explained. In proof of this contention the mines of the Adirondack region may be instancer.

There has ever been a disposition to under-estimate the great importance of the magnetic iron ores of the Ottawa and Pontiac counties, the specific objection raised against the availability of the ores in that region being that the cost of fuel to smelt the ore is prohibitive. With the steadily decreasing quantity of coal required per unit of finished product, due to the better utilization of fuel by modern methods, this objection is, however, of lessening importance, while on the other hand we have these favorable factors: The ores are rich, the bodies are large, and cheaply mined, for little timbering or pumping is necessary. The objection is occasionally raised that magnetic ores are not as readily reduced in the furnace as hematites, and are, therefore, not worth as much to the smelter. In a general way this is true, although one fact deserves consideration, and that is that magnetites are practically free from moisture, so that their carriage is proportionately less. It is estimated by one of the leading furnacemen in the country, that magnetite involves an extra expenditure in smelting of about twenty-five cents per ton of pig, and even that is only a general statement, since there is considerable difference in the ease with which different magnetites are reduced in the furnace. An interesting practice bearing on this point has been developed at the Wharton furnaces, where New Jersey magnetites are roasted in kilns fired with waste furnace gas, or with producer gas, before being charged into the furnace, a practice for which important economics are claimed.

Another feature which speaks greatly in favor of cheap reduction is the enormous amount of available water power in the vicinity of the mines, which could be readily used for the production of electric energy in electric smelting, as suggested by Dr. Haanel, Dominion Superintendent of Mines; and reference may be here made to the Chats Falls, on the Ottawa River, near the Bristol Mines, and to the Chelsea Falls, on the Gatineau River, in the vicinity of the Ironsides Mines, where more than 50,000 horse-power can be cheaply produced for general mining and smelting purposes.

Referring to the concentration of these iron ores, which are to a great extent of low grade, it should be stated that the Port Henri mines in the Adirondacks, where conditions are similar to those obtaining in the Ottawa and Pontiac counties, have successfully adopted separation processes.

For years the concentration of low grade ores by some form of electro-magnetic separator has attracted the interest of the miner and inventor alike. Among the first to test and develop processes of magnetic separation in the Adirondacks were Witherbee, Sherman & Company, who were called upon to meet two sets of conditions. The New Bed and Harmony ores, low in phosphorus and varying in purity from 40 to 69 per cent. iron, form one group, while Old Bed ores, practically of uniform grade at 60 per cent. iron, but high in phosphorus—1.35 to 2.25 per cent.—form the second group. The magnetic separation, or rather purification, of the latter is particularly interesting and unique, the problem being to eliminate the apatite or phosphorus-bearing gangue, which is practically non-magnetic. The apatite varies in color and in the size of crystals. These two characteristics have a bearing upon the degree of concentration possible. In the case of the apatite of a deep red color the magnetic characteristics are sufficient to carry at times an appreciable percentage of the free crystals into the iron concentrates. Then, too, these deep red crystals adhere more tenaciously to the crystals of magnetite than the green or yellow varieties. The yellow apatite crystals break away most freely from the magnetite. When the magnetite is a shot ore, or of large crystalline structure, it is not difficult to bring the ore into a condition admitting of practical concentration. When the ore is massive, or the crystals of magnetite and apatite are both small and finely disseminated throughout the mass, finer crushing is necessary for the same degree of concentration.

In order to meet these conditions of the ore, it has been found necessary to carefully prepare the ore by crushing, drying and sizing before treating it on the magnetic separators. Aside from this treatment for physical peculiarities of the ores, a rough cobbing is made at the pit head, the first-grade product being sent direct to the furnaces and the second-grade ores being sent to the separators, except at such times when the whole run of mine is concentrated.

To make the Old Bed high phosphorus ores of more value to the blast furnaces, Witherbee, Sherman & Company built a separating plant about two years ago, and later erected another mill, to care for the total output of this grade of ore. During the two years of operation of the plants the methods of treatment have been improved from time to time to assure uniformity of product. While from the start the process has been a commercial success, the improvements introduced have tended to lower the percentage of phosphorus. It is very doubtful if a true Bessemer product can ever be made from Old Bed ores, yet the limits of variation in the phosphorus of the concentrates are being narrowed.

The separating plant is divided into three main sections, the crushing plant, the separating plant and the re-treating plant. Each of these product divisions is also made a power division, a motor being so placed as to control the machinery and conveyors in each division without reference to the others. In the original plant direct current motors are in use; in the second plant alternating current is the motive power. Between each division there are interposed bins, which, through their storage capacity, make it possible to operate each section individually for about two hours without obtaining fresh supplies from the preceding section.

Crushing Division.—The crude ore is first crushed in a 30x18.inch Blake crusher, operating at a speed of 250 revolutions, to 1.50 to 2 inch cubes. The resulting product is then passed over a screen of 0.75 inch opening, the oversize being crushed to 0.75 inch cubes in a Blake 36 x 6 inch double jaw crusher, running at 225 revolutions. The material passing through the screen and the crushed product unite, and are again screened over a six-mesh screen, the ruling size of the mill. The oversize is crushed in a set of 36 x 14 inch Reliance rolls, of Allis-Chalmers make, running 100 revolutions. The troughs of the screens and the product of the rolls unite, and the combined materials are passed through a dryer.

The dryer is a square vertical stack, with baffle bars placed at right angles to one another in alternate sections, there being eight sections with six rows of bars to a section, and six bars to a row. In falling over these bars the body of ore is broken up and permits a free circulation of hot air throughout the mass. The ore being fed in at the top of the dryer, passes constantly into a hotter zone, the heated gases from the grate passing from bottom to top of the stack. On discharging at the bottom of the dryer the ore is elevated to a tower screen, having 288 square feet of screening surface. This screen is divided into equal sections of 30, 16, 10 and 6 mesh screens. The product of each size screen is delivered to a separate pocket in a bin. The oversize of the screens is returned to a set of 36 x 14 inch Reliance rolls, so placed that the product of the rolls meets the original stream from the dryer. By this arrangement material is confined to a closed circut, the only outlet being through the screens. The finest screens of the series are placed at the top, in order that the coarser particles may scrub the fine material through and cause a more effective sizing.

The object sought by frequent screening is the elimination at each stage of the coarse ore, thus preventing pulverization. That the process amply pays is shown in the fact that of the total shipping product about 65 per cent. consists of particles larger than ten mesh—an ideal ore for blast furnace use, as has been fully demonstrated during the past two years.

Separating Division.—Under each pocket of the bin is placed a Rowand Type F magnetic separator, treating one size ore. Ball & Norton separators have lately been introduced on the 30 and