Chairman's Summary — 1st Session, Section 4

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This morning we have listened with great interest to several papers dealing with fundamental research and development work associated with ferro-alloy production. I do not have to tell you that the standard of work presented has been high indeed, and valuable information is now in our possession, which, in the forthcoming months, you will be able to study at leisure. Research papers such as these take a great deal of digesting, and full discussion in this large audience and in the time available is hardly possible. They can best be discussed objectively in small research groups of people interested in the same subject. Nevertheless, I believe it has been of vital importance that our research workers have been given the opportunity of presenting their work to such a distinguished and expert audience. In the first place, other research workers can learn what has been done, and this leads to a cross-fertilization of ideas. Secondly, it gives production men the opportunity of learning what research is being done, thereby enabling them to use the knowledge to improve or modify their operations. It also gives them the opportunity of making suggestions, from a practical viewpoint, of what further aspects should be researched. The position of the researeh man remaining in an ivory tower or wandering off into avenues of little significance is avoided. I do not believe this happens too often as we have ample evidence that facts disclosed by fundamental research have practical significance sometimes not originally envisaged.

Mr Björklund, in his plenary address this morning, gave us an authoritative account of four new steel-making processes and their influence on future requirements for ferro-alloys. These processes are all based on the principle that, with low partial pressures of carbon monoxide, it is possible to reach normal end carbon contents in stainless steel at a higher chromium content than at moderate bath temperatures. He demonstrated that this can be achieved in two ways: either by vacuum refining, as in the VOD and AVR processes, or by dilution of CO_2 with an inert gas in the AOD and CLU processes. He has left us with a message that steel-making techniques are far from static and are, in fact, changing in a dynamic fashion. The ferro-alloy producer must be prepared to meet the challenge and give the steel-workers what they want to achieve best results. This may not always suit his own purposes best. This very able summary of the developments in stainless steel from a person of Mr Björklund's stature is of great use to all of us in the industry.

Dr Cohen adopted the interesting approach of giving us the basic thinking behind the research he carried out into the large-scale processing of chromite ores. His paper dealt in particular with the chromothermic reduction of ores to upgrade the chromium-to-iron ratio for the production of low-carbon ferrochromium, chromic oxide, chromium metal, and chemicals. His process is based on the use of chromium metal as a reducing agent, and this is certainly an interesting approach. Many methods have been tried over the years to upgrade the chromium content of low-grade ores in order to produce conventional 68 per cent ferrochromium. In the 1950s, much work was done on Transvaal chromites, but without much success. Subsequently, it was decided to leave the ratio alone and manufacture ferrochromium with a higher iron content. We had a difficult job persuading steelmakers to use this unconventional product containing 50 to 55 per cent chromium, but it was not long before it was accepted, particularly when steelmakers realized they were receiving iron in a pure form. In view of the tremendous developments that have occurred since, it sounds strange today that this minor change in usage of ferro-alloys encountered such marked resistance. Dr Cohen's paper aroused some discussion. Dr Edwards suggested that a more economical approach might be to use charge chromium for the reduction. Professor Howat questioned the energy requirements. No doubt, all these matters have relevance and warrant more detailed discussion.

Dr Jochens reported results of some interesting work carried out on the influence of the composition of slags on the operation of the high-carbon ferromanganese process. In his usual meticulous and systematic way, he has broken down the various components and demonstrated the old adage that, when one knows how to make a slag, one knows how to make steel or ferro-alloys. A better understanding of a slag is vital for the successful operation of furnaces and will help the producer to control the process and achieve optimum efficiency.

It was most reassuring that Mr Magruder of Union Carbide was able to substantiate Dr Jochens's work from practical experience.

Dr Hayhurst demonstrated that information acquired from studying refractory-brick manufacture can be applied to a better understanding of the crystallization processes taking place during the cooling of a slag. His conclusions have an important bearing on furnace operation. I quote: 'If, in practice, reduction of the solid chrome spinel in the slag is taking place, it appears to be important that slag composition and temperature are adjusted in such a way that any $MgO.Al_2O_3$ spinel formed in the reaction is rapidly dissolved, i.e., no solid reaction rims are formed round the chromium-ore particles. It also appears important that, for good slag workability, the slag composition and volume should be adjusted so that all the alumina and magnesia from the original chromium ore are taken completely into solution when complete reduction has been achieved. If all the spinel is not in solution, primary crystals will be present, which will increase the slag viscosity and may cause problems by settling out in, for example, the taphole area.' He gave us a most interesting slide presentation, which ably demonstrated his subject.

Dr Urquhart has applied a technique known as 'stationary charge in controlled environment' (SCICE) to study what happens during the melting of Transvaal chromites

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for the production of high-carbon ferrochromium. This is a practical way of simulating what goes on in a furnace. His work explains why Transvaal chromites tend to yield ferrochromium with a high carbon content. It also explains why the ready dissolution of chromite ore in the slag phase can result in the ore draining away from the electrodes prematurely, giving rise to flushing or removal of unreacted ore from the taphole during tapping. All furnace operators will be grateful to have this better understanding of the mechanisms involved in furnace operation.

In conclusion, I should like to express our thanks to the authors and contributors for these valuable research papers. I am sure they are going to lead to more work and further advances. The contacts established at this Congress will be most valuable in promoting and accelerating research and development. The interchange of technical information is a welcome innovation and augurs well for the future health and prosperity of this great industry.