named; but it will make these notes too long to go into the question of the different combining powers of each base with silica, and when each should be added or reduced on account of the specific gravity of the proper slag to be made for matte settling purposes.

The first heat required is for heating the air blast up to the temperature when the oxygen will combine with either the carbon of the coke or the sulphur contained in pyrites; then the necessary heat for smelting ores and fluxes so that they will combine to form the proper silicates for fluid and clean slag is produced by the oxidizing of the fuel added to the charge by the free oxygen contained in the blast. If cold blast is used, any free oxygen going in with it is required to oxidize the extra fuel required to heat the blast, thus leaving none for the sulphur. If more cold blast is used so as to get still more free oxygen, it drives the heat still further away from the tuyere openings into the furnace and reduces the smelting area of the furnace in that proportion, driving the heat higher up in the furnace, burning the fuel and smelting the ore so near the top of the furnace that and metals volatilized have no chance to get caught. It keeps the fuel burning so high above the tuyeres that it leaves very little for the blast to encounter as it enters, unless a large quantity has been used.

When the cold blast enters the furnace from the tuyere openings, and encounters the hot material without fuel mixed with it to generate the heat, a crusted furnace is soon the result, starting at the tuyere nozzle and reducing the capacity of the furnace until it closes it. This is the result when too much cold blast is used, or too little fuel is used with the cold blast. By the use of the hot blast this trouble is greatly decreased, and the hotter the blast is the better it is, up to a point where all the remaining heat necessary for smelting can be produced by the combination of the oxygen in the blast with easily oxidized elements in the ore, such as sulphur, arsenic, etc. When these elements are not in sufficient quantity to produce an oxidization the balance of the heat without making too high a concentration; that is, when there is not enough sulphur to make matte for the regular clean working of the furnace; then sufficient fuel should be used in order to save the necessary sulphur for making a proper grade of matte. With a hot blast, a cool top, and careful feeding, a more uniform grade of matte is made than it has ever been possible to make by the use of the cold blast. At the same time, there is less loss of precious metals by volatilization.

The advantages of a hot blast over a cold blast are in the improved chemical conditions, economy of fuel, and the greater capacity of the furnace. When the blast is heated without any expense, every degree of heat so obtained is a saving of a percentage of coke needed for fuel in the working of the furnace. As a matter of fact, the saving goes beyond that point of contact in the furnace from each one of tuyeres, thus reducing the activity of the coke furnished, and imposing an increased demand on it.

This chilling action reduces the capacity of the furnace in proportion to the area occupied by the chilled portions, and near the nozzle of each tuyere will be found a large surface of the charge chilled below the fusing point by the action of the cold blast, which, with hot blast, would be kept active. This portion cuts a material figure, so that the use of the hot blast in that direction alone is a decided advantage. As a matter of fact, it has been found in the practical working of furnaces on a large scale that it is advantageous to heat the blast by separate ovens, where the expense for fuel in operating these ovens was more than double the saving of the fuel in the furnace charge. It was found that the increased capacity of the furnace, and the improved chemical conditions which resulted in bringing about a more thorough fusion of the ore, more than compensated for the extra cost of the fuel to heat the air. This fact having been demonstrated on a large scale, one can see how much advantage it will be in the cost of operating any furnace if the air can be heated automatically without cost. Realizing the field for improvement in this direction several inventions have been brought out to accomplish that end. Most of those I have seen utilized the heat escaping from the fumes of the furnace by means of coils of pipe, at some distance above the feed floor of the furnace. Where a furnace is properly fed and properly operated so as to prevent volatilization of the precious metals, there should be very little heat above the feed floor, so that to utilize the invention it is necessary to keep a strong blast running through the entire charge of the furnace, igniting the free atoms of sulphur and the coke on the top of the charge. This causes a heavy loss by volatilizations where the ore contains tellurides, lead, or other volatile substances, and destroys a great portion of the fuel heat, before the charge reaches the oxidizing portion of the furnace. In other cases, attempts have been made to use the waste heat escaping from the slag, but this has been taken in such a way that the fumes from the slag were driven back into the furnace again, furnishing an impure blast with a great portion of the free oxygen already removed.

The object of my researches has been to secure a hot blast which would furnish the air heated to a sufficient degree of heat to prevent chilling, at the same time increasing the capacity of the furnace and minimizing the use of fuel; and to accomplish this without any additional cost for operation. This I have been able to do by what is known as the Bretherton hot-blast apparatus. In constructing this apparatus I have kept in mind the principal features required for its successful operation, doing away with the back pressure on the blower so that the volume of air would not be minimized; taking the heat of the hot slag by building an oven around the forehearth, the oven having flues passing through it for the escaping fumes of the hot slag; and augmenting the heat acquired in that manner somewhat by using a set of air jackets around the furnace, the air having a continuous passage from the blower to the tuyeres. In this way I have been able to keep the top of the furnace cool, so as to prevent volatilization.

The first and most important item to consider when heating the air blast is to see that it in no way interferes with the regular working of the blower, as the blast passes through the blower cold. All calculations as to the amount of blast required and can be based on the regular volume handled by the blower, the same as when using cold blast. It is customary to calculate the amount of blast furnished by the tables sent out by the manufacturers of the different blowers. In this way, the amount of free oxygen sent into the blast furnace, whether heated or cold, can be calculated, provided there is no obstruction to the free passage of the air through the heating apparatus. It is therefore, necessary that the area of the heating box shall be larger than the inlet where the cold blast enters, so that no back pressure is created. The outlet of this heating box should be made with nearly double the capacity of the inlet.

By our latest arrangement at Silverton, Colorado, we not only utilize what little heat there is to be saved practically above the feed floor, but utilize the heat which would otherwise go to waste through a much needed, large enclosed matte-settling arrangement, excepting that all the heat in that case was obtained from the slag and the wood burned on the settler's surface, as in the one we first started with. With that we reduced our fuel to one-third, and dispensed with all preliminary roasting, where we had been roasting two-thirds of the ore and concentrates smelted.

The matter of the transmission of power from Niagara Falls to Toronto, Ont., has been taken up by two local corporations, the Toronto Street Railway and the Toronto Electric Light Company. Although no decisive action has yet been taken by either of the companies, at least one of the concerns engaged in the development of power at the Falls is confident of selling a large quantity in Toronto. While three power companies intend to operate at the Falls, the Ontario Power Company has been the most active in endeavouring to find its market away from that district. This company is utilizing the natural advantages offered it, by which it secures its water power from the Welland river, the water being carried over the cliff into Queen Victoria Park, will it is estimated, be able to produce as much power with an expenditure of $5,000,000 as the American company has secured at an expenditure of $15,000,000.