturing nickel-steel is explained at length in the patent specifications of both Schneider and Marbeau, and has much to recommend it. It is only rational to assume that where two metals, iron and nickel, are already alloyed in the ferro nickel, the latter will become very evenly diffused through the steel bath when the ferro-nickel is introduced into it. At present the French manufacturers appear to have substituted metallic nickel in the place of ferro-nickel in manufacturing their nickel-steel; but in either case the nickel is introduced into the steel bath in the metallic form. In this country a different method has been employed by our nickel-steel makers —one which, when the object to be obtained is considered, does not commend itself either upon chemical or mechanical grounds. The nickel is introduced into the steel in the form of what is known as "commercial oxide," and the incorporation of a small amount (between 3 and 4 per cent.) of nickel, in the form of oxide, into a bath of steel so as to form a homogeneous alloy under the condition named is hardly to be expected. It is difficult to understand how the nickel can become evenly distributed throughout the bath, and if by chance the oxide should not be thoroughly reduced the cohesion of the whole mass is naturally weakened. A priori it would appear as though the European practice of incorporating the nickel in the metallic form were the one most likely to lead to uniform results, and the practice of using nickel in the form of oxide may account in some cases for the uneven results obtained over here. The production of alloy is not always an easy operation; but there are other metals forming component parts of alloys in common use, which possess essential characteristics so widely differing from each other that they are much more difficult to alloy than is the case with nickel and iron; yet practice and experience have overcome the difficulties at first encountered. Similarly happy results may be confidently expected in the case of nickel-steel when the manufacturers have gained the requisite experience, and probably occasion to refer to blow-holes or uneven distribution of the nickel will not then rise so often.

One point clearly established by experience with nickel-steel up to the present time is, that as far as applied to large castings the alloy has unquestionably come to stay, but to what extent it can be utilized for smaller articles remains yet to be proved. There appears to be no good reason why it should not eventually find general introduction wherever a tough steel of great tensile strength is required.

The non-corrodibility of nickel would seem to fit it especially for culinary utensils, and these have been placed upon the market for some time, manufactured both from solid nickel as well as combined iron and nickel plate, manufactured in the manner already mentioned. The method of welding nickel to iron and then rolling them both to plate, gives us a material possessing most of the desirable qualities of nickel without its excessive cost. Iron "plated" in this manner does not readily part with its nickel coating, as is so generally the case when it is plated by galvanic action.

Solid nickel coins have recently been issued by some of the European governments, and alloys of nickel and copper, the so-called "nickels" in common use, have long been in circulation in this country and elsewhere; but the uses to which metallic nickel is put to-day are comparatively few, and will probably remain so until improvements are introduced for reducing the metal out of its ores.

Engineering Instruments and their Calibration.—*Continued.*

generally be found that successive observations taken at the same pressures will not repeat themselves exactly. The lines will wander round about a mean position. If readings be taken first with rising, and then falling pressures, it will often be found that one of these will remain constant for successive repetitions, while the other varies owing to slight alterations in friction. Oftener, however, both will be found to vary together.

5. The atmospheric or zero line alters with alteration of temperature, and should therefore always be taken immediately after the diagram, time only being allowed for the complete escape of steam from the underside of the piston. This is naturally only important for measuring the absolute pressure of steam at any point of the diagram, and will not affect the mean pressure. If the atmospheric line be taken previously, the pressures above the atmosphere will all be too high. It is probable that this error is not so great in actual practice, where the spring has not so much time to fully acquire the temperature of the steam as in static calibration, where the steam is steadily applied for an appreciably longer time

The author finds that, for purposes of correction, all the foregoing errors may be summed up under two heads, viz., scale errors and backlash errors.

With regard to the former, the combined effect of rise of temperature and unavoidable inaccuracies in both spring and linkwork, is to alter the scale of the diagram so that the spring becomes of higher or lower scale than its nominal value. By plotting the errors of several cards taken at each of a number of successive pressures, an error curve may be drawn with a base line representing the successive pressures, and vertical ordinates representing errors. It can then be seen at a glance what the general character of the inaccuracies is. The curve generally approximates to a straight line, with larger or smaller undulations; and if a straight line be drawn through the mean values, it will usually be found to differ by less than 1 per cent. of the total pressure from any individual observation for a large portion of the range. In general, the actual observed errors will leave this line after a certain point, which will define the range beyond which the spring should not be taken. A spring which deviates widely from such a mean line should not be used where errors less than these deviations are important. A spring and indicator which show a less mean combined error than 2 to 3 per cent. is unusual. Many indicators, if taken beyond a 1¼ inch range of diagram, exceed 10 per cent. errors from their true reading. These occur in both a positive and a negative direction. By the means of this correction line the true scale of spring in the given indicator can be determined. If observations be taken on both rising and falling pressures, two sets of readings will be obtained, one up, the other down. A second mean line will then have to be drawn, and the difference between the two will represent backlash errors.

In all such calibration, pistons, linkwork, and all moving parts must be oiled at frequent intervals, as would be done in practical use. Dryness or foulness of piston, etc., will, of course, largely modify the backlash. Under static tests, or with the steady and slow rise and fall of pressure which are necessary for the accurate determination of the pressure, it is probable that the maximum difference between the rising and falling position of the piston will be shown. In actual use, with the rapid alternations of pressure and quickly moving pistons and parts which then take place, it is probable that backlash may, to some extent, be reduced. On the other hand, any undue pressure upon the pencil point would very largely increase this effect. In some experiments made on this point, the author found that with engines running at a constant speed and doing constant work, by modifying the pressure on the pencil the diagram was altered in precisely the direction one would anticipate. The effect of backlash upon an indicator diagram would be to make too low an admission line too high an expansion curve and too high an exhaust line, as long as it remains straight or drops. If any drop in the admission line, or rise in the exhaust line, occurs, this effect would be reversed. This is precisely what the author found in the cases referred to. With straight admission and exhaust lines, increase of pressure on the pencil produced lower admission line, higher expansion line, and slightly higher exhaust. This indicates a method by which backlash can be approximately corrected for. Under the above conditions it will generally only be necessary to correct the admission line, as the expansion and exhaust lines erring in the same direction, the mean distance between them will be practically unaltered by backlash. Where the admission line falls, or the exhaust line rises, instead of being straight, it is the exhaust line which will require correction. This correction, of course, involves some trouble where a large number of cards have to be measured, and if backlash could only be avoided, or reduced to negligible dimensions, the simple correction for scale would alone be required.

An indicator has recently been introduced in this country which seems to promise great possibilities in this direction. It has a rotary in place of a reciprocating piston, and there being no linkwork of any kind between pencil point and spring, there is little opportunity for backlash. The friction between piston and cylinder has been reduced to a minimum. If the spring is initially adjusted out of the centre line, side pressure, and therefore friction, is caused upon the journals, increasing as the pressure rises, and there is some backlash. With the springs properly adjusted, however, the backlash is remarkably small. In the Crosby and Tabor instruments the springs are attached to the pistons by ball and socket joints, so as to allow them to adjust themselves if any slight deviation of the spring pressure should occur. But the danger of vertical play prevents sufficient slackness in this joint to render it always effectual.

It is curious that one of the indicators which the author tested, and which gave the most consistent results, had a spring from which the ball had accidentally become unfixed, though fitting it perfectly and sliding upon it without perceptible play. This seems to indicate that if this ball and socket joint could be made effectual, some of the irregularities due to piston friction would disappear. The backlash due to the linkwork was still present, however.

In conclusion, the author hopes that, in pointing out the possible values of indicator errors, he may in no sense be deemed to depreciate their value. A clear idea of what these errors are, and how they can be avoided and allowed for, must only tend to increased confidence in the indicator as a scientific instrument. If in any degree this paper has helped to attain that result, it will have accomplished the object the author had in view.

AUTUMN MEETING

OF THE

Mining Society of Nova Scotia.

Federation endorsed provisionally after a long and lively debate.
The July papers discussed.

The Autumn meeting of the Mining Society of Nova Scotia was held at Halifax on Tuesday 6th instant. The attendance was not large but the proceedings were lively. There were present:

Mr. John Hardman, S. B., Halifax, *President.*
Mr. H. S. Poole M. A., A. R. S. M., Stellarton, *Past President.*
Mr. C. Fergie M. E. Drummond Colliery, Westville.
Mr. W. R. Thomas, F. G. S., Montague.
Mr. J. H. Austen, Halifax.
Mr. B. F. Pearson, Halifax.
Mr. W. G. Matheson, New Glasgow.
Mr. Chas. Archibald, Halifax.
Mr. G. F. Boak, Halifax.
Mr. A. A. Hayward, South Uniacke.
Mr. C. E. Willis, Halifax.
Mr. J. D. Sword, Halifax.
Dr. E. Gilpin, Inspector and Deputy Commissioner of Mines.
Dr. Murphy, Halifax.
Mr. C. F. Andrews, Country Harbor.
Mr. R. G. Leckie, M. E., Londonderry.
Mr. M. R. Morrow, Halifax.
Mr. Alex. Dick, C. and M. E., Halifax,

and Messrs W. H. Smith, J. E. Leckie and Mr. H. M. Wylde, secretary.

After the minutes of the July meeting had been read and adopted the following were elected:

NEW MEMBERS.

Mr. A. N. Whitman. Mr. J. G. Leckie. Mr. J. D. Sword.

FEDERATION.

THE CHAIRMAN—We have to go back as far as the March meeting on this matter, the whole question was referred to a committee consisting of Messrs Poole, Willis and the President and the Secretary. That committee formulated a scheme which was sent on to the Quebec Association, was amended by them and reported back at the Sydney meeting. The report is as follows:

"In the matter of Federation of existing mining societies or associations, it was agreed:—

(1) That in so far as the subsequent paragraphs are concerned, it is deemed desirable that all existing mining associations or societies in Canada should be invited to join;

(2) That all members of such organizations should become, ex-officio, members of the proposed "Canadian Mining Institute."

(3) That each organization should pay annually to the funds of the Canadian Mining Institute a sum per head of its membership to be hereafter agreed upon.

(4) That the first and main raison de être of the Cananian Mining Institute should be the printing and publishing in one volume under one editing, of all the transactions of each of such organizations, thereby relieving the local organizations of this matter and expense entirely; the expense being met by the per capita contribution to the funds of the Canadian Mining Institute.

(5) That it is not desirable to have, or attempt to have, any large body of officials for the Canadian Mining Institute, but rather that such business as may arise should be transacted by a small body or committee to be composed either

(*a*) of the several Secretaries to the local organizations, or

(*b*) of one specially elected delegate, or

(*c*) of a specially elected delegation, based on one member per so many members, for each local organization.

(6) That the committee, or governing body, so constituted should appoint or elect one individual to act as Secretary-Treasurer—Editor of the Canadian Mining Institute.

(7) That each local organization preserve, to the utmost extent, its autonomy and individuality.

The report came before the Council of the Society and was indorsed by it before transmitting it to the Quebec Association. This is the first time it comes before this Society as a whole, and I will have to ask for your verdict on this report.

On motion the report was recieved and adopted.

THE CHAIRMAN—The next step is to read what action has been taken by the other associations. Ontario and Quebec have each appointed a committee, which committees have drawn up two schemes practically identical. The first is from the Ontario Mining Institute and is endorsed by their full committee. (Scheme as outlined read.) The second one is from the General Mining Association of Quebec and is signed by three of the four members of the committee, the fourth member while endorsing it as a whole has forwarded a letter which, perhaps, will be better read after the schemes have come before the meeting. The scheme is substantially as follows: (Scheme as outlined read.) I think these reports sent by the Ontario and Quebec Societies are properly before the meeting for discussion.

MR. THOMAS—Are these outside members to be represented on the Board?

THE CHAIRMAN—No. In that connection I will read the criticisms of Mr. L. A. Klein in a letter to the Secretary of the Quebec Association:

"On the whole I approve of it for the purpose as a starter—there are, of course, a good many things which I wished to have discussed at a full meeting of all the delegates.

(Par. 4, sec. 5.) While it may be a good thing to enable any one to become a member of the Federation *without* being a member of any Society, in federation, I don't see where such members are going to have any representation from, *i. e.*, the Governing Board or Council; further,

(Sec. 6, par. 5.) I am not in favor of this method of representation in Council, as it places all the larger and more important societies in a disadvantage, being eventually out-voted by smaller organizations and such that have become members *after* federation. I would much more favor a "de capita" representation, but knowing there is a vast difference in the subscription fees (and therefore quite possible to acquire a large membership with a small fee) I would wish to have the representation in council based on the annual subscription list of each society *pro rata*. The idea may strike you strange, but we will have to deal with this subscription list anyhow in some measure or another, viz. (Par. 6, Sec. 12) re annual subscription of each society, which could not possibly be the same amount in each and every case. I would suggest that the council should consist of the Presidents (which would give a representation of any society in any case) and one member "*for every*, say $250 or $300, *Annual Subscription*," to be elected annually by each such society. The subscription list of the previous years to be governing.

(Sec. 7.) Is the Secretary-Treasurer to be elected from the delegates or from the members of any of the societies? I would suggest the latter.

It seems to me also that we touched a number of points at the Meeting in Sherbrooke which are worth while considering and I trust you will bring the matter before the Nova Scotia members so that we may be enabled to federate under conditions approved by all."

MR. THOMAS—I take it that the object of the amalgamation is to publish the proceedings at a cheaper rate. Therefore I was surprised that there should be outside members at all.

THE CHAIRMAN—I think Mr. Thomas' idea is the one most of us have. The men who might wish to come in as outside members are persons not directly interested in mining in any of our provinces but are interested in it as a whole.

MR. THOMAS—If a lot of such men were to come in they might have a representation on the Council and thus injure our standing as a society.

MR. STUART—I think we should insist that the men who would join this Institute should join it as members of one of the original societies.

MR. THOMAS—In our Committee's first report something was said about electing the Council according to the numerical standing of the Societies. Now we have one member from each. I understood that the Ontario Institute had not been formed when we were in Sydney.

THE CHAIRMAN—The Ontario Mining Institute was formed in April and is a thoroughly representative organization of the mining interests of that Province; its annual subscription is I believe two dollars. The General Mining Association of Quebec is composed almost entirely of owners or men engaged in the management of mines and the fee is $10.00, the same as ours.

MR. WILLIS—It looks as if all this business will be done by one man, the Secretary elected by the six members of the Council. There might be a man whom the members of the other two Societies might wish to elect who would be offensive to the people down here. We would have only two members to their four. If it ever came to a vote they would always combine against us. They have a much larger membership.

THE CHAIRMAN—There are always chances to make combines.

MR. WILLIS—I think the Secretary of this Federation should be elected by a vote of the different Societies.

MR. GUE—The same majority would be against you with the larger number. I am in favor of the original scheme, federation for the purpose of publication of transactions.

THE CHAIRMAN—The scheme before the meeting is the very one you mention.

MR. WILLIS—My objection is to the manner of electing the Secretary. I object to that part which says that the Secretary shall be elected by the Council.

MR. GUE—Why do we want a Council and Secretary for the editing of the joint report?

THE CHAIRMAN—The object of this scheme is economy. It costs us about $500.00 to publish our proceedings. The scheme is, that by the payment of one-third of that amount we get the same thing and in addition the papers published by the other two Societies. This programme is open for amendment. We can reject it, or we can send them a substitute, or we can reject it altogether and stand on our own footing.

MR. ARCHIBALD—I think the simplest way out would be to give us the simple object of this federation. There seems to be a suspicion that this Council can do us an injury in some way or other, or call upon us to pay more money. If the object of the Society is simply as you specified, to have the reports issued cheaper than before, I do not see that I have any objection to it.

MR. THOMAS—I don't see that it is necessary to have a Council in this affair at all.

THE CHAIRMAN—I think a few figures will show the reason. This Society with a membership of eighty or ninety purchases two hundred volumes of its transactions. Five hundred copies of the transactions would cost little more than the same amount. Putting the membership of the Quebec Society at one hundred and twenty and Ontario at one hundred there would be about three hundred altogether.

THE SECRETARY—Our printing has been done at Ottawa. The printing here is slightly cheaper, but we have to have the plates done in Montreal and Toronto.

Mr. FERGIE—I would suggest that the representation for Council be one for every forty members, following the precedent of the English Federation. I move this as an amendment.

MR. POOLE—I second it.

MR. THOMAS—The words "affairs and business" should be better defined. Why not make the Secretary responsible to the Council of each Society.

THE CHAIRMAN—You would find that more difficult than to make him responsible to one body.

MR. HAYWARD—I fail to see why it is necessary to appoint a Council to transact a matter of one hundred and fifty dollars a year.

THE CHAIRMAN—The Council will have the control of more than four hundred and fifty dollars a year. There is another object in view also. The Royal Society of Canada, as I am informed, gets a grant from the Dominion Government of about $10,000 a year, which sum is almost entirely devoted to the publishing of their transactions. If our federation goes through we shall apply to get a grant from the Dominion Government which will help to pay for the publication of our proceedings.

MR. THOMAS—Why not say what the object of the federation is?

MR. POOLE—Let us first have it established that it is the desire of this body to form a Federated Institute and then consider the details of the organization section by section. We will make better progress in that way.

THE CHAIRMAN—I would like to point out that at the united meeting in Cape Breton it was passed unanimously that we do federate. Mr. Wylde made the motion.

MR. WYLDE—When that motion mas made, the question of federation simply for the sake of economy in publishing the transactions, was under discussion. Any objects other than this have been brought up since that resolution was passed.

THE CHAIRMAN—At the suggestion of our Past President, unless there is objection, having agreed to federate, we will proceed to discuss this scheme paragraph by paragraph. The two schemes of the Quebec and Ontario Associations are practically the same, where they differ I will read each.

MR. HAYWARD—I move that the proceedings taken in Cape Breton be reconsidered.

THE CHAIRMAN—I cannot entertain that, as that was a united meeting and we cannot deal with what was done there.

(Mr. Hayward appealed to the meeting, but the Chairman was sustained.)

MR. PEARSON—I must confess to considerable ignorance on the subject. As it appears to me, a decision was arrived at by the united meeting at Cape Breton to amalgamate, the object being the joint publication of the proceenings of the Societies. If that was defined distinctly then it is only a question of the machinery necessary to carry that out. Is there any clause of the constitution by which the object is limited to that particular thing. I would say it would seem to be a pity that the object should be limited.

THE CHAIRMAN—Mr. Pearson has stated the facts as they are. It does define the objects, viz:—

(*a*) The publication in one volume of the papers and proceedings of the several organizatians in the federation.

(*b*) Action upon all matters affecting or relating to the mineral industries of Canada.

These objects can be extended with advantage.

As to the first paragraph, the name. Ontario suggests "Mining Institute of Canada," Quebec, "Canadian Mining Institute."

MR. PEARSON—I would move that this Society approve of the name "Mining Institute of Canada."

MR. POOLE—I second that, because we will use the expression "The Mining Institute" in conversation.

The motion passed.

Paragraph 2 was then read and the first part down to "(*b*)" adopted.

MR. WILLIS—I move that sub-section (*b*) "Action upon all matters affecting o relating to the mineral industries of Canada" be struck out.

MR. HAYWARD—I second the motion.

MR. POOLE, seconded by Mr. Fergie, moved that it be retained.

MR. WILLIS—The report of the first committee limited the object of this federation to the publication of the reports. Now this is added on to that, I am not in favor of federation for any other purpose.

MR. POOLE—It is desirable that there should be some organization with a Dominion character. I would not like to see the Mining Society of Nova Scotia become of secondary importance, and I do not see how it can under this new formation. I think giving it a Dominiun character would add dignity to it in the eyes of the public. We have allowed the mining business to be run by the politicians alone; now we all want to have a say in mining matters.

MR. PEARSON—As I understand it the proposition is to create a council and clothe it with powers to do something as representative of all the Societies of Canada. It commends itself to my mind that that council should have some functions besides editing minutes, functions by which it could talk in the name of the Mining Societies of Canada. Limit them entirely to the mining interests in Dominion matters. The Dominion Government control the duties on coal coming into Canada. They may negotiate reciprocity treaties. The societies at the two ends of the country should have some central institution which could speak for them. The jurisdiction should, however, be limited to matters of general Canadian interest. I would move that that clause be not passed upon now, but that it be sent to a committee to consider what limitations be put in it. It seems to me that it is very desirable to have an additional clause to the one passed, but it might be well to limit the jurisdiction of the council to some class of subjects distinctly Canadian.

MR. THOMAS—I second that motion.

Messrs. Willis and Poole withdraw their motions.

THE CHAIRMAN—Mr Perrson's motion is as follows "Resolved that section (b) be not now considered, but that the same be referred to a committee to report at once whether any limitations are desirable to said clause, and if so, what."

The motion passed and the following gentlemen were appointed the committee: *Messrs Pearson, Dick, Archibald, Gilpin and Willis.*

The committee withdrew to draw up a report.

Paragraph 3, comprising sections 3 and 4 was then passed.

THE CHAIRMAN—The next paragraph relates to ordinary members and is as follows: "Any gentleman interested in the Canadian mining industry who may not be a member of the societies in the federation is eligible for election as an ordinary member.

Ordinary members shall be elected by council and will pay an annual subscription of ten dollars."

MR. STUART—I should decidedly object to that clause. Any member should be required to obtain his membership through one or the other of the existing societies. I move that it be struck out.

MR. WYLDE—I second the motion.

MR. MORROW—There might be mining men in New Brunswick who would like to obtain the Journal, and it might not be convenient for them to join either one of the societies.

MR. WYLDE—They are eligible to ours now, and it would not cost them more, and they would get greater privileges.

The motion was then put and passed.

THE CHAIRMAN—Paragraph 5 is as follows: "The affairs and business of the Institute shall be managed and controlled by a Council consisting of the Presidents of the socities in the Federation and one member to be elected annually by each society. The Council shall elect a Chairman and a Secretary-Treasurer each year."

MR. POOLE—I move that the different societies have one representative for every forty of its members in addition to the President of the society.

MR. FERGIE—I second the motion.

MR. GUE—I fail to see why we should care whether they have the control or not. If the object is merely to publish the reports in combined form, we need not care whether they have four thousand members.

THE CHAIRMAN—As a matter of fact the Society is not committed yet to federation. We say we are willing to federate if the scheme commends itself to us in its details. In connection with representation, the Ontario society is not on the same par with Quebec. The members of the Ontario society only pay two dollars per year. Mr. Klein proposes, therefore, that the representation be based on so much annual subscription. On the basis of per capita representation they would have two members and a half. On the basis of money representation they would only have one member.

MR. POOLE—The vote could be to some extent controlled by providing that all members having votes respecting the constitution and by-laws should pay an equal fee.

THE CHAIRMAN—Mr. Chas. Archibald the chairman of the committee appointed to revise sub-section (b) of the second paragraph, presents the following report: "Your committee having considered the construction of clause (b) beg to report that the same be adopted with the following proviso added thereto, viz—'Provided that nothing in this clause shall be construed as conferring jurisdiction or power to act with reference to any matter or thing affecting the said mineral industries or any of them unless thereto requested by a majority of the members of one or more of the societies associated in such federation."

The report was on motion adopted.

THE CHAIRMAN—(reading paragraph 5 section 6.) There is a motion to amend that so that it will read—"The Presidents and one member for every forty members of each society."

MR. POOLE—It was found necessary when the federation was made in England that there should be some uniform lines in order to put members on an equal footing, and the fees were made identical. Ontario should raise the membership fee to $10.00

MR. WILLIS—How would it be if there were ninety or one hundred members. Would there be one representative for the members over the eighty?

THE CHAIRMAN—I would suggest this view might be met by altering the amendment to "every forty members and fraction thereof."

MR. AUSTEN—The thought has struck me when I heard Mr. Poole suggesting that the Ontario society should be asked to raise their fees to $10.00 that they could say to us "We find that two dollars is full and sufficient to pay all the bills we propse to contract". I dont know whether it is correct for one society to ask another to raise its fee to $10.00 because it finds a $10.00 fee to be just sufficient. I would suggest that the President and one from each society be the Council and do whatever little business is to be done, then the Nova Scotia Society would have equal representation with any other. I think the paragraph reads fairly at present.

MR. WILLIS—I will incorporate my motion with that of Mr. Poole.

THE CHAIRMAN—The following is the amendment proposed by Mr. Poole, seconded by Mr. Fergie "and one member for every forty full members of each federated society and fraction thereof."

"The qualification for full membership as specified above shall be an annual fee of ten dollars."

"*Nothing in this clause shall prevent the various Societies from having other* classes of members paying other rates or fees." This amendment passed.

THE CHAIRMAN—The next paragraph reads "The Council shall elect a Chairman and a Secretary Treasurer each year."

MR. WILLIS—I beg to move the following in amendment:—

That the Council elect a Chairman each year, and that the office of Secretary-Treasurer shall be an honorary one, and that this officer shall be elected by the individual votes of the members of each of the Societies in the Federation. This was seconded by Mr. Hayward and carried.

MR. POOLE—I move that the following words in Section 8 "shall be appointed by, and his salary if any, shall be determined by the Council" be struck out, and the rest of the clause retained.

This was seconded by Mr. Andrews and passed.

Sections 9 and 10 were then, on motion, passed.

THE CHAIRMAN—Section 11 reads as follows: "The accounts of the Treasurer and the financial statement for the year shall be audited by two members of the Institute. The auditors shall be elected at the Annual General Meeting."

MR. STUART—I would suggest that the auditors be one from each Society.

THE CHAIRMAN—I take it that the accounts shall be audited at the annual general meeting, and the auditors would be elected then.

The clause passed.

THE CHAIRMAN—The next section, 12, provides for an annual subscription not to exceed $150.00.

MR. POOLE—I don't like the last part. If the papers are illustrated they could not be got out for that. I prefer a per capita tax. I move that that clause be amended to read "not to exceed $3.00 per capita" in lieu of $150.00.

This motion was seconded by Mr. Stuart and passed.

Section 13 was struck out as the subject matter was embraced in a previous amendment.

THE CHAIRMAN—The next section provides for the Annual General Meeting to be held each year in the month of July at such time and place as the Council may determine.

The clause passed.

Paragraph 8, respecting publications was then read.

MR. POOLE—I would not allow the Council the privilege of distributing free copies. I would allow a certain number also to the authors.

MR. DICK—There is no provision for exchanges. I move that one copy be allowed to each member, twenty to the authors, and that the balance be sold by the Council.

This motion was seconded by Mr. Austen and passed.

MR. MATHESON—In regard to exchanges I move that the following be incorporated with the 15th section,—"That copies of the Transactions sent for exchange shall be accompanied with a request for a copy of such exchange for each Society in the Federation." Seconded by Mr. Fergie, and passed.

Section 16 was also approved.

THE CHAIRMAN—The last section reads:—"The Council may accept communications from persons who are not members of the Institute and allow them to be published." We may desire to have papers from members of the Geological Survey, or from members of McGill and other Universities. It is simply a permissory clause. The clause passed.

MR. POOLE—I move that the scheme as amended be forwarded by the Secretary to the two other Societies as the basis upon which the Mining Society of Nova Scotia will enter the federation.

MR. WILSON—I second the motion. Passed.

COMMITTEE ON MINING LEGISLATION.

MR. B. C. WILSON—seconded by Mr. Willis moved the following:—

"*Resolved that the President is hereby empowered to nominate a committee of* five members of this Society to take into consideration legislation affecting the mining industry of this province and to secure such modifications and changes therein as may be desirable in the best interests of such industry." Passed.

The Chairman thereupon nominated the following committee:—Messrs. Poole, Drysdale, Stuart, Pearson and B. C. Wilson.

(To be Continued.)

Gold Milling—The Vibration of Stamp-Stems.*

Philip Argall, Denver, Col. (communication to the Secretary): Dr Raymond claims (*Trans.* xxiii., 560), that my statement (p, 559) regarding the crystallization of iron "is beyond question incorrect." He says: "It is not even settled that vibation will crystallize iron under any conditions." While admitting that authorities differ on the possibility of cold crystallization of iron, I believe it is a settled and undisputed fact that vibration in the presence of heat will crystallize iron. Bloxam and Huntington say: (1) "Vibration assists in converting fibrous material (iron) back into a crystalline state when heated, a lower temperature sufficing than in the absence of vibration." Mr. A. F. Hill, (2) summing up a very exhaustive review upon the crystallization of iron and steel, pronounces against crystallization, but only at temperature below 900° F. Mr. Howe, (3) discussing the breakage of a 20 foot porter bar with a crystalline fracture, suggests that it was attributable to heat, jointly with the jar. We see, then, that vibration of heated iron bars will induce crystallization and consequent change of structure.

Referring to my statement, I wish to point out, that I was discussing the vibration of stamps and should have said, "vibration under all *such* conditions," etc. That is, vibration attended with sharp blows, such as a stamp-stem is subjected to, will crystallize iron; yet I believe that intense vibration under any condition will eventually crystallize iron. It is only a function of time, a very long time, perhaps, when the vibration is unaccompanied by shocks or blows.

I an not aware that any law of modern physics, or of the molecular theory of matter, would be violated by the assumed rearrangements of molecules in a viscous solid, such as iron, at ordinary temperatures. We must admit that the molecules are in motion, and that any force capable of increasing the amplitude of their vibrations may induce a change of structure. What is electrolysis but the direction, by means of an electric current, of the movement of molecules in the electrolyte to form new bodies? We have seen that vibration of hot iron bars induces crystallization at temperatures far below plasticity; so that it can be understood, that at ordinary temperatures, where the molecular motion is comparatively slow, the vibration must either be intense or long continued, in order to cause crystallization. Dr. Barus (4) has shown that "the chemical equilibrium of a solid changes with each change of strain." Osmond (5) claims that strain more or less completely converts cold metals from one definite molecular condition to another. Warbug and Ewing (5) have proved that hysteresis is not only associated with mechanical stress but may also be induced by magnetic stress, while the experiments of Rowland and Bell (5) prove that magnetic iron is more electronegative than unmagnetic iron. From which Barus infers that this pheonmenon is to be interpreted as directly evidencing "a chemical difference between magnetic and unmagnetic iron."

It has also been proven by Dr. Barus (6) that, "even at temperatures slightly above mean atmospheric, the molecular configuration of glass-hard steel is always in a state of incipient change." He says:

"During the last three years I have been making experiments on the secular annealing of cold hard steel. The results are very striking, and show that mean atmospheric temperature acting on freshly quenched steel for a period of years produces a diminution of hardness nearly equal to that of 100° C. actin for a period of hours. I examined some twenty rods, the specific resistence of which, within thirty-seven months, has fallen from 46.5 to 42.5 in the case of thin rods (diameter 0.08 c.m.) and from 43.7 to 35.4 in the case of thicker rods (diameter 0.13 c.m.)."

It is true that these quotations do not support a crystallization theory for iron but they do prove that the molecular structure of iron can and does change under different physical conditions and at atmospheric temperatures. This conceded, the possibility of cold crystallization of iron becomes apparent, the "current fable" and the "myth" to the contrary notwithstanding.

Apart from the abstract theory, however, we have practical experience on the one hand and two sets of theorists on the other, from which conclusions may be drawn.

The cold crystallization of iron is a subject that has long been agitated and never satisfactorily settled. It is true, some eminent authorities have at various times settled the matter to their own satisfaction, but good, fibrous iron will continue to break with

* A continuation of the discussion arising in connection with Mr. Rickard's paper on "The Limitations of the Cold Stamp-Mill," Trans. American Institute of Mining Engineers, Bridgeport meeting, October, 1894.

a crystalline structure, in stamp-stems, for instance; and practical men cannot accept the dogmatic assertions of the theorist as evidence against their own observation and daily experience.

In 1866, Kirkaldy (7) settled the matter to his satisfaction, and published his sixty-six conclusions on iron. Of these, No. 18 bears more directly on crystallization. Said Kirkaldy:

"Iron, when fractured suddenly, presents invariably a crystalline appearance; when fractured slowly, its appearance is invariably fibrous."

The crystalline appearance here referred to is very different from that of iron crystallized by the vibration and sharp shocks to which a stamp-stem finally succumbs. In the first case the fibres are not given time to stretch, but are broken off at right angles to their longer axis, whence the apparent fine crystallization; while, in the latter case, actual crystals are developed in the iron, some reaching as much as 0.25 inches in diameter. It is with this latter phenomenon we have to deal in stamp-mills.

Fairbairn (8) has said: "We know that in some cases wrought-iron, subjected to continuous vibration, assumes a crystalline structure." Greenwood (9) tells us that "continued hammering of iron in the cold state induces hardness and brittleness, with a more or less crystalline structure in the iron."

It must be admitted that stamp-stems invariably break with such a structure. Again, it is generally admitted that railway axles are, on the whole, inclined to break with a crystalline fracture. The fracrure of the 5-inch connecting-bar of the Washington Navy Yard testing-machine was considered by Beardslee "an unmistakable instance of crystallization."

Rankin (10) sums up his conclusions as follows: "It is certain, at all events, that iron ought to be as little as possible exposed to sharp blows and rattling vibrations."

R. W. RAYMOND, New York City: The subject of Mr. Argall's reply to my former remarks is so important as to justify the most extended discussion. And I would not deny that, as a part of such discussion, the citation of authorities is pertinent and valuable, although the mere heaping up of contradictory statements and opinions is not likely to determine the truth, without such further sifting and weighing of the evidence as will show what may be taken as thus far reasonably proved.

I may be permitted to recall that the remark of Mr. Argall originally criticized by me was, that "vibration, under all conditions, will crystallize iron."(11) This I declared to be "beyond question, incorrect," adding, that "it is not even settled that vibration will crystallize iron under *any* conditions."(12) In the same connection, I observed that Mr. Rickard and Mr. Argall had "adopted a current fable, which may or may not have a basis in occasional and exceptional experience, but which owes its vitality chiefly to its availability as an excuse to shield manufacturers from the blame deserved for bad work."

Mr. Austin (13) presented, in opposition to my view, some considerations to which I have already replied. I wish to recall here only the fact that I disclaimed any narrow sense of the term "crystallize," and accepted, as the subject really under discussion, the question, whether there is really a molecular change produced by vibration in iron or steel.

Mr. Argall now restates his original proposition so as to confine it to such vibration as takes place in the stem of a stamp. I accept this modification also, although I may be permitted to point out that it greatly narrows the field of inquiry originally suggested by him, and excludes most of his evidence and reasoning, as well as some of mine. It is now quite possible for him to say, that an experiment, in which prolonged vibration had no effect upon a piece of iron, is not conclusive, because the vibration was not like that of a stamp-stem in a battery. But I conceive, on the other hand, that it devolves upon him to show the difference, or else to abandon the argument from theory and analogy, and to confine himself to experimental proofs drawn from stamp-stems exclusively.

But Mr. Argall cannot be permitted to state this question as one with regard to which practical men are arrayed on his side and theorists on the other. That is a ludicrous reversal of the situation. The wildest theorists are notoriously so-called "practical" men, when they once let themselves loose in the field of speculation; and in this case the so-called "practical" men are the only ones who have set up any theory at all. The fracture of a stamp-stem is a fact; the notion that it is due to a molecular change caused by vibration is a theory. Nobody denies that this is conceivably a true theory; but a good many observers have been led to doubt it, because there is not a single clear experimental proof of it, and because attempts to prove it by careful experiment have proved the contrary, so far as they have had any definite result whatever. It is quite out of place for the defenders of the theory to characterize as dogmatic theorists those who have no theory at all, but are simply asking for the facts.

Dr. John Percy said in 1864: (14)

"Another point remains to be considered, namely, whether vibration caused by impact, or otherwise, may induce a crystalline arrangement which did not previously exist, or was only imperfectly developed. I have not met with any evidence to justifiy an answer in the affirmative."

This is not abstract theory but practical common sense, as is also the observation which follows:

"Neglect in observing the essential connection betwen the character of the fracture and the particular mode in which it has been effected, has led to the conclusion that the crystallization of iron has originated from mechanical treatment, when, in reality, crystalline structure pre-existed, and was only rendered easily manifest by fracture consequent on induced brittleness." (15)

This declaration of Percy's represents correctly, I think, the conclusion to which any competent observer, critically examining the evidence accessible in 1864, would have been led. That the situation has not been changed in favor of the vibration-theory by any subsequent evidence, will appear in the following passage, translated from the hand book of Prof. A. Ledebur, (16) who may fairly be called the highest, as well as the latest, authority on iron and steel:

"The observation has been often reported, particularly in former times, that iron exposed to continuous shocks, as in railway-axles, crane-chains, etc., suffered a loss of strength and toughness as the result of a change in its structure; especially, that fibrous tough iron was in this way gradually altered to granular brittle iron and that in this process could be found the cause of the occurrence of fracture in pieces which had served their purpose for decades without breaking. According to this view, continued shocks (*anhaltende Erschütterungen*) would produce the same effect as .....heating wrought-iron nearly to melting-point and gradually cooling it.

"This supposed observation received a seeming confirmation from the law announced by Wohler, in 1870 (17) as the result of thorough experiments, according to which the fracture of a body might be brought about by numerous repeated strains, no one of which reached the breaking limit. Later experiments (18) have shown that fracture is not induced, even by an unlimited number of strains, if a certain limit of strain is not exceeded.

"But the opinion that a fracture caused by repeated strains is the result of a change in structure, and particularly that fibrous wrought-iron is transformed into granular under continuous shocks, has proved to be entirely erroneous (*vollstandig irrig*). On page 642 the circumstance has been pointed out that the appearance of the fracture of fibrous iron is dependent upon the manner of the breaking, and that fibrous iron shows a complete coarsely-granular fracture when suddenly broken by a heavy blow. Such a shock is usually the cause of the fractures in which it has been believed that the transformation of fibrous into granular iron was observed.

"Bauschinger, in 1878, took links from a chain bridge erected in 1829 at Hamburg, and subjected in service to continual shocks (*Erschutterungen*), and compared them with similar links of the same material, which had remained in stock unused. (Here follows a table of tests.) The fracture of the broken pieces showed no change due to use; the pieces which had been in service showed to a large extent fibrous structure. (19)

"The wrought-iron bolts of a wooden railway-bridge on the Allgau road, having been tested for strength before use, showed, when tested again by Bauschinger after twenty-five years, no diminution in strength. (Here follow the figures.)

"Again, a comparative test made by Belelubsky, in 1888, between the links of the Kiew chain-bridge, which had been forty years in service, and the links of the same material which had remained in stock, indicated no change in these properties. All the test-pieces showed fibrous structure. (20)

"Numerous experiments instituted by Bauschinger in the mechanico-technical laboratory of the *Technische Hochschule*, at Munich, in which bars of iron and steel were submitted to repeated shocks, led him to the conclusion that 'strains of iron and steel repeated frequently, millions of times, bring about no change of structure.'"

The word *Erschutterungen*, which I have translated "shocks" in the foregoing extract, is a stronger term than *Schwingungen* (vibrations). It includes both shock and vibration, and exactly represents Mr. Argall's definition, "vibration attended with sharp blows." *Prof. Ledebur's conclusions are, therefore, directly contradictory* of Mr. Argall's view.

Mr. Argall replies to my statement that "it is not even settled that vibration will crystallize iron under any conditions," by asserting his belief that "it is a settled and undisputed fact that vibration in the presence of heat will crystallize iron." He is, of course, aware that I was speaking of cold metal only; and I do not care to be drawn away from the issue which he has himself taken pains to confine to the conditions obtaining in stamp-mills. Nevertheless I may venture to say that the authorities he cites do not warrant his sweeping conclusion: "We see, then, that vibration of heated bars will induce crystallization and consequent change of structure." The really "settled and undisputed fact" is that heat-treatment alone, without any vibration, will produce the change referred to, as Prof. Ledebur, in the passage I have quoted, incidently points out. All that has been suggested as to vibration is that it facilitates the work of heat. The essential agent must still be the heat, for the simple reason that heat alone will do the work, whereas vibration alone, so far as we can find out experimentally, will not. At the very best Mr. Argall's assertion that *heat and vibration* will produce a certain result, is no contradiction of my assertion that it is not settled that *vibration* will do it.

Moreover, there is no argument to be drawn by anology from the behavior of iron under special heat-treatment to its behavior at ordinary temperature and after complete solidification. The very term vibration means different things in the two cases. Shock is differently transmitted in a heated bar, and structure is unquestionably under incipient obliteration. Mr. Argall's statement, "We have seen that vibration of hot iron bars induces crystallization at temperatures far below plasticity," is not warranted, even in its vagueness. The only temperature he specifies is 900° F. (482° C), which is not "far below plasticity." This temperature is, in fact, almost exactly the point at which iron exhibits a remarkable and sudden change in physcal qualities, indicative of a weakening of structure. The tensile strength and elongation, as determined by Kollman (21) for the temperatures below and near this point are as follows:

Deg. C.	Tensile strength kilo. per sq. mm.	Elongation. per cent.
310	33.5	33.0
340.....	32.1	35.0
410.....	27.0	45.0
510.....	11.1	37.0

It will be seen that, between 410 and 510 degrees, the strength has diminished more than one-half, and the elongation has passed its maximum. In a word, what I suppose Mr. Argall means by "plasticity" has clearly set in.

Mr. Argall says that he is not aware that any law of physics or of the molecular theory of matter would be violated by the assumed rearrangement of molecules in a viscous solid, such as iron, at ordinary temperatures. For my part, I am not aware of such a fact either. If there were any known law thus violated, the assumption would, of course, have to give way to the law. But the arguments and citations by which Mr. Argall seeks (as I suppose, for I cannot conceive on what other ground he considers them pertinent) to render his assumption theoretically probable, fall far short of that effect; while the effect itself, if achieved, would amount to nothing. For Mr. Argall and his molecular argument are confronted by practical men, not theorists; and when he says, "Why should not this be possible?" they may reply, "We don't know; all we know is, that the thing, possible or not, has not been proved to occur. Mr. Argall seems to dislike my term "fable" and Mr. Howe's term "myth," as applied to his theory. If he prefers Prof. Ledebur's term "entirely erroneous" he is welcome to that. I beg to observe, however, that a fable, as I understand the term, is not necessarily an impossible, but simply an untrue story—in this case, a product of the "scientific imagination."

But what does the theoretical argument of Mr. Argall really prove?

1. Barus, he says, has shown that "the chemical equilibrium of the solid changes with each change of strain." Dr. Barus, in the paragraph quoted, refers not to vibration at all, but to steady pressure; and not to molecular or physical equilibrium, but to chemical equilibrium. And his conception of chemical equilibrium is measured simply by electrical resistance. Moreover, his experimental basis was a non-fibrous solid, namely, glass.

2. Mr. Argall's second quotation from Barus asserts a change in the molecular configuration of cold glass-hard steel, produced by time alone. This change is in hardness—not necessarily in structure. But here also it will be observed, we have a non-fibrous material, and one which is already under intense internal strains. All that Dr. Barus has proved is, that these strains, existing between molecule and molecule, readjust themselves at ordinary temperatures, in the course of years, almost as much as they would do at 100° C. in the course of a few hours. There is no tangible necessity here for a change in "molecular configuration," even; but, besides that, I do not understand that Dr. Barus means by "molecular configuration" molecular arrangement, or what we call structure.

3. Mr. Argall quotes from Dr. Barus the statement that Osmond claims, "that strain more or less completely converts cold metals from one definite molecular condition into another." I may be permitted to quote, in addition, the remark of Dr. Barus, which immediately follows:

"I have been unable to find, however, that Osmond has any direct evidence to support his assertion, and I have already pointed out some of the difficulties which Osmond must surmount before his view can gain general credence."

This shows pretty plainly where Dr. Barus stands on the question here under discussion. It is evident that he does not draw from his own experiments on glass and glass-hard steel inferences favorable to Mr. Argall's theory of stamp-stem crystallization. But M. Osmond is an observer of recognized acuteness and authority if he has really asserted the general proposition, apparently attributed to him by Dr. Barus, *his assertion of it has weight, whether Dr. Barus agrees with it or not; and that* weight bears unquestionably in favor of Mr. Argall's theory, though the term "strain" may or may not designate the particular kind of strain to which Mr. Argall ascribes a particular kind of molecular change.

I have, therefore, examined with care the statement of M. Osmond; and I find that he speaks exclusively of the two varieties of iron (*alpha* and *beta* iron) which he considers as two "molecular conditions"—not two different arrangements of the molecules—and of which he says: (22)

"The *alpha* variety (malleable) predominates in steels slowly cooled from red heat, and the more exclusively, as these metals approach more nearly pure iron.

"The *beta* variety (hard and brittle) is formed:

"*a.* Artificially, by the action of any mechanical pressure applied below very dark red heat and producing permanent deformation.

"*b.* Spontaneously, at a certain critical temperature not yet determined."

Clearly enough M. Osmond is announcing no general law, but explaining (upon his own *alpha beta* theory, not by any means universally accepted as yet) the familiar *effects of cold-rolling and hammering upon iron and steel. He carefully excludes* strains which do not produce permanent deformation, and thus implicitly contradicts Mr. Argall's hypothesis.

4. The researches upon "hysteresis," concerning which Mr. Argall quotes Dr. Barus's reference to Warburg, Ewing, Rowland and Bell, are too abstruse and too little pertinent to repay special analysis and discussion here. If they proved anything for his purpose, they would prove too much. The kind of molecular change which these writers call "hysteresis" is something which they can produce by magnetism as well as by mechanical force; it is evidenced by electrical resistance, wholly or chiefly; it is not shown or asserted or believed to produce a granular structure out of a fibrous one; and it is only called a molecular change, because, on the molecular theory of matter, the molecules must be somehow concerned in it. Pure and simple, it is a change in electrical resistance, which is inferred to involve a change in "chemical equilibrium," which is again inferred to be a change in molecular condition.

I can easily understand Mr. Argall's frank admission that his citations "do not *support a crystallization-theory for iron*;" but I will leave others to decide whether they prove "that the molecular structure of iron can change and does change under physical conditions and at atmospheric temperatures."

With regard to Mr. Argall's question, "What is electrolysis, but the direction, by means of an electric current, of the movement of molecules in electrolyte, to form new bodies?" I beg to say that I do not pretend to know exactly what electrolysis is, but I strongly suspect, that whatever it is, it is not *that*. I cannot conceive, however, the remotest connection between this question and the one under discussion; and will therefore abstain from introducing a purely outside and wholly theoretical issue.

But a little investigation of Mr. Argall's theory itself may not be out of place. It is, if I comprehend it:

A. That the iron of new stamp-stems has a fibrous structure.

B. That this structure is changed during use, by the effect of repeated blows and vibrations, which cause the molecules previously arranged in fibres to separate and rearrange themselves in crystals.

C. That the result of this process is shown by the granular fracture when the stamp-stem breaks.

It seems to me that any stamp-stem thus fractured in service would break at the beginning, rather than the end, of such a process. The molecules can not be expected to rearrange themselves without separating; and how they are to retain cohesion when they have once separated, so as to resist the breaking-effect of shock until they have got comfortably crystallized, is not clear. The beginnings of separation are incipient fracture; and the experiments of Wohler and others, cited above, show that shocks producing such slight separation of particles may, by repetition, go on increasing the fracture thus begun; so that at last, the peace breaks by the dissolution of its original, not of a secondary, structure. This conception involves no molecular theory whatever. It rests on the established fact that iron is made up of joined and cemented particles, which can be pulled apart; and that, when they are sufficiently pulled apart, the iron breaks. Such a conception explains all the phenomena thus far adduced, and it is scarcely necessary to set up an auxiliary and imaginary theory that the particles first separate, then reunite, and then break apart again, under strains which tended to fracture all the time.

The whole question of the fibrous structure of wrought-iron and its supposed relation to strength, has received much new light within recent years, especially in connection with the attempt at Avesta to produce fibrous soft steel in the Little-Bessemer process, by casting some slag with the steel. The peculiar lamination caused in puddled iron by the presence of intermingled cinder was thus reproduced in steel for the benefit of prejudiced consumers; but it was not shown that this structure gave increased strength. However, I will not now pursue that part of the subject.

Let us now examine the testimony of practical experience, adduced by Mr. Argall "apart from abstract theory."

The opinion quoted from Commander L. A. Beardslee, U.S.N., that the fracture of the 5 inch connecting bar of the Washington Navy Yard testing-machine was "an unmistakable instance of crystallization," might be construed as an assertion that this crystallization was unmistakably due to repeated shocks. Since the statement quoted is part of the report of a committee of which Commander Beardslee was chairman, and was apparently concurred in by the other members, namely, Gen. Q. A. Gillmore, A. L. Holley, William Sooy Smith and David Smith (all experts of recognized ability), the precise language employed is worthy of careful consideration. It will be found in the *Report of the United States Board for Testing Iron and Steel*, Part I., Washington, 1878, pp. 181, 182:

"The question as to whether crystallization can be produced in iron by stress, or by repetition of stress with alternation of rest, or by vibration, has been very much discussed, and very opposite views are entertained by experts; therefore it was considered that any data which might be gathered during our tests, bearing upon this point, would possess a value.

"We have met with but one unmistakable instance of crystallization which was probably produced by alternations of severe stress, recoils and rest.

"The connecting-rod of the chain-prover was 5 inches in diameter, had been in use for forty years, and had, during this period, been frequently subjected to stress up to 250,000 pounds, with recoils produced by rupture of test-pieces.

"It was carefully made in the anchor shop, being hammered from the best quality of wrought-iron scrap; it is not probable that any section of it, if broken when first made, would have displayed crystalline structure, but while we were testing, it parted one day at less than 200,000 pounds stress, and the surface of the fractured ends showed well-defined crystallization, the facets being large and bright as mica; the ends having become injured by rust, the bar was again broken by impact, at a point distant over a foot from the first fracture, and the same appearance was found, which is shown in the illustration, Plate V., Fig. 1, the original of which is now in the cabinet of the Stevens Institute."

The illustration here mentioned is a heliotype, reproducing a direct photograph of full natural size; and, while I have not had the opportunity to examine the actual *piece said to be at the Stevens Institute, I feel sure that the appearance of the fresh* fracture is better shown in the illustration than it could possibly be shown by the piece itself after the lapse of sixteen years. At the same time, the broken piece might still yield, under proper microscopic and other examination, some important further information, although, as I shall point out, its pedigree is not good enough to justify precise conclusions.

The photographic illustration plainly shows, I think, the laminated structure due to rolling. Whatever crystallization there is, is clearly subordinate to that general structure, and therefore may have existed always, as it existed at the time of fracture, together with the lamination.

The statement of the committee is, that this is "an unmistakable instance of crystallization," but the opinion as to its cause is much more cautiously stated as merely "probable." And the degree of this probability is carefully indicated by a statement of all the data upon which the committee's opinion is based. The facts personally known to the committee, or verifiable by it beyond reasonable doubt, are, that the piece had been in service for forty years; that it had been frequently under *stress up to 250,000 pounds; and that it broke under less than 200,000 pounds.* A fact presumably less certainly established, is that it was carefully made, about 1838, by hammering from the best wrought-iron scrap. The committee infers that "it is not probable that any section of it, if broken when first made, would have displayed crystalline structure." And this is the only reason for supposing that such a structure has been since induced.

In weighing the force of this conclusion, it must be remembered, first, that wrought-iron has a crystalline structure to begin with, and that this structure can be made clearly visible by cold fracture produced in a certain way; so that, in fact, what the committee means is, that it is not probable that the piece of iron in question, if broken by continued increasing tension, when it was first made, would have failed to show the fibrous fracture due to the elongation of the crystals under such tension. Such an elongation in mass implies that the adhesions of the individual grains in mass is sufficient to resist, for a time, their separation in mass. That a sudden shock or strain might produce separation with little or no elongation is to be expected according to familiar mechanical principles.

Again, the illustration given by the committee represents a fracture *under impact*, which would have been likely to be crystalline in any event. But, considering the character of the observers, we may safely accept their assurance that this fracture presented the same appearance as that produced by tension. The committee's statement, then, is substantially that, after forty years of service, a piece of iron, broken by tensile strain smaller than that which it had previously endured without breaking, showed a tension-fracture exactly like its impact-fracture, whereas, if broken when first made, the tension-fracture would *probably* have been more fibrous.

Even this *probably* is open to somewhat damaging inquiry. For the committee does not say, and evidently does not know, what heat-treatment this piece of iron received when it was forged forty years before, or whether, during these forty years, it was ever heated, straightened, annealed, or otherwise subjected to heat-treatment. Yet such treatment, as is well-known, might induce a crystalline structure both coarser and less firmly cemented than would have existed without it. It is to this unquestionable fact that Mr. Howe refers, (23) when he says, in discussing the present case, and also that of the 20-foot porter-bar at the Morgan Iron Works, cited by Mr. Argall:

"Now I find nothing here which indicates strongly that any change in crystallization occurs under vibration or shock. The cases of the Washington testing-machine and of the Morgan Iron Works porter-bar may well be due to over-heating under manufacture."

We have, then, as equally "probable," the hypothesis that the crystalline structure, ultimately exhibited upon fracture, had existed in the iron ever since its last heat-treatment; (24) and the only remaining question is, why should the iron break under a smaller strain than it had previously sustained without breaking?

The answer to this question is given by Wohler's experiments, and may be summed up in popular phraseology by the statement that repeated stresses, no one of which is sufficient to produce fracture in mass, may, when they individually surpass the limit of elasticity of the weakest elements of the mass, gradually loosen (not transform) the existing structure, and thus by their cumulative effect, ultimately produce visible mass-rupture. This is a fact; and it offers a sufficient explanation of all the facts thus far observed with scientific precision.

The theory which it suggests may be, either that the loosening of structure is gradual and uniform, so that, at a given moment during the process, the cohesion of all the granular or crystalline elements under strain which has been equally dimished; or that it is progressive, like the breaking of a wire-cable, wire by wire, so that the final visable mass-fracture is simply the cumulative result of incipient fractures, or minute separations of structural units, which have left fewer and fewer coherent units to endure strain. To my mind, the appearance of all tension-fractures, indicating, as it does, that the strain upon the mass is not equally sustained by all parts of the section of fracture (*i.e.*, that some parts elongate more than others before breaking), favors the second of these theories, which is, moreover, made plausible by what we now know concerning the unequal internal strains produced (especially by heat-treatment) in manufacture. But it is not necessary to maintain either theory. The true explanation of the phenomenon may involve them both; and neither the phenomenon nor its theoretical explanation involves any process of re-crystalliation under shock at ordinary temperatures.

Under careful analysis, therefore, the instance presented by the U. S. Board *(which is, in my judgment, the strongest that Mr. Argall has adduced) amounts only to a* guarded opinion, based upon an incomplete statement of facts, which permits a different explanation.

The declarations of Fairbairn and Greenwood, quoted by Mr. Argall, are simply reiterations of the traditional belief, unsupported by fresh experiment. Like many similar passages in the text-books, they have merely the force of the earlier opinions of which they are echoes.

Rankin's statement that "iron ought to be as little as possible exposed to sharp blows and rattling vibrations," is not only consistent with the theory of breakage without "crystallization," but immediately follows the intimation of Rankin's doubt of the earlier theory, and a report of experiments made by him on railway-axles, which do not confirm the notion of crystallization by vibration.

The only question here at issue is, does the vibration to which stamp-stems are subjected in practice, change the structure of the iron of which they are composed? It is not, "Do stamp-stems break after continued use?" Nor is it, "Do they show a granular fracture when they break?" A thousand instances of such breakage and fracture will prove nothing. But any one of the following suggested tests would prove a good deal.

I.—Let a stamp stem which has been running a long time without breaking be-

taken down and examined as to fracture and structure. This has never been done, so far as I know.

II.—To make the result of I conclusive, let a comparison be made between such a stem and one made at the same time from the same metal but not used. This has never been done, so far as I know.

III.—Let a stem which has broken in service be examined as to its structure at other points than that of fracture.

IV.—Let such a stem be tested to ascertain whether, *at any point in it*, it is not possible to produce at will either granular or fibrous fracture by simply varying the means and method of fracture. This has never been done, so far as I know. Nor has Mr. Argall's claim, that such a granular fracture is very different from the "crystallized" fracture, ever been supported by the actual production and comparison of the two.

V.—Let any stem, new or old, used or unused, be tested as in IV. This has been done often with bars of iron or steel, and it has been proved that a granular or a fibrous fracture can be thus produced at will. But if there is anything peculiar about stamp-stems the experiment would show it. It has never been performed upon a stamp-stem, so far as I know.

It is such evidence as this that would convince doubters, and prove the crystallization-theory. That theory is now a fable, because such evidence in its support is wholly lacking. And it will never cease to *have been* a fable, because it was framed and held without evidence. It may, indeed, cease to *be* one, and become an acknowledged fact—when the necessary evidence is forthcoming, but not before.

SILVER LEAD MINING IN BRITISH COLUMBIA.

Contracts are being let to various packers and teamsters to bring ore to the Forks. The rates of hauling are low in many cases, some of the contractors not being familiar with the packing of ore down steep mountain trails filled with many feet of snow.

The concentrator which is being built on Carpenter creek will be completed and put in operation in the early spring.

A 1,600 pound sample of "Nonpareil" ore delivered at Three Forks this month went 640 ounces to the ton. The "Nonpareil" claim is in the Jackson basin, 25 miles from Kaslo.

Three car loads of machinery for the Pilot Bay smelter are at Nelson.

Shipments from the Alpha have averaged $105 to the ton, and high grade ore has been struck on two levels lately run.

A 50-ton concentrating plant has been shipped from Fraser & Chalmers, Chicago, to the Pilot Bay smelting works.

The development work on the Noble Five group of claims to date is as follows: There are two short tunnels in on the 'World's Fair,' but the main work is done on the ground of the 'Bonanza King.' The No. 1 tunnel has been run 204 feet on ore all the way. The depth beneath the surface at the breats of the tunnel is about 200 feet. Eighty feet from the mouth of this tunnel a winze has been sunk 50 feet to the middle drift. The middle drift itself, was run 100 feet in ore towards the face of the hill, and from that point an upraise made to the mouth of No. 1 tunnel. No. 2 tunnel is in 340 feet and for 300 feet they have been drifting on ore. At 145 feet in depth a raise has been made connecting with the middle tunnel. No. 3 tunnel is in 150 feet, with a raise to the surface of 110 feet for air. Only the smallest fraction of the immense quantity of ore in sight has been shipped as yet. The first shipments were made during the winter of 1893-4, and aggregated about 500 tons of an average value of $125, making during last winter an output of $72,500 gross. The highest grade shipment ever made from the Slocan country came from this mine. One carload was shipped of which the average return was 549 ounces to the ton in silver. Far below the Bonanza King a tunnel is being run on a fine chute of ore on the Noble Five. It is now in 60 feet and there is a considerable quantity of clean ore on the dump; not less than 50 tons. The amount of ore shipped this winter will depend very largely on what the railway facilities are. There is in the mine a large quantity of oxidized ore which cannot be concentrated, and is not sufficiently high grade to stand a long haul. It is possible that it may be shipped to the Golden Smelter. At present, the ore has to be rawhided from the mine to Cody creek, and then transferred by sleigh to Three Forks, from which it will be shipped by rail if the railroad runs, and it will.

A most remarkable sight on the Reucau is the outcrop of solid ore on the surface. The galena is 8 feet 8 inches wide, and for that distance is solid and clean. The ledge has been traced for a few hundred feet and prospect holes dug on it. It shows up clean ore all the way, at the widest place about twelve inches. Part of it is clean galena mixed with seams of oxidized ore, which assays 900 ounces to the ton. The clean galena is said to average $50 a sack. There is some of the prettiest looking ruby silver ore on the ground that was ever seen. It is not by any means beyond the capacity of the Reucau to ship at least 600 tons of ore this winter, and the owners are preparing to ship all they can. The Reucau has the makings of a great mine in it. The upper tunnel is in 353½ feet. There has been continuous ore in this tunnel for 330 feet of its entire length. There is a raise from this tunnel of 65 feet, and 100 feet of the vein in length by 24 feet in height was stoped out last winter, and resulted in the shipment of about 80 tons of clean ore. In sinking, a very fine showing of ore was struck in the winze.

Byron N. White of the Slocan Star mine has contracted for the delivery of 1,000 tons of ore at Three Forks before the 1st day of January. The teams will begin to haul the ore on or about first of December and will haul 30 tons a day at least. The mine will ship not less than 3,000 tons if transportation facilities are available. But Byron White does not venture to figure ahead of the first of the year. The output of the Slocan district has been conservatively estimated at 10,000 tons; 1,800 from the Slocan Star and 1,000 from the Alpha, makes 25 per cent of that amount from two mines, with the Idaho, the Fisher Maiden, the Cumberland, the Mountain Chief, the Alamo, the Wonderland, the Noble Five, the Reucau, the Payne, and a number more to hear from.

ASBESTOS CLUB.

Mine Explosions Generated by Grahamite-Dust.

At the ordinary quarterly meeting of the Asbestos Club, held in their rooms, Black Lake, Que., on Thursday evening 8th inst., a paper on this subject was contributed by *Mr. William Glenn,* Baltimore as follows:*

"The Ritchie grahamite-mines of Ritchie county, West Virginia, were situated near the central part of the upper barren coal-measures of the Appalachian coal-field. The rocks of the region are shales and sandstones, which lie almost horizontal. They show no evidence whatever of containing carbonaceous ingredients, except that they enclose, at long intervals, thin veins of exceedingly impure coal.

The vein of grahamite is a straight and vertical fissure, which cuts downward across the horizontal strata of the rocks mentioned. It will be sufficient here to state that the fissure is about 4 feet wide, and that it was compactly and completely filled with the asphalt-like mineral first described by Prof. Leslie in 1863.† He regarded it as a mineral pitch or insipsated petroleum, which he called asphaltum. The name grahamite was proposed in 1865 by H. Wurtz,‡ who more fully considered and described the mineral. Both these writers together with Prof. Blake,§ who studied the body in 1890, maintain that it is a form of asphalt.

An accurate and comparatively full study of the mine was made in 1873 by Prof. W. M. Fontain, of the University of Virginia, who published his observations under the title "Notes on the West Virginia Asphaltum Deposit,"‖ thus further maintaining that grahamite is an asphalt.

Fig. 1. represents that part of the mine first to be considered. As no maps can now be had, the writer has been compelled to construct the sketch in part from material found in his leather copy-book and in part from memory; yet, so far as concerns the present purpose, it may be regarded as accurate. The figure represents a vertical section of the mine, and is in effect a view of the vertical vein with one side-wall removed, showing all the workings therein existing at the date presently to be mentioned.

The levels numbered 2, 4 and 6 represent workings made for removal of vein-matter when it was supposed that the proper way to mine the material was by means of a succession of such levels. The rooms lettered A B were the initial rooms, constructed when it was determined to mine by a method called by miners "standing breasts." In this method the miner stands upon the material he already has broken down, and attacks in turn that above his head. As all rocks occupy increased space when broken into smaller masses, it will be seen that the miner at work must soon nearly fill the space between the vein-matter over his head and that which he has mined already. To prevent this, the latter is removed at proper times and in necessary quantities. When a room is mined upward to its extreme height, then all its contents may be withdrawn. The details of the process do not pertain to this paper.

In the west mine (Fig. 1), on Feburary 9, 1871, room A had been completed and the material had been removed from it. Also, the communication between its bottom and level 4 had been closed, so that air could not be passed from the level through the room. Room B was being mined, and had attained about the condition indicated in the figure. Mining consisted simply in digging down the soft vein-matter by means of the exceedingly light pick used by bituminous coal-miners in Pensylvania and West Virginia.

The contractors for room B, believing they could blast out the grahamite cheaper than they could dig it, received permission to try the effects of powder. But the attempt failed, either because the charge was insignificant or because the powder failed to explode. The Dupont mine-powder used in this hole was contained in a paper cylinder 1¼ inches in diameter, in which it occupied 3 inches height. Two days after a second hole was prepared and charged with a similar cylinder containing 6 inches depth of powder. The position of this blast is shown at *a*, Fig. 1. The shot was fired at 3 p.m. of the date given, and immediately there occurred what was apparently a mine-explosion; such a disaster as is known among miners as a fire-damp explosion. For the size of the workings, it would have been judged unusually severe.

The first effect observed was, that so much of the pit-head structure (not shown in Fig. 1) as lay near the prolongation of level 4 had been demolished, A man who had been standing at that moment on the bridge leading from level 4 to the storage-bins, had disappeared, together with his mine-car. The latter had been driven almost horizontally for 90 feet, and there had been wrecked against the east hillside of the ravine of Mine Run. Even the cast-iron car-wheels had been broken by impact against soft earth, while the wooden car-body was little more than splinters. The man was driven 60 feet, when, by impact against a heavy tool-chest, he received injuries almost immediately fatal. "He was burned and blackened past recognition."(1)

The effect was as if level 4 had been a great gun, out of which the man and car had been projected. So much of timber structures as lay near the line of fire had been swept away.

Before those near the pit-head had recovered from consternation, one of the men belonging to room B appeared at the portal of level 4. He was seriously burned and could tell no connected story. Upon his clothing and on his bare arms adhered more or less of what seemed half-burned coke, and some of this material was still aflame. His burns were fatal. His brother and partner was found under room D, or nearly so in level 4. This man survived, and was subsequently able to give a clear account of the incident up to the moment of his injuries.

The third and only remaining man in this level was 140 feet inside of room B, and was engaged in constructing the initial work of a room, such as is indicated at C, D, E, Fig. 1. When the explosion occurred, he came down into the level and walked along it to the open air. He had seen the reflection of a flame in the level, was aware of what had occurred, but was in nowise injured.

Two other men were driving the end of level 2, then 640 feet long. They had heard the sound of the explosion; their lamp-flames had nearly been extinguished by an air-wave; but otherwise they had nothing to relate.

The ravine of Mine Run, less than 100 feet wide, contained all the pit-head structures. Upon so much of them as lay near the prolongation of level 4, and upon the east hillside, there adhered a coating of coke. This was not only peculiar but striking and prominent. On all parts of the old storehouse left standing, and upon the hillside near the portal of level 3, there remains adhering, about a ¼-inch thick of cinder such as our mineral makes. The fire seems to have melted the mineral, thrown it from level 4 towards level 3, and left it a cinder sticking to every opposing

*The observations herein set forth were studied and discussed by the late P. G. Sauerwein, of Baltimore, who was the president of the Ritchie Company, together with the author, who was the manager of that company's mines and railway. As the more learned and able one of us cannot take part in this paper, the author alone must be held responsible.

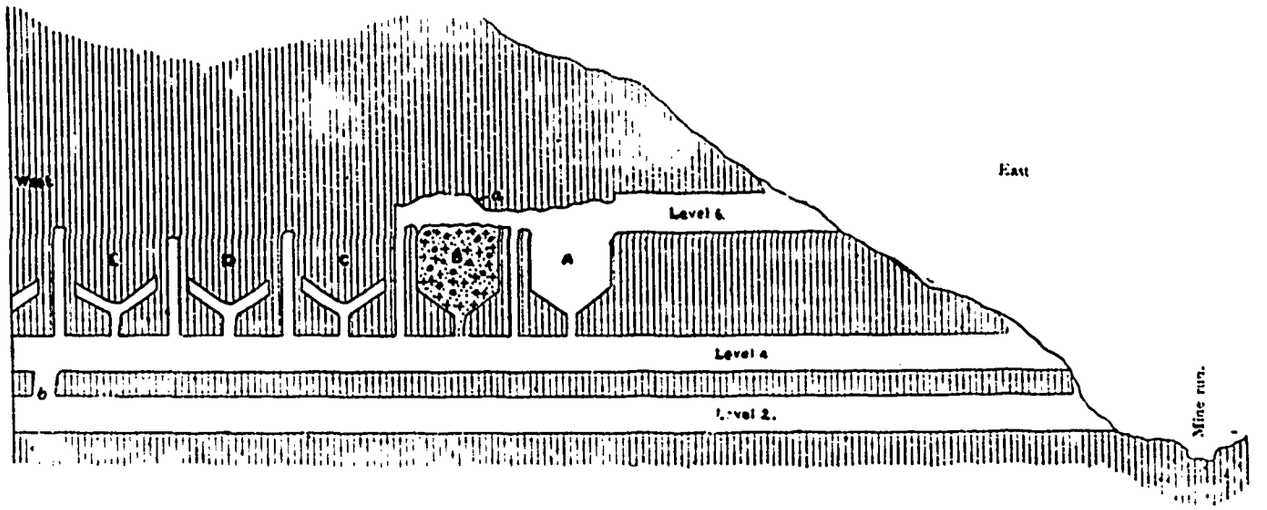
†Proc. Am. Phil. Soc. ix., 185.

‡Am. J. Sci., 1866, ii., xlii., 430; Proc. A. A. A. Sci. xviii., 124.

§Trans. xviii., 563.

‖Am. J. Sci., iii., vi., 409, 1873.

¶Report of the manager upon this explosion. It was written February 10th and contained about four thousand words.



Vertical Section of the Ritchie Mine (West) as it existed February 9th, 1871.

Vertical Scale, $\frac{1}{8}$ *: Horizontal Scale,* $\frac{1}{16}$

thing. To use again the illustration of the cannon: Imagine it (level 4) to have been loaded with melted mineral with which its discharge coated all opposing objects; then imagine the mineral to have charred after sticking fast."* It might be well to mention that grahamite is plastic while hot; upon cooling it again solidifies.

In comparison with what was to be observed about the pit-head, relatively small quantities of the half-coked grahamite were found adhering to objects within the mine. The coarse-grained, whitish sandstone forming the two walls of the mine was quite free of it, except at two points, namely, about the top part of the air-way next west of room B, and about the portal of level 4, where the walls were much blackened. The occurrence of this material within the mine was noticeable chiefly because of its exceeding peculiarity, and not because of its abundance.

We supposed that little vein-matter had been burned within the mine, because of lack of air there, and that the abundance of dust in level 4 had been swept along it to the portal, and there heated to the plastic state and thence projected by the explosion. As the material had been thrown forward along the projected axis of level 4, and not laterally as well, we were led to suppose that the explosion had occurred just without the portal, where the restraining side-walls were without a roof-covering.

The evidences were that the disturbance initiated in room B by the blast was propagated downward along the air-way next west of it, as shown by the coked vein-matter adhering along the air-way, chiefly about its upper part, as already stated. Having reached level 4 it extended itself westward along the level at least 30 feet, as proved by the severe burns received, as above narrated, by the two men there. But it did not extend 140 feet in that direction, because the flame was not evident to the miner working above and in plain view of the level there. He saw only the reflection of a light in the level, and heard the sound of an explosion. The principal extension of ignition was eastward, outward to the portal of level 4 where that explosion occurred.

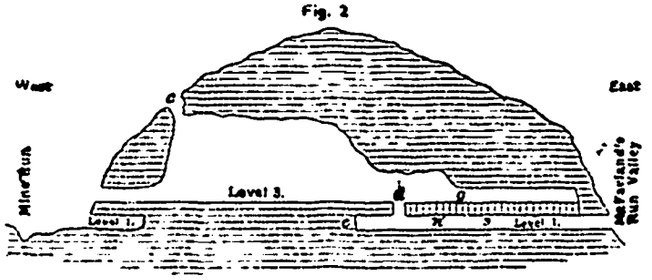
We were not able to find evidences of any ignition or of violent force in level 2, which might have occurred because of the air-way *b*, Fig. 1, between it and the level next above. The two men working at its end were conscious of nothing beyond the sound of a violent explosion and of an air-wave which nearly extinguished the flames of their open lights.

Nor could we learn of a commotion in any part of level 6; it exhibited no evidences of heat. Room A exhibited blackened walls at top, at least; but otherwise there was detected in it nothing unusual.

The impression entertained first and finally was, that gunpowder had been responsible for the accident. It was for this reason that its agency was promptly examined into. The magazine, a primitive structure, had been erected 1400 feet from the pit-head, and it stood intact after the explosion. The guardian of it was able to state that all the powder in or near the mine at that time had been contained in a tin tomato can which he described. We recovered this, and by his aid we determined that 18½ cubic inches of powder had disappeared out of it. The quantity was ridiculous as compared to the results we had witnessed. The report already cited contains this passage: "I have said to the men that the burning of the powder generated an explosive gas, which was driven out, mixed with air, and ignited." A supplementary report further stated in explanation: "Explosion of the powder pulverized a certain quantity of mineral, and in that state it was easiest decomposed. The mineral lying in the room B was slack, and every adjacent wall contained dust to be acted upon. The indications are that gas burned along all the air-passages and exploded at the portal."

The Ritchie mine above water-level was dry beyond all mines of which the writer has any knowledge. The only water which entered the part now under consideration

Fig. 2



Distorted Vertical Section of Ritchie Mine (East) as it existed February 25, 1873.

came after heavy rains through the roof of room A and through the adjoining part of the roof of room B. It was, in fact, surface-water, which found its way through the partly decomposed grahamite forming the backs of those workings.

It is also important to recall that the vein-matter was soft and friable, much reduced to dust in mining; and that it was pulverized in the levels by the traffic through them. Within the mine, all surfaces were abundantly coated with its dust, and the floors of the levels contained more than an inch in depth of it; and, of course, room B contained it in quantity, because it was nearly filled with the already mined vein-matter.

It may be said at once that so far we had not observed any indications of fire-damp (chiefly CH^4) within the mines. To quote once more from the report: "No fire-damp or choke-damp (CO^2) ever was detected in these mines, even when there was no ventilation; and the explosion began where ventilation was excellent. We have a level (No. 2) 600 feet long and no ventillation for it." An inspection of Fig. 1 will disclose that the air-currents flowed in through levels 2 and 4, then up the air-way next west of room B, then across both rooms and onward to and out of level 6. As February 9, 1871, was comparatively a cold day, ventilation then was all that could be desired. Moreover, we could not suppose that so light a gas as fire-damp could lie in room B, when at times water dripped from the natural surface into the east end of it, as well as into room A. Fissures which can convey water must readily permit the passage of a gas. We supposed that if fire-damp were present at all, necessarily it must have found lodgement in the small workings above the roof of level 4. These were ideal receptacles for it, and yet we had not found it there; we had not observed even so much as the lengthening of the naked lamp-flame of the miner who constructed them, or of that of the writer who visited them frequently. The tight end of level 2 was another good receptacle for the collection of fire-damp. If such had been present, we supposed it must have exhibited its presence any morning, after the quietude of a night in which to collect. But it had not done so.

Anticipating a little, it may here be said that fire-damp was first encountered in an inclined traffic-road (mine-slope) sunk subsequently, from the narrow ravine of Mine Run and under level 2. At about six fathoms vertically under water level a blower was disclosed in the south wall of the slope. The gas was promptly ignited; but it soon ceased to burn. While the lower levels disclosed other gas-blowers, none of them were serious, and the gas was readily disposed of. It never became necessary to use safety-lamps.

It was rather a curious fact that gas was never observed to issue out of the vein-matter. Apparently, that was so compacted into the fissure that, practically, gas could not circulate through it.

In these damp lower levels, shots were frequently put into the side-walls because of the necessity of widening the roads. And even though fire-damp at times must have been present in some degree, yet no disaster ever followed.

Among the many surprises which grahamite offered, none were so striking as the peculiarity of combustion of the mineral and of its dust. When warmed over the flame of an open light, the mineral grew viscous, and then might be drawn out into a thread. Warmed yet more, it kindled into a dull and smoky flame, which burned until the mass became a smutty coke of slight tenacity. Dust which fell from one's hand about the flame of the lamp, created a halo of scintillations around the light. Yet more widely diffused and brilliant effects at times followed the falling of dust from one's clothing upon a flame.

*Report already cited.

Vein-matter mined in the rooms was permitted to slide from them into cars standing in the level below. More or less dense dust-clouds necessarily followed ; and when one of these clouds was sufficiently dense, if it then enveloped an open light, a flash followed. Several men were in this way burned ; but none seriously. Such flashes always produced watery blisters upon their victims. Glass lanterns offered a remedy ; but dust soon coated the glasses. Following the invariable ways of unrestrained miners, these car-loaders risked the danger of open lights. These they would place at a distance greater, as they supposed, than the dust-cloud would roll, and they would then open the chute and permit the grahamite to descend, almost flowing like water, from the room into the car below.

A few weeks after the explosion of February 9th, the writer stood near the car-loaders' lamps when a car was being loaded in level 4. He saw the dust-cloud extending unpleasantly near to the lamps, which stood upon the floor of the level, and observed it to roll onward until it reached a lamp full 30 feet distant from the column of falling grahamite. Immediately a flash followed, so brilliant and complete that one might have judged it due to gunpowder-dust disseminated through the air.

An unsuccessful attempt was made to recover the details of a grahamite dust-flash which occurred in the waters of New York harbor, perhaps in 1871. While a cargo was being discharged, a workman in the hold of the barge attempted to light his pipe by means of a match. Agitation of the grahamite had afforded the sufficiently dense dust cloud, and a flash resulted. The flash was reported to be unusually vigorous ; or more likely it was so regarded because the observers were unused to such occurrences.

The reader is now in possession of all information known to us as bearing upon the explosion of February 9th, and almost necessarily he must anticipate our conclusion as to its cause.

We are compelled to assume that the blast pulverized, and immediately decomposed into coke and inflammable gas, a great deal of the dry vein-matter ; these assumptions are imperative. The remainder follows easily from what is known of the behaviour of mixtures of marsh-gas and air.

The first effect was a burning of the air in room B, as proved by blackening of the side-walls and the adhesion to them of coke formed from the dust which had lain upon them. Expansion of heated gases could occur in two directions. Toward the open air there was but little fuel to feed the flame; and it ceased in level 6, because no dry dust was found there. Inward, every surface supplied its store of dust whereby ignition was led downward through the airway next west from room B. Once in level 4, the dust so abundant there was freely converted to gases which burned vigorously. After reaching and passing the two men 30 feet west of the airway, there was a cessation. We supposed it was due to the resistance of the air-cushion offered in that direction to the widely expanding gases. The line of least resistance was toward the open air, in which direction ignition was propagated to the portal of the level. The hot gases there encountered that abundance of air necessary to form with the mixtures which were explosive, and the result has been stated.

No explosion occurred within the mine, because the requisite volumes of air and gas were nowhere present. That is to say, there was at no point as much as eight volumes of air to one volume of explosive gas, if each had been measured at the same temperature.

Coke found within the mine was, of course, a product of destructive distillation, and it was the best of evidence as to what had occurred. Moreover, its abundance about the pit-head demonstrated that a great deal of grahamite dust had been swept along the level to the open air ; in a hot state it had been projected thence upon all opposing objects. The Executive Committee of the Company's Directory, of whom Mr. Enoch Pratt alone survives, attempted to find a remedy against the future occurrence of dust-explosions. They had the advantage of good advisers, among them Dr. D. K. Tuttle, a chemist, now of the United States Mint, at Philadelphia. But they could suggest nothing better than to dampen the dust by means of small jets of water thrown from pipes secured within the mine, a method suggested by the fire-protection pipes in the cotton-duck mills of Mr. William E. Hooper, at Woodberry, near Baltimore.

The precaution actually taken was to put no more blasts in the vein-matter, and to fire none in the side-walls, except when the mine contained no men. Even these precautions at length failed ; the east mine suffered an explosion which much injured it, and in connection with which four men assumed risks which cost them their lives.

Fig. 2 is a distorted diagram of a vertical section of the east mine, at February 25, 1873. There are no existing records from which a scale-drawing might be constructed ; and unfortunately the writer has not clear memories of the distances involved. However, we shall not be seriously in error if we accept these assumptions ; Distance between east and west portals of the two parts of the level, 1,800 feet, length of cavern in level, 3,350 feet, and height of it, 40 feet ; the distance from airway to the closed end of the level is important, perhaps, and yet the writer cannot recall what it was—it may have been 30 feet, or even somewhat more.

It should be stated, that the back of the east part of level 1 was mined-material, about 300 tons, which rested upon boards supported by timbers upheld by the two side-walls.

About the closed end of level 1, the road-way had to be widened by means of blasts in the side-walls. Shortly after 10 o'clock in the morning of the date last mentioned, a shot was ready to be fired there, near *e* of the figure.

Blasts were invariably charged and fired by the mine captain's helper, and nearly always they were discharged when the mine contained him only. But occasionally, as in this instance, when but few men were at work, noon or evening was not waited for, but those few men were notified to leave the mine while a shot was fired. So in this instance they were notified, and the notice was repeated. The two men who were mining down the back of level 3, about the point *g*, twice replied that they would take the risks of any accident. The car-loader in level 1 was ordered to leave, but instead of doing so concealed himself in some timbering (a battery) about the point *n* in the back of the level. All the above was learned later from the man who fired the shot. The four men mentioned were all who were at the time in the east mine.

After the captain's helper had ignited the fuse of the shot in the side-wall of the level near *e*, he walked east to about *s*, a point in the level at which the north side-wall had been cut away that cars might there pass each other. He passed under the car-loader who had concealed himself, and for whom he was on the lookout, but did not observe him.

A mine-explosion resulted, fully as violent as those which occur at fiery coal mines. Cars which had stood in level 1 were shot in complete wreck out of its portal, and onwards far into the valley of McFarland's Run. Some timbers took a similar course, notably an oak board which was driven through an irregular track and which landed at last upon the opposite hills of the valley, more than 500 feet distant from the level-portal.

In the ravine of Mine Run, at the portal of level 3, there was another explosion which did no little damage to the pit-head structures. At *c* a crater was formed, and from it were thrown what we judged to be 40 tons of earth and stone, A tree which had stood there was thrown at least 50 feet, and being a mountain hemlock of complete growth, it afforded some measure of the energy which had formed the crater. According to my present memories, the latter was 14 feet deep. Its figure was tha of an inverted flat cone.

The helper who fired the shot was found wandering in the level, burned and mentally deranged, but otherwise uninjured. During lucid intervals which preceded his death, he told us the story of the accident, as he alone knew it ; of his warnings to the men, and of his having seen the level filled with bluish flame as it approached him.

After several hours of labor, the car-loader was dug out from under a pile of hot vein-matter which had fallen into the level when its supporting timbers were swept away. The two men who had remained at *g*, level 3, bore no marks of injury whatever, no burns and no abrasions ; yet both of them had been killed. We judged they had died of asphyxia, or because of the pressure which had existed in the level at the moment the crater was formed.

The already-mined grahamite which had formed the back of level 1, had, in part, fallen into the level when its timber supports were swept away. It was ignited and it afforded a troublesome fire to deal with. By throwing upon it water from pipes led into the level, we were able to shovel it into cars and thus remove it from the mine.

The writer is aware that this second explosion may be explained by use of the theories now held of coal-mine explosions—that it was a result of fire-damp and dry-dust as well. There was a sort of gas-trap where ignition began, and, possibly, there was another in the roof of the cavern in level 3, even if surface water did drip at times through it. But, as fire-damp had not been observed, and as it was not essential to the explosion, it seems more rational to regard this as having been a dust-explosion simply.

In the paper published in 1873, and already cited, while relating the characteristics of grahamite, Professor Fontaine says :

"The fine dust produced by handling the mineral, is capable, when very dry, of inflaming from an open lamp. This has led to two accidents from explosion. The dry dust having caught fire in the lower levels, the gaseous products became mixed with air in the upper works and exploded."

This mention is but the briefest statement of bare fact ; yet it has this additional interest—it seems to have been the first printed announcement of a purely mine-dust explosion.

Nineteen years after the conclusions reached by us in the early summer of 1871, while reading in the library of the British Museum, the writer saw, for the first time the paper printed by Faraday and Lyell in Janurary, 1845.* It was a report made by them to the British government upon the Haswell collieries explosion of the year previous ; a report written in parts by each of them, as is clearly indicated in the text. Faraday wrote :

"In considering the extent of the fire for the moment of explosion, it is not to be supposed that fire-damp is its only fuel ; the coal-dust swept by the rush of wind and flame from the floor, roof and walls of the works would instantly take fire and burn, if there were oxygen enough in the air present to support its combustion."

They found upon the mine-timbering "coke gradually increasing in thickness," as they "neared the place of ignition ;" coke which, they believed, had resulted from partial combustion of coal-dust so abundant in the mine. The report continues :

"There is every reason to believe that much coal-gas was made from this dust in the very air of the mine itself by the flame of the fire-damp, which raised and swept it along ; and much of the carbon of this dust remained unburned only for want of air.'

Thus Faraday announced what has come to our present belief regarding fire-damp explosions in coal-mines.

In a Royal Institution lecture,* Professor Abel took for his subject the dust-explosions which then had become so numerous in wheat and rice-mills. The lecturer stated that such explosions had, "prior to 1872, appeared enveloped in mystery, until their probable cause was indicated by an Austrian observer." Referring to the paper of Faraday and Lyell, printed in 1845, the lecturer continues, "ten years later, M. de Souich, an eminent French mining-engineer, published as original" work which sustained the deductions of those writers. Professor Abel added, "Later on M. de Souich extended his inquiries into the part played by coal-dust in mine-explosions.'

After an ordinarily diligent search, made in the library of the British Museum, and in the Peabody Library at Baltimore, the present writer must say, that he failed to find records of any work done by the Austrian observer of Abel, or of M. de Souich. Several recent writers mention both of them, but nobody has cited the places of their communications.

*Nature, xxvi., 19, given April, 1882.

The Blast Furnace.*

By E. C. Potter.

Raw iron, or "pig iron" as it is commonly called, is produced by deriving from iron ores (oxides of iron) the metallic iron they contain in their composition. Stated briefly, this is accomplished by exposing the ores to the chemical action of carbonic oxidide, formed by the combustion of coal or coke, which, by taking up the oxygen of the oxides of iron, leaves the metalic iron free. In addition to this, the earthly impurities of the ores have to be dealt with in a manner to be explained later.

The apparatus in which this process is carried on is known as a blast furnace, so called because the ordinary combustion of the fuel is augmented and accelerated by forcing into the furnace by mechanical means large volumes of air. This air, delivered into the furnace under high pressure, is known as "the blast." As indicated above, the materials to be dealt with in the operation, are, first, the ore ; second, the fuel, by whose combustion we obtain the active element in the reduction of the ore, carbonic oxide (this fuel is a more or less pure carbon in the shape of charcoal, coke or anthracite coal) ; third, a material technically called a "flux" is required, whose office is to remove the earthy impurities of the ores. For this purpose limestone is usually employed. The way in which this is accomplished is rather an intricate chemical reaction, but stated as simply as possible the action is as follows :—The principal earth associated with the ore is common clay, or silicate of aluminum, as it is chemically called. This material, as everyone knows, is quite infusible, and hence impossible to remove by the mere application of heat. It is a chemical fact, however, that by the addition of lime to the silicate of aluminum, forming the double silicate of lime and aluminum, this double silicate being quite fusible and being lighter than the metallic iron floats upon its surface, and is thence drawn off in a manner to be indicated later.

This is, briefly, the office of the flux. These three materials together with the air blown into the furnace are all that are required to carry on the operation of smelting pig iron. I mention the air, as that is not by any means as insignificant a feature

*Phil. Mag., iii., xxvi., 16

as would be at first imagined; for the actual weight of air blown per ton of iron produced is six or seven times the weight of the solid materials charged.

The blast furnace itself is a very large structure, circular in section, of a height varying from 60 ft. to 90 ft., and a largest diameter of about one-fourth the height. The contour of the interior is not that of a perfect cylinder, but from the point of largest diameter (technically called the "bosh" diameter) the walls are drawn in both upward and downward, so that at the bottom of the furnace the diameter is only about one-half the bosh diameter, and at the top about 30 per cent. smaller than the bosh. The lowest part of the furnace is called the "*hearth*" or "*crucible*," for it, is here that the molten iron collects before being drawn off. The walls of the crucible are from 5 ft. to 6 ft. in height and usually perpendicular. From the top of the crucible walls the furnace slopes outward and upward till the bosh is reached. This whole section of the furnace is also known as the "boshes," and it is here that the actual fusion of the materials takes place. From the bosh up to the top the walls slope in again.

The materials, viz., ore, fuel and flux, are charged into the furnace by means of a mechanism known as a "bell and hopper," which at the same time closes the top of the furnace. A heavy cast iron hopper is fitted over the top of the furnace, leaving *an opening in its centre of about half the bosh diameter. This opening is closed by a* heavy iron bell, fitted into position from the interior of the furnace so that the lower edge of the bell laps over the lower edge of the hopper on its under side for three or four inches. Thus when the bell is drawn up tightly against the hopper, the furnace is tightly closed even to the escape of gas. The materials are then dumped into the hopper until it is full, when the bell is then lowered by means of a mechanically actuated and balanced lever arm, so that a space of 15 in. to 20 in. is opened between the contact edge of the bell and the hopper, and through this space the materials slide over the sloping sides of the bell into the interior of the furnace. This bell shape is used for the purpose of obtaining an equal and uniform distribution of the materials over the area of the furnace, which would not be possible were the materials dumped into an ordinary opening. This uniform distribution in charging is very important to the uniform working of the furnace; for if the materials were all dumped into the centre or to one side, the ascending carbonic oxide gas, seeking the easiest way out, would but imperfectly act upon the great mass accumulated in one locality, and the furnace would work one-sided. The great height of the furnace is required in order to expose the ore for a sufficiently long time to the action of the carbonic oxide. The descent of the ore from the top to the bottom of the furnace occupies from 18 to 24 hours. On a level with the floor of the crucible, on the front side of the furnace, is the situated the "tapping hole." This hole pierces the wall of the furnace to its interior, and through it the molten iron is drawn out. The tapping hole leads directly into a trough which communicates with the casting beds. This hole is stopped up with clay during the time the iron is collecting in the crucible. Tapping takes place usually every six hours. About 3 ft. above the tapping hole and sometimes directly over it, sometimes to one side, is the slag tap or "cinder notch" as it is technically called. The slag formed by the flux, floating upon the surface of the iron, is here drawn off from time to time as it rises to its height. It is usually run directly into buggies or cars constructed for the purpose and hauled of to the cinder dump.

The blast is introduced into the furnace at the top of the crucible, about 5 ft. or 6 ft. above the floor. At six or eight equi-distant points in the circumfrence of the furnace wall openings are made into the interior of the furnace. Into these openings water-cooled "holders" of bronze or iron are fitted. Into these holders are accurately fitted the blast nozzles or "tuyeres," also water-cooled. The water-cooling is accomplished by casting a coil of pipe in the iron holder or tuyere, through which water is contmually forced, or in the case of the bronze tuyere and holder the walls are made double, with a space between, in which water is kept circulating. At a sufficient height above the tuyeres a main blast pipe encircles the furnace, from which branches are let down to each tuyere. The tuyere nozzles are inserted from 6 in. to 10 in. beyond the inner wall into the furnace. The water-cooling of the tuyeres and holders, while designed primarily for their maintenance, aid much in preserving the brick work adjacent to them. Following up this hint, the bosh walls of the furnace are now greatly prolonged in life by inserting rows of water cooled plates completely encircling the furnace at distances of about 30 in. between the rows. These are built in the brick work and are invisible, except the outside edge of the plate and the water connections. These plates are removable in case of leak, which is rare.

The accessories to the blast furnace proper are the boilers, blowing engines, hot blast stoves, hoists and water supply. The boilers and stoves are heated by waste gases from the furnace, so that the furnace is practically self-supporting in the matter of power, the only fuel necessary being that put into the furnace for the purpose of smelting. *The furnace gases rise to the top of the furnace,* and are thence conducted away by a large pipe called the "down-take," which carries the gases down to the main flue which lies underground. This flue conducts the gases to the boilers and stoves. The lower end of the down-take is enlarged just before it enters the flue into a chamber of considetable size known as the "dust-catcher," which name sufficiently describes its function. The gases carry with them considerable quantities of dust which accumulate in the flues, stoves and boilers, seriously impairing their effeciency by choking them. This the dust-catcher is designed to obviate. The boilers and blowing engines need little description, as they speak for themselves. The use and operation of the hot-blast stove is a subject of much interest, and to the furnaceman it is a very considerable factor in the furnace economy.

It is apparent that if air at the temperature of the surrounding atmosphere be blown into the furnace it will require a certain amount of fuel to bring it up to the temperature of the seething mass. If this air could be heated, and that, too, without further expenditure of fuel, before it is delivered into the furnace it is evident a considerable economy of smelting fuel must result. This is what is accomplished by the hot-blast stove. The waste gases of the furnace, which formerly were permitted to escape into the air, are by this apparatus utilized for the heating of the blast. Stoves as constructed nowadays consist of a large shell of tank plate enclosing a mass of fire-brick so disposed as to form a large number of small flues or checkerwork. Each stove measures from 15 ft. to 20 ft. in diameter, and 60 ft. to 70 ft. in height, being nearly as large as the blast furnace itself. A total cross-section area of, say 300 square feet is subdivided by the brickwork into a large number of small flues, of say, 40 square inches, thus multiplying the heating surface enormously. These flues are constructed perpendicularly. The gas is admitted at the bottom of one side into a chamber where it is mixed with the proper proportion of air to produce combustion; thus ignited it rises to the top of the stove, where it is deflected down again through a series of small flues. On reaching the bottom, it is deflected up again and then down, having traversed the height of the stove four times before it passes off by the chimney. The gas having been passed through the stove a sufficiently long time to bring the whole mass of brickwork to a bright red heat, it is then shut off and the blast from the blowing engines is then admitted on the opposite side of the stove from the gas, and is made to travel over the same path through the stove in the reverse direction. During its passage it absorbs the heat from the brickwork, raising its own temperature to from 1,200 to 1,500 deg. F. From the stove the air is then carried by the blast main directly to the tuyeres. There are usually three and sometimes four stoves attached to each furnace. Each stove is kept on gas for two hours and on air for one hour; three stoves, therefore, permit of two stoves being kept continually on gas and one on air, a stove being changed every hour. Of course before the blast is shut off of one stove it is admitted through a fresh one, as the blast must be kept continuously on the furnace.

Another valuable feature of the hot-blast stove is the fact that it places within the control of the furnace manager an amount of caloric or heat energy entirely subject to his manipulation; thus, if the furnace is disposed to work cold, an increase of temperature of the blast will usually act as a corrective, and *vice versa*. In the uniform production of a desired grade of iron, this is of the highest value. In this connection a very brief consideration of the chemistry of pig iron may not be out of place.

In recovering from the ore the iron it contains, we do not obtain that iron chemically pure, nor is it desirable that we should do so. We have seen how the earthy impurities were to a considerable extent removed, viz., the silicates of alumina, lime and whatever of magnesia there might be in the ore. But certain other elements, notably phosphorus and manganese, are not thus removed; nor are they ever completely removed, the second only partially, the first not at all. In addition to the impurities of the ores we are adding with the fuel, especially where coke is used, another lot of impurities, notably silica and sulphur. Silica, or silicic acid, as it is *chemically called, being a compound of silicon and oxygen, is not capable of being* decomposed into its constituent elements, silicon and oxygen, except at the very highest heat. Therefore out of the very large amount of silica in the form of silicates that is charged into the furnace, we find only a comparatively small proportion appearing in the pig iron as silicon, which has doubtless been decomposed in some areas of very high temperatures before the tuyeres. A portion of the sulphur is carried off in the slag, but enough remains to make a good deal of trouble to the pig iron consumer. In the resulting iron then, we find in addition to the metallic iron such impurities as silicon, sulphur, phosphorus, manganese and carbon. The carbon in pig iron exists in two states, free carbon in the form of crystals or flakes and combined or dissolved carbon which has been taken up by the iron before the tuyeres. The proportions in which these two conditions of carbon exist in the pig iron depend upon the temperature of the furnace; if the furnace is hot, the carbon exists in very large percentage as free carbon or graphite; if the furnace is working cold, the carbon in the iron will be found largely as combined carbon with little graphite. So, too, as might be inferred from what was said before, a cold iron will contain little silicon as the temperature before the tuyeres has not been sufficient to decompose the silicic acid. The temperature also has a marked influence on the behavior of the sulphur. With the furnace working hot, it is nearly all carried off in the slag, but at lower temperatures its greater affinity for the iron asserts itself and a cold iron is found to contain an objectionable amount of sulphur. Cold iron, therefore, will be low in silicion, low in graphite carbon, and high in sulphur; for most purposes an undesirable combination. The value of the hot-blast stoves in enabling the furnace manager to correct the temperatures of his furnace is thus made plain.

The operations of the blast furnace are continuous until the fire brick lining wears out. This occurs in from two to three years under ordinary circumstances; or a better way of stating the life of the lining is that it will generally yield 125,000 to 150,000 tons of iron, though one or two of America's famous furnaces have turned out 300,000 and even 400,000 tons on a single lining. The management of a blast furnace, the proper mixing of the materials, the regulation of the working of the furnace itself for the production of a large, uniform and economical output calls for the highest skill, watchfulness, patience, and often courage. An accident to the furnace is almost always expensive and often dangerous; the apparatus is always operated under high pressure and the highest heats known to science. Altogether the management of a blast furnace presents a most intricate problem in economical metallurgy.

Cheaper Steel Rails.—A significant article on the steel rail trade appeared *recently in the Iron Age. The opinion expressed* is that the trade is on the eve of important improvements and that new factors will have to be taken into account next year. The Youngstown mill now nearing completion, may enter the rail trade whenever there is a sufficient difference between billets and rails; and thre is the possibility of foreign rails being imported on the Gulf and the Pacific coast. The six great mills, however, may be able to hold their whole territory in spite of any rivals. One has made important important improvements in plant; another has secured a source of supply of cheap raw material; a third has the advantage of a lower duty on foreign ore; and a fourth is extremely aggressive in its management. There is a widespread opinion that lower prices for rails would help the billet market by increasing the con*sumption, and with present prices of raw materials the rail mills could afford* to sell at lower prices than those ruling if they had a larger tonnage. But the financial condition of the railroads is such that the prospect of a tonnage up to anywhere near the capacity of the mills, is not bright.

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OF

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A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.

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ARCHIBALD BLUE,
Director Bureau of Mines.

TORONTO, May 25th, 1894.

IN PREPARATION. TO BE ISSUED IN JANUARY, 1895.

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FIFTH YEAR.

FOR 1895.

Mining, Engineering . Iron and Steel Trades Companies Manual . .

EDITED AND PUBLISHED BY

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Secretary General Mining Association of the Province of Quebec, Honorary Secretary the Mining Society of Nova Scotia, Secretary Ontario Mining Institute.

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Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

School of Practical Science,

TORONTO, CANADA.

THE DEPARTMENTS OF INSTRUCTION ARE . . .

1 Civil Engineering (including Sanitary Engineering).

2 Mining Engineering . . . .

3 Mechanical and Electrical Engineering.

4 Architecture . . . . .

5 Analytical and Applied Chemistry.

The regular course for the Diploma of the School, in each of the above departments, is three years in duration.

A Post-Graduate Course has been established, consisting almost entirely of laboratory work, which leads to the degree of B.A. Sc. in Toronto—Special Students are received in all Departments.

The Session continues from October 1st to May 1st.

SUMMER SCHOOLS FOR PROSPECTORS AND MINERS

And others interested in Mining, have been established at Sudbury and Rat Portage, and a Winter School of a similar character, but covering a more extended course, will commence in the SCHOOL OF PRACTICAL SCIENCE, TORONTO, on JANUARY 8th.

Properly equipped **ASSAYING, ENGINEERING AND CHEMICAL LABORATORIES** are provided for the use of students of the various departments, and the museum contains collections illustrating **MINERALOGY, LITHOLOGY, METALLURGY AND PALÆONTOLOGY.**

For further information regarding the regular Courses and the Prospectus of the Winter School for Prospectors,

APPLY TO THE SECRETARY,

L. B. STEWART, D.L.S.

SCHOOL OF PRACTICAL SCIENCE, TORONTO.