forwarded to the Secretary of the Share and Loan Department, Stock Exchange, London."

Mr. Jonathan Packman moved a hearty vote of thanks to the Chairman for his able statement. They all joined with him in the sanguine view he took of their prospects, but there was one thing of which mention ought to be made, and that was that their operations were being carried on under the British flag. (Hear, hear.)

Mr. Halliday seconded the motion, and it was carried amidst applause.

The Chairman having briefly acknowledged the compliment, the meeting terminated.

Saw-Bill Lake Gold Mining Co.—The following is excerpted from a report of the Managing Director to the shareholders under date of 13th ulto.:—We now have erected an office and living camp for Manager, 14 x 16, a sleeping camp 12 x 16, kitchen 14 x 20, warehouse 15 x 15, and stabling. The timber for those buildings had to be cut and hauled from about one mile south of the location, there being no timber large enough on the ground. This of course detained us considerably. On the 27th April the buildings were all completed and two shifts of miners were started in the shaft, the dimensions of which are 7 x 10 outside the timbers, making a good, commodious double compartment shaft.

At the time of leaving the location we had reached a depth of slightly over 50 ft. from the floor of the shaft house to the bottom of the shaft, and 55 ft. from the actual starting point.

A hand windlass was used with a bucket till the 10th of June, when we discontinued work pending the erection of our shaft house and the setting up of our machinery, and since that time the hoist has been in operation and with decided success. We are now erecting a house 24 x 30 to cover the machine and boiler, and a blacksmith shop adjoining it. This engine house building will also make a very comfortable "dry" both winter and summer, for the miners, and being heated with the boiler will save the expense of another building.

The hoist is of 20 ton capacity and capable of sinking 300 ft. We have two pumps purchased from the Northey Manufacturing Company of Toronto; one a feed to the boiler and of sufficient capacity for fire protection, the other for a mine pump, which so far has not been needed, the mine making water only at the rate of two barrels an hour, and easily taken care of by hoisting with the bucket, thus saving considerable trouble and expense in delays.

The following mining results should be most encouraging to the company.

At the point where the shaft was begun it showed a width of about 3 ft. and has gradually increased till its present showing is 5 ft. wide in the north end and over 6 ft. at the south end of the shaft, with both foot and hanging walls well defined, and the quartz showing a larger amount of free gold than on the surface, assays from which show as follows:

Hille	...Free Milling Test	$ 8.50
Hille.....	...Free Milling Test	14 50
Billings, Duluth.....	Assay	35 00
Billings, Duluth.....	Assay.....	45.00
Giblin	...Assay.....	97 00

These assays represent average of the shaft at different depths.

The amount of ore on stock piles, the result of this work, I estimate at over 200 tons, which is over double the quantity that was estimated by Mr. Chewett in his report, and represents a large amount of work in such a short time.

It is the intention to proceed with drifting north and south at the 60 ft. level. This will begin when the shaft has reached a depth of 75 ft., when damage to the shaft timber by blasting will be avoided.

You will observe that in drifting from the 60 ft. level the vein is of such width that little or no waste material will be handled, the vein being the full width of the drift. Nothing will be handled but vein matter, which will make quite a saving over a vein about 3 ft. wide—the width thus showed on the surface. It is my opinion that while the drifting proceeds we will meet with richer ore than so far obtained from the shaft.

With the present staff of miners engaged sinking it is expected that by the end of October we will have reached a depth of considerably over 100 ft. (providing no accidents to machinery), the product from which, together with ore mined and raised from the drifts, will place a very large quantity of ore on the stock piles ready for milling, and if the present conditions as to quantity and quality continue—and I have every reason to believe they will—the results should be most satisfactory to the shareholders, as very large dividends may be expected.

Improvements in Blasting Operations in Collieries.*

By M. C. Illsens, State College, Pa.

One of our humorists said of powder, with more truth than poetry, that in itself it is perfectly harmless, but it is the fire that makes it dangerous. This thought has been pressed home during the past few months while engaged in analyzing our own mine inspectors' reports and comparing the results with those of foreign countries. In fuse, cap, squib, lamp and pipe are the elements of danger. Fire-damp, coal-dust and air are the ever present fuel for the flame, and may be passive or active, according to the attendant circumstances which we do not fully understand. Imperfections in manufacturing, carelessness in handling and over-confidence in its use are the conditions which finally result in an explosion in which neither life nor property is spared by the devastating flame. The concomitant circumstances inducing or aggravating colliery explosions seem to elude our most vigorous search. Some of the causes are easily traced and are well known. The origin of some of the explosions is not thoroughly conceded. Many of the disasters occur under circumstances apparently mysterious and where much fire damp did not likely exist. Some causes are still unaccountable; they baffle our closest investigations. Some seem remediable, yet they resist our greatest defensive skill, while of others their effects may be mitigated, if not actually controlled. We may dilute the inflammable gases by a copious well-directed air supply and render them innocuous. We may seclude the illuminating flames of our safety lamp. We may sprinkle and precipitate the coal-dust, and we may regulate the manner and the time of blasting. The mine inspectors, operators, and employees alike may, and do, co-operate to give effect to the regulations for the safety of the mine and the health of the employees; and yet during last year 240 lives were sacrificed in hundreds of accidents from explosion of gas. This aggregate is much smaller than has been witnessed in seven years, and compared to the total number of fatalities is only a trifle smaller than formerly. Indeed, this comparative figure, as a matter of fact, will continue to increase rather than decrease, because with the growing intelligence and care of our miners, accidents from falls and cars do perceptibly diminish each year, and because with the increasing depth and consequent dryness of mine is added that dreaded element of danger which has the power of propagating flame and of imparting explosive characters to a slight admixture of fire-damp with air.

The explosive material may consist of gas, of traces of fire-damp and dust, or of mixtures of air and dust alone, but whatever they be there will be no explosion, no ruinous hurricane unless and until the necessary and sufficient element, fire, be brought into contact with them. The source of the combustibles may be unknown, their composition may vary and the most patient search fail to reveal the reason for their violent behaviour, but we do not know how disastrous are the results when heated to a temperature above their point of ignition.

Fire-damp continually exudes from the coal and white damp from goaf or gob to threaten us; of the former from one district there was carried out by the ventilating air currents 39,700 tons per year, and of the latter gas an average of the numerous analyses of the upcast showed 650 tons of the poisonous inflammable carbonic oxide to have been swept out of the mine atmosphere. These combined nearly equalled in aggregate calorific power the total volume of coal produced by the same colliery during the same time. But these are not our sole enemy; for while they create a condition for explosion there is always a possibility of reducing the extreme danger by a plentiful supply of air, and there is a probability of its immediate detection upon expulsion into the mine: its presence is not always necessary for the propagation of flame with explosive effects if dry coal dust is afloat in the air. For the latter, in its highly comminuted and porous state, has the power of condensing upon its surface and retaining there, also absorbs oxygen from the ventilating current. A room full of such dust is actually a huge explosive cartridge of solid and gaseous combustible matter which needs but one element for its decomposition. This condition prevails in our bituminous mines. They are not regarded as gassy, and yet explosions therein involve greater areas than do those in anthracite mines which rank as the most gaseous in the world. In the latter there is comparatively little dust and a very small amount of absorbed gases to propagate the explosion. Explosions in anthracite mines are therefore comparatively local in their results. No coal mine is free from gas or coal-dust and its safety depends upon the elimination of every source of flame or fire from all its operations. Illumination we must have and that by flame, even if it is not better than the Davy or the Clanny, which gives us but one-fourth of a candle power; and this is the only form of flame permissible underground. Grant that it may be supplanted by some better illuminant for our roof. Though other sources of flame yet exist in our underground workings, all are accidental except that developed at the time of the ignition of the blasting powder employed to release the coal from its place. It is true that the amount annually employed is gradually decreasing with an increased skill and the employment of underholing machines, nevertheless we still use throughout our State 2,000 tons of black powder in the combustion of which we liberate into the mine gas, flame and sparks enough to account for many of the seemingly mysterious explosions. The importance of a closer attention to this branch of operations cannot be over-estimated. An improvement in their grade and the exercise of greater care in their use I am sure you will agree with me will procure for us a healthier and a safer condition of mine, for there will be eliminated some of the prevailing dangerous conditions with which we are fully cognizant, but with which by our present means seem to be unable to cope.

That black powder is totally unfit for use in gaseous collieries we must admit, also that the time has come when we should have the courage of our convictions and restrict its use. Long have we been familiar with the accidents from misfired shots, from premature explosions and from blown-out shots. Long have we recognized its deficiencies and continued to use it without protest, and probably the most of us have witnessed the degeneration of some grades of these disruptive agents. Why continue to accept the present order of things? Let us fulfil our mission as engineers and render still more safe the lives of those who are entrusted to our care and the property of our employers.

It was once my misfortune to have some experience in another field with one of the inferior grades of black powder containing, as a result of the active trade competition, an excess of the cheap constituents which resulted in the development upon ignition of an excessive amount of carbonic oxide. One pound of such powder projected into the mine atmosphere four ounces of this gas, sufficient to vitiate a room 20 ft. wide, 5 ft. high, and for a distance back from the face of 3 ft., to a poisonous degree. A human being could not live in this atmosphere. And this product, itself combustible, is in a nascent state and will ignite at a comparatively low temperature. When the heat of combustion reaches the temperature of ignition of this gas, it is exploded with the emission of a flame which becomes the nucleus of the auxiliary explosion which is so much dreaded because, while the first raises a cloud of dust, the second converts the workings into a seething mass of flame. This expands the later products of combustion and forms a new explosive zone which traversed great lengths of gangways and into vast areas of workings. This arises from the incomplete combustion of the ingredients of the blasting agents. They are either not in proper proportions or are not in mechanical intimacy. The combustible and oxidizing bodies must be perfectly resolved into their respective molecules for instantaneous combination into gaseous forms, and there must be sufficient available oxygen to burn the combustibles. These deficiencies it remains for the manufacturer to supply. In this regard it must be said that the unglazed powders are undoubtedly an improvement upon those whose grains are glazed, for they burn more quickly with the evolution of less noxious products. But even these are better and more powerfully fired by the aid of a detonator than by the treacherous, sputtering time fuse. A strong detonator with a sufficient fulminate and an electric machine for firing it are the *sine qua non* of any safe explosive. If in addition to this the powders be well rammed and tamped with a hard, non-carbonaceous material the gases would be more strongly confined and more of the evolved heat would be converted to mechanical disruptive energy. By this means both the efficiency and safety would be increased to a comparative degree. Even with these improvements in our use of powders there remains the liability to blown-out shots or the deleterious effects of the products of their combustion which have so toxic an effect upon the system.

Explosives which are capable of complete detonation, as are the nitroglycerine compounds, are safer for mining purposes, though more shattering in their effects. They emit little, if any, flame and evolve no combustible gases. Nitroglycerine has a sufficiency of oxygen in its composition for completely burning the combustible elements to carbonic acid, and at the risk of arousing criticism, I venture to commend the use of dynamite in proper charges as productive of good results, even in so brittle a material as are our coals. The deep grooves and the deeper holes which would be necessary would militate against the extended employment of dynamite in rooms as well as in rock work. It is perfectly harmless, safe to handle, easy to transport, so long as no liquid nitroglycerine exudes, and so long as it has not suffered deterioration by being stored underground or in a damp place. The risks of explosion are lessened but not eliminated by its use, and it is a gratification to notice the increasing use of dynamite in the gaseous mines of this State. I predict that the near future will witness its entire substitution for black powder.

In several countries of Europe the use of black powder has been prohibited in coal mines, and in more has its employment been restricted to districts which are regarded as absolutely safe. The number of mines embraced in the latter category is rapidly diminishing with the recognition by the operators of the amount of energy wasted in incomplete combustion of their explosives and the discovery by the officials

* Paper read before the joint meeting of the W. P. C. M. I., and the O. I. M. E., June, 1896.