Naturally, the flux is used within certain limits, according to the quality and physical features of the slimes after calcination. All new plumbago crucibles are subjected to a preliminary treatment before use, thus increasing their life to a considerable extent. The treatment is as follows:—They are placed in the furnace and heated for 30 minutes, to remove the glaze, after cooling they are placed for 45 minutes in a saturated solution of borax, and are afterwards dusted over with powdered borax and placed over the calcining furnace to dry, and when dry, reheated in the reverberatory furnace until the borax fuses. New clay liners, whenever possible, are used in the first charge of the smelt. This obviates the necessity of suddenly subjecting them to the high temperature of the furnace prevailing with subsequent charges.

A type of furnace which, with a few slight alterations, would be quite suitable for this work, is the old reverberatory pan furnace, known locally as the Tavener furnace; one point I may mention in connection with furnaces used for smelting rich gold bearing materials, is the lack of proper condensing chambers in the flues. I am convinced that some kind of condensing chamber is necessary and should be attached to all furnaces smelting finely divided and rich product, such as cyanide gold slimes. Even with all the precautions that can be taken in fluxing, such as using a borax cover, or placing covers on the pots, I have every reason to believe that gold is carried off to the flue, both mechanically and by volatilization.

The buttons of gold obtained from the fusion are usually of high grade, and ready for casting into bars. Occasionally, a thin skin of matte may appear on a few of the buttons, and when this occurs they are arranged so that those with the matte are placed in the same crucible as the highest grade button of the smelt, thus averaging up the fineness in the bars. No attempt is made to desulphurize the matte in smelting, but this is skimmed off and kept for future treatment with the bye-products in the pan furnace, where it will be desulphurized with battery screens. This matte generally occurs in case of cracked liners when the slag comes in contact with the graphite crucibles. My experience goes to show that to a very large extent the fineness of the bullion produced on these fields depends mainly on good calcination. Perfect calcination has two other great advantages, firstly, by reducing the bulk of the material; secondly, by perfect oxidation of the base metals, doing away with the necessity of using a large quantity of oxidizer in fluxing, thus reducing the value driven into the slag—particularly of the silver.

For very base bullion, owing to the presence of metallic lead and copper, I find that cupellation with clean lead is the only satisfactory method of bringing up the grade. This, however, should not be necessary on these fields, as low grade bullion is rare and unnecessary.

In casting cyanide bars it is usual to keep their weight in the neighborhood of 700 oz. A point that has often been raised on these fields, is to what degree of fineness should bullion be brought. At present we have all kinds of pains and penalties to avoid at the hands of the refiners in London. This seems rather extraordinary when we consider the tonnage, for that is what it amounts to, of the gold we turn out. A mine that refines its gold up to over 900 parts per 1,000 fine receives no better terms than one which just reaches the mark of 900 gold and silver. There is no doubt that every penny we spend on refining our bullion beyond the point necessary to escape the penalties, is to my mind, unnecessary. The present system is certainly not satisfactory, and would bear thorough investigation at the hands of those who have the disposing of the gold on behalf of the mines.

Another point also suggests itself, why should we ship all our bullion home for refining? I can see no reason why a refinery should not be established on these fields. The technical part of the work can be successfully carried out here, but I will leave the discussion of the financial side of this question to members who may have more data at their disposal.

For the treatment of bye-product many mines are equipped with the usual kind of reverberatory pan furnace. As the construction of the furnace is the main factor which governs efficiency and working costs, I give the following dimensions of a furnace of this kind, hoping they may be of use to some of the members.

The pan in which the furnace hearth is built is made of ½ in. iron, measuring 9 ft. x 6 ft. with a depth of 24 in.:—

Size of grate in fire box, 3 ft. 6 in. x 3 ft.; from fire box of grate to top of roof, 2 ft. 4 in.; top of bridge wall to roof, 11½ in.; size of furnace hearth, 7 ft. 6 in. x 3 ft. 6 in:; bridge end of hearth to roof, 2 ft. 5¾ in.; centre of hearth to roof, 2 ft. 6 in.; lowest point of roof to hearth, 1 ft. 7 in.; the hearth of the furnace has a fall from all points to tap hole of 3½ in. to 1½ in.; uptake flue from furnace, 2 ft 6 in. x 9 in.; capacity of furnace for lead bullion 4,200 lb.=61,268 oz. troy.

The bye-products consist of the slag from the smelting of gold zinc slimes in the reverberatory pan furnace, ground up crucibles, liners, etc. In treating these bye-products, the aim is to produce a liquid slag of low specific gravity, and thus reduce as much lead as possible from the materials treated. This is done by the addition of metallic iron in the form of battery screens. As a precaution against any residual high values of the precious metal in slag, the charge, prior to withdrawing the slag, is given a wash down with litharge and coal dust.

All variations in the charges smelted are regulated by experience. It would be very interesting to know by analysis the exact composition of the slag and other materials to be treated and so be able to flux from a theoretical standpoint. However, as these parcels of slag and other bye-products are not very large, and the composition of them varies from time to time, an analysis would not furnish any definite information for the treatment of future bye-products.

The present method is crude, but the value of the residual slags shows that the results are satisfactory. Naturally, this method is only applicable in a case similar to the one we are dealing with, because fully 90 per cent. of the material treated has already been fluxed, and merely requires re-smelting and reduction of the metals. The principal material to be smelted being the slag from the zinc slimes smelt, this is always taken as a base from which to work. When there is a large quantity of refractory materials to be smelted, it is worked off in small lots. Should these present any difficulty, the amount of assay slag usually added to the charge is slightly increased, ground up liners, or any other gold bearing silicious material is added in small lots to each charge, as the slag from the cyanide smelt is nearly always basic, and some protection is need for the furnace lining.

In commencing a smelt, a few bars of lead are