PROCEEDINGS OF MEETING HELD AT KELVIN HOUSE, JOHANNESBURG, ON 22ND OCTOBER, 1968 AT 4.30 P.M.

The President: We are very fortunate tonight to have with us Professor Franz Pawlek, Head of the Institute of Extractive Metallurgy for Non-Ferrous Metals of the Technical University, Berlin. In him we have a representative from one of the few mining and metallurgical universities in Western Germany, since I understand there are only three such universities, Berlin, Aachen and Kassel. The latter is represented by Mr Schmelling who has accompanied Professor Pawlek here tonight. The famous Freiberg University is on the other side of the Iron Curtain, and so is Breslau.

Professor Pawlek was born in Vienna many, many years ago, and he obtained his diploma and then later his Doctor's Degree in metallurgy, in Vienna.

For four years he worked for an Austrian company, and then moved to Berlin and joined the A.E.G. Company. After the war, he joined the Institute, which had been very heavily damaged, and he was closely associated with the rebuilding and re-equipping of the faculty of mining and metallurgy. He has written numerous papers, and I am sure we are going to have a most entertaining and interesting evening's talk.

The President: Gentlemen, I am sure you would like me to thank Professor Pawlek for his talk tonight. My knowledge of pressure leaching is particularly small, limited to a friendship with Professor Frank Forward, to whose original work at Fort Saskatchewan reference has been made by Professor Pawlek.

I enjoyed Professor Pawlek's talk, and as a mining engineer I managed to follow most of the argument, mainly because it was so lucidly presented, aided by these informative slides; but I never realised how complicated a problem this process can be.

I am taking the liberty of asking Professor Howat to express our thanks from a more technical point of view. After Professor Howat has spoken, and possibly posed a few questions, I shall throw the meeting open in the hope that various people here will be prepared to ask questions. I see one or two gentlemen who have been over in Canada studying pressure leaching lately, and I hope they will ask questions, informally if they so wish. We will not record the full proceedings of this meeting tonight, in the hope that there will be more questions of a general nature. Thank you.

Professor Howat: Mr President, Professor Pawlek, I am afraid I am up here under false pretences, because the matter that I thought I was asked to do was to propose a word of thanks, and I usually thought that a word of thanks was taken at the end,—however.

It is always very intriguing to think that for all these thousands of years that have passed, pyrometallurgical processes have provided the main methods of extracting metals from their ores. Within the last 100 years, hydrometallurgical processes have become of increasing importance, and it is quite interesting to speculate that the largest single hydrometallurgical process is the one that we operate in this country,—which was devised by two distinguished countrymen of mine,—namely, McArthur and Forrest.

Following on this simple, and yet amazingly effective process for the recovery of gold, many other much more intricate and sophisticated processes have been proposed, and Professor Pawlek made reference to that very well-known one at the Sherritt Gordon Mine in Canada.

The particularly fascinating thing about the Sherritt Gordon process is the fact that, for the first time, it made possible the direct utilisation of the sulphur contained in the ore, and made possible the production of ammonium sulphate, which is such a widely used and such a badly needed fertilizer.

Then, of course, more recently we have had the introduction of bacterial methods for solublizing metal sulphates, and there, of course, you are really in the highly-sophisticated region, and I am beginning to wonder if all these years that we have spent in pyrometallurgy, where we relied on heat and more heat, and still more heat,—whether that age is now rapidly giving place to the chemical engineer, with his beautiful pressure gauges and a lovely computer.—after all, you cannot operate any process today without a computer—and to the bacteriologist, and I picture him sitting in an aseptic lab., with a beautifully white lab. coat, and immaculate fingernails—in fact, he probably wears gloves,—peering through his microscope, and growing culture after culture of special bacteria—well-trained bacteria—and then you may imagine his going out, again into a most beautifully appointed plant, where he carefully innoculates the ore with these bugs, and there are all sorts of cultures,—one to convert iron into insoluble oxide another one to convert the copper into the most beautiful soluble sulphate, which will not have a single trace of any of these impurities which make the normal refining of copper such a horrible business. The only thing that suddenly occurred to me was, will these ores do what other human bodies seem to have an amazing power to do, and that is to become immune to the action of these bugs? Then, perhaps, we will have to go back to the pyro-metallurgist after all.

It struck me that, had I stumbled on the real explanation why so few students nowadays go into pyrometallurgy. Do they reckon it is really a dying profession, and one that is far too crude and unsophisticated for this modern world?

What really intrigued me about Professor Pawleck's paper—and, of course, I had an unfair advantage, because he very kindly gave me a copy of his paper beforehand—was the fact that he has really tried to tell us something of the basic and fundamental aspects of pressure leaching. He and his school have been asking, what makes the process work? Into what steps can you divide the process, and what physical and experimental laws govern each of these processes? I rather think that one of his long-term views, which he has not said an awful lot about, is to rival his friends and Sherritt Gordon, and to extract and recover the sulphur directly in the pressure leaching.

I have also the feeling that he probably wants to get one up on the Sherritt Gordon crowd, by producing the sulphur in the elemental form, and not in that horrible, messy, weighty material of ammonium sulphate. After all, of course, elemental sulphur is a much more flexible raw material, and it can be moved and transported about the world much more easily than ammonium sulphate, and there are very few plants, of course, that are so conveniently situated to a great bulk ammonium sulphate market, as the Sherritt Gordon mine.

We, in this country, have been up against this problem of sulphur shortage for many years, and I am sure this aspect of Professor Pawleck's work is of much more than academic interest to us. If we could find the method of producing elemental sulphur directly from the ores, then that would really be something, particularly to

us in this country, and I was thinking that I cannot get away from this question of the oxidation of sulphides, because the pressure leaching process that we have had most experience with in this country has been the process that we tried out, to extract the insoluble urananite from gold ores, and although the basic idea was to solublize the U_3O_8 into nice, soluble uranyl sulphate, the whole success of that process was tied up with the controlled oxidation of the pyrite in the ore. Of course, we do not want to convert all the pyrite into sulphuric acid. We only want to convert enough pyrite into sulphuric acid, to deal with the uranyl sulphate, and then we thought we would go a much more long, roundabout way, of recovering the residual pyrite by froth flotation, but I wonder if Professor Pawlek would care to tell us how, instead of going that long way roundabout, we might be able to produce elemental sulphur along with our soluble sulphate, in the pressure leaching vessels.

So, for all these reasons, Mr President, I have great pleasure in proposing a word of thanks to Professor Pawlek, but I suppose, before you accord him the vote of thanks, you want to ask him some questions.

Dr Lloyd: The comment I would like to make to Professor Pawlek is one that faces me, as a hydrometallurgist, which is the amount of use that one is likely to be able to make of pressure leaching in the future, and the difficulty that I find, really, is that hydrometallurgy falls into two parts.

There is the one part, which relies upon the purification of relatively high-grade materials,—and here the Sherritt Gordon example is quite a good one for pressure leaching, and then, on the other side, there is the treatment of ultra-low grade materials, such as, for instance, the extraction of gold from ores, where hydrometallurgy allows you to get away without—in Professor Howat's terms,—cooking up several million tons of ore to get several hundreds of ounces of gold out. It saves you all that energy, and it is the reason why you have to go for hydrometallurgical processes.

The trouble, it seems to me, with pressure leaching, is that the productivity of each single item that one has at one's disposal, is extremely low. The amount of metal per cubic foot of the vessel volume that can be produced is far too low to enable it to treat low-grade ores and, therefore, the long-term benefits of pressure leaching is only really to be found in that field of hydrometallurgy which covers the separation of two metals from each other, and not from the treatment of low-grade ores. I am not certain whether this thought is correct—whether there are not already sufficient techniques available for difficult separations, to make pressure leaching a little bit non-viable. I am not certain, but I certainly feel that, in the long term, the use of pressure leaching for the treatment of extremely low-grade materials appears, at the present stage, to be out.

Professor Pawlek: I think that the pressure leaching is not of use for a low-grade material,—only for concentrates, and I think that in most cases, it is very easy to make a concentrated ore. I know this work is very difficult. In Australia there are many troubles with a new ore deposit. The grain is too fine to make a flotation concentration first.

It is used for by-products, for concentrates, I think, not for low-grade materials, and the use of pressure leaching with oxygen is also a question of the cost of electric power. In our country it is very expensive. It is only of interest if you have a very large plant for oxygen. There are many processes investigated also in Germany, whereby using pressure leaching, we can get cheap oxygen.

The President: The many questions that have been asked this evening have been an indication of the great interest in the lecture given to us by Professor Pawlek.

May I say that Professor Pawlek's lecture will be published later, and if those people who have asked questions, would like to have their questions recorded, would they please send them in to the editors. We will then hand them to Professor Pawlek, so that he can give a fuller, or a more consolidated answer. If anybody else has any other question which they would like to ask, would they let the Secretary have it as soon as possible, and we will see if we can get Professor Pawlek to answer it.

Gentlemen, I would like to thank all of you for the manner in which you have made this meeting so interesting, but in particular, I must again say how fortunate we are tonight to have had Professor Pawlek to tell us some of the ideas that they are working on in Berlin. I could not help thinking to myself how lucky we are that he managed during the short period of uncertainty after the war to get back from the Russian side into the West German side, otherwise he would not have been with us tonight!

Secondly, I would like to support David Howat in his vote of thanks. I apologize to David, for asking him to make the vote of thanks so early, but I hoped that, if I got him to talk then I would get the audience to ask questions, which in fact they did.

Professor Pawlek, may we thank you most sincerely for giving us some of your valuable time during your very short trip out here, to talk to us, and to bring us up to date on what is happening in Europe. Thank you very much indeed.