When these metalliferous particles are separared from the mass of tailings, it is found that they principally contain the gold, so that it is now usual in practice to pass the tailings through some form of concentrating machinery, of which the well-known Frue vanner is a good example, whereby the pyrites and other sulphides are retained in virtue of their higher specific gravity and the sand washed away. The rich proportion now called 'concentrates' may contain up to 20oz. of gold per ton, though 4oz. or 5oz. is much nearer the average figure.

"If the concentrates are examined closely, even microscopically, no free gold can be distinguished, and if they be treated with mercury, they will yield to it little or none of their gold contents. Sometimes a considerable portion of gold may be got from them by a long-continued grinding in cast-iron pans in presence of mercury. This grinding seems to force the sulphur and base metals, as well as the gold, into combination with the mercury, so that the bullion got from the amalgam often contains over 95 per cent. of copper, lead, and other base metals, while there is a corresponding loss of mercury which is carried away partly as sulphide and partly in a 'floured state.' The flouring is caused by the small globules of mercury being coated with a film of sulphide of mercury, which prevents the particles coalescing. Thus there is a double loss—chemical, by the formation of sulphide of mercury, and mechanical by flouring. This loss is so well known that concentrates are only treated by this form of amalgamation in localities where Nature forbids any more elaborate process. Sometimes the amount of loss may be lessened by roasting the concentrates before amalgamation, but this is by no means a perfect remedy, as the roasting removes only volatile constituents of the concentrates, principally sulphur, while the base metals—lead, zinc, &c.—are left in the form of oxide to oxidise and waste their equivalent of mercury. Attempts have also been made to decrease the loss of mercury and increase the yield of gold by adding to the contents of the pan all sorts of chemicals to 'doctor' the 'sickened'—that is, floured mercury. These chemicals are generally mixtures of sulphate of iron, sulphate of copper, salt, lime, soda, &c. This kind of 'doctoring' may be effective in some cases, but it is seldom practised with intelligence. Where the percentage of concentrates is limited, and where there are a number of mines, it is common for some enterprising man to set up a smelting or chlorination work which is made large enough to deal with the concentrates of the district.

"I will not take time to describe the various processes of smelting, nor could it be done at any evening sederunt; but we may bear in mind that all smelting processes end in alloying the gold with lead, and cupelling in the usual way, with which we are all familiar. Because of the obvious impracticability of smelting, requiring well-built brick furnaces, coals, fluxes, &c., at the typical gold-mine high up on the mountain range, possibly near or beyond the timber-line, chlorination is much more commonly practised, and consequently merits a full description. In giving this description I will confine myself chiefly to the old standard Plattner process as I have seen it practised in California, where timber is abundant and cheap.

"The first and essential operation prior to chlorination proper is roasting. It is obvious that a mixture of sulphides and arsenides of iron, copper, lead, zinc, and metals generally will absorb an almost unlimited amount of chlorine, so that the small proportion of gold present would fare badly in a general scramble of the molecules for chlorine. That the metals may have the least opportunity to combine with chlorine, the sulphur is expelled, and their affinities satisfied as far as possible with oxygen by roasting. The roasting is generally done in a large reverberatory furnace, that has no very noteworthy feature in its construction. The concentrates are charged into the furnace at the cold end, heated very gradually, continually stirred and slowly worked forward into the hottest part, care being taken to admit air freely during the whole operation. Where chlorination is practised on the most extensive scale this roasting generally takes about twenty-four hours, and consumes from a minimum of half a cord to a cord of wood per ton roasted. (A cord of wood gives about as much heat as a ton of coal.) It is a common saying that the success of chlorination depends more on the furnace-man than on the chlorinator, and on looking into hard chemical facts we find that this is really the case, for if only $\frac{1}{2}$ per cent. of iron were left unoxidized it would absorb nearly 1 per cent. of chlorine, equal to about 3 per cent. of bleaching-powder, and all this before the gold gets a single molecule of chlorine. Towards the end of the roasting, and about fifteen or thirty minutes before the ore is discharged from the furnace, it is usual to stir in a small proportion of common salt. The object of this is to satisfy with chlorine, as far as possible, copper, zinc, and other metals whose oxides have a tendency to form chlorides when they get chloride presented to them in the free state. This chloridizing device is, however, only partially effective, as the chlorides formed are apt to be immediately decomposed under the influence of hot air, and in the case of lead the oxide of sulphate will not combine with chlorine in the furnace, but combines with it readily when offered moist and at the ordinary atmosphere temperature,

"The roasted and oxidized ore is now sprinkled with water to make it slightly moist, and is then charged into a wooden vat having a perforated false bottom. The chlorine, generated at an outside source, is led in between the true and false bottom, and gradually permeates upward through the mass of the porous ore. The small amount of water held by the ore then becomes a saturated solution of chlorine, which gradually acts on the gold, so that in the course of one or two days it may be washed out as the soluble chloride by a further amount of water. This weak solution of chloride of gold is run into a tank, a solution of ferrous sulphate added, precipitate of gold allowed to settle for forty-eight hours, if possible, and the supernatent solution allowed to flow off. When sufficient gold precipitate has accumulated, it is collected and run into bars. Besides the Plattner form of chlorination which I have described, there are others which vary from Plattner and among themselves in the manner of application of the chlorine—most of them using revolving barrels instead of open vats for the chlorination proper. The best known of these are: The Mear's process, where chlorine is used under its own gaseous pressure; the Newbery-Vautin, where air-pressure is used; the Pollok, recently described before this section of the society, where hydraulic-pressure is used; and the Thies, where the chlorination is done in a barrel without any pressure.