

the gearing of the Brückner the speed may be varied from zero to six revolutions per minute, according to the requirements of the roasting process. In the Brückner furnace the charge—of about 3,000lb.—is introduced through a door in the cylinder, placed half-way between the two ends, which is closed by means of a clamp. These furnaces are constructed with two doors opposite each other. A characteristic feature of the Brückner cylinder is the diaphragm, which consists of iron plates about 1in. thick, fastened to tubes passing through the cylinder at right angles to its axis. The plane in which these tubes are placed makes an angle of about  $30^\circ$  with the axis of the cylinder, so that the line where the plates and cylinder meet is an ellipse. This diaphragm extends to within 18in. of each end, and when the furnace revolves it produces a circulation of the pulp from one end of the cylinder to the other. Although this diaphragm gives an almost perfect motion to the ore, it has several disadvantages, among which are the following: The cast-iron of which the plates are composed is corroded by the action of the sulphur and chlorine; and the lively motion conveyed to the pulp causes a great portion of it—sometimes as high as 30 per cent.—to be carried into the dust-chambers. A great part of this dust, too, leaves the furnace before it has had time to be roasted, and thus escapes decomposition altogether. In consequence of these disadvantages the diaphragm is now usually omitted. Although the furnace as at present constructed does not chloridize to quite as high a percentage as it would if provided with a diaphragm, it has been proved to be far better suited to the economical working of ores. When the charge has been properly roasted, it is discharged through the doors by opening them and revolving the cylinder. As these furnaces are at present built the speed can be increased when it is necessary to discharge by introducing a gear-wheel of larger diameter than that which ordinarily gives motion to the furnace. The Stetefeldt is a high-shaft furnace, into which the flame enters from two fireplaces on the sides at the bottom, the ore, mixed with salt, being fed into it at the top. The fumes and dust pass out through a flue at the top, descend, and, after passing through the flame of a smaller auxiliary fire, are conducted to the dust-chambers, whence the fumes escape through the stack. The ore only occupies a second or two in passing through the flame; but it is retained at the heat at the bottom of the furnace three-quarters of an hour before drawing the charge. The auxiliary fire has also been applied in connection with the revolving cylinders, and with good results. The reverberatory furnace, as applied to the chloridation of silver-ores, has sometimes one hearth, and sometimes two or three hearths. When several hearths are used the ore is first put into the one nearest the flue, and after roasting a time is raked to the next, and finally to the last near the fireplace. Thus, in a furnace with three hearths there are always three charges in different stages of roasting. The O'Hara furnace is a brick double-decked reverberatory one, 9ft. high, 8ft. wide, and 60ft. long, in which the ore is stirred with scrapers or hoes attached to an endless chain moved by the mill machinery. The two hearths are level, one above the other, and 47in. apart (arches 10in. spring), 60ft. long, and only closed at the ends by hinged sheet-iron doors. These doors close the furnace so that the draught is not injuriously affected, and also enable the scrapers to pass under them readily. There are four fireplaces, two on each side, so arranged that all may be used to heat the lower hearth, or two of them may heat the upper hearth. The draught is through a stack connecting with flues from the arches over the hearth. The endless chain passes over both hearths in opposite directions, and over a pulley at the end of the furnace. To one of these pulleys power is transmitted by spur- or friction-gearing. To the chain, at equal distances apart, are attached two scrapers. Each of these carries fourteen hoes—plates of wrought-iron, about the size of a hoe—which are dragged along the hearths through the ore. These hoes are set at a slight angle with the chain, thus moving the ore somewhat forward as well as turning it over. The hoes of one scraper are set in a reverse position from those of the other: thus the ore is not pushed to the centre or sides of the hearth, and the furrow made by one scraper is filled by the next. As the links of the chain and scrapers pass from one hearth to the other through the outer air, they are but little attacked, and last for months. It is not absolutely necessary to line any of these furnaces with fire-brick; but it is always best to use fireproof material in the neighbourhood of the flame. As a rule, fire-brick is much harder than the ordinary brick, and for that reason is better suited to stand the tear and wear of a revolving-furnace. There is not much difficulty in keeping the brick in place in the Howell and White furnaces, their diameter being small; but with the Brückner it is otherwise. The large diameter of the furnace causes the arch to be insecure unless the bricks are good and put in very tightly. A very good method of increasing the security of the lining is to divide the circular arch into four parts by running flanges of boiler-plate the length of the cylinder, thus making four independent arches. For this furnace it is cheaper in the long run to use the best fire-brick, and as little clay as possible. Salt and ashes are said to make a very good mortar for laying the bricks in place, and they certainly form a mortar which does not contract on being exposed to heat. The heads of the Brückner furnace are usually lined with the best fire-clay, tamped around and over projections of iron, or large bricks are moulded in the form of a segment of a circle and fastened to the heads by clamps and bolts.

*Dimensions of Furnaces.*—The dimensions of the Howell furnace are as follows: Length, from 16ft. to 27ft.; inside diameter, from 24in. to 38in. The furnace is made in several sections, which are bolted together. Formerly the two sections near the fireplace were made larger than the others, and were only lined with brick. It has been found good policy, however, to make all the sections the same diameter and line the cylinder with brick throughout. The White furnaces are usually shorter than the Howell, and of greater diameter, and are lined throughout their whole length. The bricks forming the lining of these furnaces are usually set on edge. The Brückner cylinder is usually 12ft. long and 5ft. in diameter inside, the bricks being laid flat. Some furnaces, however, have been constructed for the *Ætna Company*, at Galena, Nevada, 16ft. long and 6ft. 6in. in diameter. These furnaces are provided with four discharge-holes. The Stetefeldt furnace is built of different sizes: the shaft proper is usually between 30ft. and 40ft. high. The usual size of a reverberatory-furnace hearth is 12ft. square, the arch being made low in order to keep the flame as near the pulp as possible; but they are sometimes much longer. In the Howell furnace the