creased yield, that the author expected improved results by the use of basic linings and more calcareous slags in copper smelting.

In May, 1889, the technical adviser of one of the largest copper-smelting companies was exceedingly anxious to make a trial of a basic lining in one of their roaster furnaces. This lining was accordingly put in and is still in perfect condition. The results obtained with this first lining were so satisfactory that at the present time the company have nine roaster furnaces at work treating arsenical "metallic bottoms" and white metal. As the old roaster furnaces require renewing, they are being rebuilt with basic hearths, so that, shortly, probably all the roaster furnaces employed at these works will be furnished with basic linings. These roaster furnaces have cast-iron bottom plates, underneath which a free current of air circulates; by this means the bottom of the furnace is kept cool, it likewise prevents the possibility of any fusing action taking place between the basic hearth and its support, which might be the case were the basic hearth built directly upon the ordinary silica arch. The basic material is ground and mixed with tar in the usual way, and the furnace bottom is formed by throwing this material into the hot furnace and burning it on in layers, well beating down each separate layer and giving it fire for some hours before applying a fresh layer. It usually takes four or five days to burn on a bottom in this way. When the bottom is properly shaped it should be seasoned by melting on it some rich copper precipitate or good blister copper. It was at first considered that the basic hearth absorbed less copper than the ordinary sand ones, but there appears to be very little, if any, difference between them, much depending on the way the bottom is formed and seasoned. The tap-hole of the furnace is shut by throwing a little basic material against it from the inside. In other respects, the working of the furnace is conducted in the usual way. After each charge any slight repairs that the banks may require are made by throwing some basic material against the place needing repair; the repairs required are, however, very slight in comparison with an acid furnace, the tendency being for the furnace banks to grow rather than to cut away.

The mineral in use at these works is arsenical, and although in the crude ore the arsenic is not high, yet when the ore is allowed to oxidise in heaps and the copper afterwards precipitated from the solution, obtained by lixiviating the ore, arsenic is concentrated in the precipitated copper to a considerable extent, the resulting precipitate usually containing some 3 to 3½ per cent. of arsenic. Very large quantities of this precipitate are treated. It is added to the mixture of slag and metal charged into the smelting furnace, and according to the amount of precipitate so added to the charge, more or less of the product tapped from the smelter consists of impure copper, known as "metallic bottoms." An average analysis of these bottoms gives:—Copper 83 to 87 per cent.; arsenic, 5 to 7; sulphur, 1 to 3; iron, 0·5; lead, 3 to 5; silica, 0·5. It is in the conversion of these metallic bottoms into blister copper containing under 1 per cent. of arsenic that the basic furnaces have shown themselves to the greatest advantage. Calculations show that taking the real copper in the "metallic bottoms" at 84·5 per cent., and the real copper in blister at 98·5 per cent., there was obtained in the form of blister 94 per cent. of the real copper from the basic furnace and 56 per cent. of the real copper from the acid furnace, showing a gain of 38 per cent. in favour of the basic furnace. The real copper in the slag works out to 25 tons 14 cwt. from the basic furnace, and 121 tons 19 cwt. from the acid furnace.

In addition to the largely-increased yield of blister obtained from the basic furnace over the sand-lined furnace when treating metallic bottoms, there is a further advantage, viz., that these metallic bottoms have a most deleterious effect upon the sand lining of the furnaces, the bottom nearly always requiring repair after three or four days' working.

After carefully investigating the results obtained from the substitution of a basic lining in the roaster furnace for the ordinary sand lining, it was resolved to test whether any substantial improvement resulted from a similar change in the refinery furnace. The margin for improvement in the case of the refinery furnace is far less than in the case of the roaster furnace process; it is therefore still a little uncertain whether the extra cost of the initial basic lining and of the current repairs are compensated for by the slightly increased yield, when making ordinary tough cake. When, however, it is a question, not of making ordinary tough cake, but of producing best selected copper from ordinary arsenical blister (containing about 1 per cent. of arsenic) there is, in the author's opinion, a very great saving in waste effected by the use of a basic lining in the refining furnace.

The basic refinery has so far been used chiefly for the production of best selected copper from B. S. precipitate only, or from pure blister containing only some ·2 to ·3 per cent. of arsenic, but some charges have recently been made from blister containing 1 per cent., and which have been worked down into B. S. ingots with very good results as regards yield, but as might naturally be expected, longer time is required.

Summing up, therefore, the results so far obtained in basic copper smelting, it would seem that where the basic process has shown itself to be of most use is in the treatment of highly arsenical material tapped from the smelting furnaces. Such material, being produced from the poorer arsenical precipitates, generally gives a great deal of trouble in the ordinary way of working, with a very high loss of copper in the slags, which necessitates extra labor and expense to rework. Another very important point to which the basic process shows itself well adapted is in the refining of blister rather high in arsenic (say from 1 to 1½ per cent. or higher) for the purpose of making B.S. ingots.