CLOSING ADDRESS

by L. Alberts*

An address to mark the end of a conference is like packing one's suitcase at the end of a holiday. It is something of an anticlimax, but it must be done - and the sooner it is over, the better one feels about it.

I shall not attempt either to summarize or to make an in-depth assessment of the various papers, but shall merely attempt to highlight a few trends with appropriate comments. We were treated to some papers that really have the unmistakable ring of in-depth knowledge and understanding, but it could be unwise, for obvious reasons, to attempt to list them.

The future of the ferro-alloy industry seems assured. It is an integral part of the steel industry seen as a whole, and the latter has an assured growth rate although a slow one. If one averages the prophecies, an overall growth figure of approximately 3,5% seems to be generally accepted. Steel forms a vital part of any country's technological infrastructure. In the developing areas there remains much to be built, and in the developed countries there is much that has to undergo continual replacement and improvement. Growth in the production of stainless steel is indeed inevitable. Conservation of energy, decrease in pollution, decrease in maintenance costs, and less-frequent replacement are all motivating factors for this growth, which is quite understandable when one considers the toll taken by corrosion, in terms of finance, in industrial countries. At an estimate, corrosion costs are in the vicinity of approximately 2% of the GNP. In one way or another, the chromium oxide film on a stainless steel will have to make a major contribution to the solution of this problem. However, the overall growth is not independent of research and development. I shall return to this point later on.

Where the growth in ferro-alloy production is likely to take place in the next few decades is becoming more self-evident as one looks at the various requirements and constraints. Over and above the investment risks associated with political vicissitudes and government legislative policies, and assuming that the necessary capital is available, the following parameters, not necessarily in order of importance, are the dominant ones in the growth equation:

i) availability of raw materials;

ii) energy costs;

iii) antipollution costs;

iv) labour costs;

v) technological infrastructure and expertise.

With regard to raw materials, it is interesting to look at the geo-political distribution figures, as available for 1978, of the reserves and supplies for

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metals such as chromium and manganese. Data supplied by the South African Minerals Bureau.

It must be remembered that the assessment of ore quantities usually refers to economically viable deposits and the norms for determining these will depend somewhat as to whether one is dealing with private or state enterprise.

CHROMIUM ORE

COUNTRY:	RESERVES %	PRODUCTION %	EXPORTS %
South Africa	81	34	28
Zimbabwe	15	6	4
Soviet Union	3	23	15
Albania	<1	9	15
Turkey	<1	7	9
Finland	<1	5	7
Philippines	<1	5	7
India	<1	3	5
Others	<1	8	10

FERROCHROMIUM

COUNTRY:	CAPACITY %	PRODUCTION %	EXPORTS %
South Africa	20	24	51
Japan	18	14	1
Soviet Union	10	16	5
United States	10	9	2
Sweden	8	7	10
Zimbabwe	7	3	6
France	5	2	1
West Germany	5	3	2
Brazil	2	4	5
Yugoslavia	2	5	5
Others	13	13	12

MANGANESE ORE

COUNTRY:	RESERVES %	PRODUCTION %	EXPORTS %
South Africa	78	20	30
Soviet Union	16	39	15
Australia	1	7	10
Gabon	1	9	18
Brazil	1	5	6
India	<1	8	6
China	<1	7	1
Mexico	<1	2	4
Others	<1	3	10

FERROMANGANESE

COUNTRY:	CAPACITY %	PRODUCTION %	EXPORTS %
Soviet Union	n/a	22	9
Japan	25	12	8
France	11	8	19
South Africa	10	9	20
Norway	10	6	17
United States	10	7	<1
West Germany	5	4	3
India	4	4	2
Brazil	4	3	2
Others	21	25	20

MANGANESE METAL

COUNTRY:	CAPACITY %	PRODUCTION %	EXPORTS %
South Africa	47	55	52
Soviet Union	n/a	n/a	22
United States	34	21	5
Japan	10	14	6
France	9	10	15

Not only are the quantities of importance, but also the countries in which minerals occur. At an international conference on resource management held in London at the end of May 1980, an industrial leader mentioned that the allies in the last two world wars had been assured of the necessary metal resources for their armaments programme. In view of his expectation that a conventional armaments programme will accelerate in the foreseeable future, the question arises as to how sure Western countries can be of a continued supply

of strategic materials for such armament programmes. The importance of this question is depicted by the following. Albert Speer, in his book *INSIDE THE THIRD REICH*, points out how the German armaments programme would, in any event, have been forced to grind to a halt early in 1946, because supplies of chromium from Turkey had ceased. Had the allies known this, the heavy bombardment of Germany in the last phase of World War II would have been unnecessary. Such is the more dramatic influence of metal supplies on human history.

Of course, we prefer not to see a stepping up of ferro-alloy production because of armament programmes. An infinitely more acceptable and, in the long run, profitable way would be to discover and develop new uses for ferro-alloys. This will require greater research efforts by ferro-alloy producers, ranging from the mining of the ore to the production of artefacts.

It is a pleasure for me to announce at this point that the National Institute for Metallurgy, in cooperation with the ferro-alloys industry of South Africa, is to create a Centre for Chromium in the near future. It will start on a modest scale, collecting, monitoring and disseminating information on the production and uses of chromium and on its alloys and chemical products. One of the aims will be the indirect and direct stimulation of research and development into new uses of chromium and its products. The Centre's activities will be a service to the industry as a whole.

Regarding energy costs, the following figures are indicative of part of the world scene:

COUNTRY	COSTS PER KWH (INDUSTRIAL USE) IN CENTS (USA)		
	4 gigawatt hours	15 gigawatt hours	60 gigawatt hours
Austria	4,8	4,1	4,1
Belgium	5,9	4,4	3,9
France	4,2	3,5	3,1
W Germany	6,2	4,7	4,6
Italy	4,2	3,7	3,5
Japan	5	4,8	4,2
Netherlands	5,6	4,5	
Norway	2,6	2	2
Sweden	3,1	2,7	2,5
United Kingdom	4	3,5	3,5
USA	4,5	-	-
South Africa	2,1	averages for all consumptions	
Australia	3,7		
Canada	2,2		

These values were taken from a report of the International Energy Agency (Paris), January 1978. The three averages given last are not taken from that report, but are estimates based on electricity utility figures. Because of the sharp escalation in fuel prices, the 1980 figures are relatively higher for the countries whose power generation depends on imported fuels. Rough figures

indicate that the price of electricity in European countries and Japan has increased by from 25% to 100%. Over a comparable period, the price in South Africa has increased in the region of 10-15%. It is regretted that energy costs for the other ferro-alloy producing countries could not be ascertained in time for this Conference. In fact, it is generally a difficult task to determine these figures for any country.

The other parameters referred to previously are more difficult to quantify. It is significant to compare the input into antipollution measures as reflected by the 1974 and 1980 Infacon Conferences. It is clear from the papers read at this Conference that, in a densely populated country such as Japan, antipollution measures are very important factors in industrial planning. The industrial communities of the world can certainly benefit a great deal from Japanese philosophy and expertise in this area, as revealed in Tomioka's paper. His plea for international cooperation in this area is well appreciated, but it must be borne in mind that human nature seems to be very susceptible to economic forces. I say this as a research scientist and observer, and not an industrialist. To illustrate this point: in an area such as energy conservation, papers at international conferences often start on an idealistic note, but, in the eventual discussions and final analyses, energy is treated simply as one more commodity in the economic equation, and the most profitable route (money wise) is ultimately followed regardless of the rhetoric on the preservation of nature's energy resources; that is, companies will save energy only if they can increase their dividends by doing so. Public opinion is the driving force in antipollution measures, but this, again, depends on the local political system, the population density, the standards of living, and a host of other sociological factors.

Indigenous technological infrastructure and expertise are important because they can ride the waves of political turbulence as imported infrastructure and expertise cannot. One can make a fairly reliable assessment of the in-depth technological infrastructure by looking at the number of scientific and technical publications, as well as the patents registered in a given country in relation to its population size, or even by visiting the production plants and studying the transportation systems.

The overall evidence from the ferro-alloy growth equation does not favour many of the highly developed countries. However, because they have very high developed scientific and technological knowledge, together with a plentiful supply of scientists and engineers, their future lies more strongly in the development of new uses for ferro-alloys, something to which I have already referred. In fact, if there is a shortcoming in the programme of this Conference, it is the dearth of papers on new alloys and new uses for alloys. This is no reflection whatsoever on the organizers and, I hope, not an indication of a shortcoming in the industry. If the industry wishes to maintain and even step up the expected 3,5% average growth rate, it will have to put much more research and development into the physical metallurgy and applications of ferro-alloys. Already plastic liners are providing the anti-corrosion protection in some industrial equipement. Should there not have been a competitive stainless steel? Composite materials are making great strides. In the relentless competition provided by intensive research and development on alternative materials the ferro-alloy industry will have to keep pace with its own r and d if it wishes to remain healthy and strong. New and improved production technology, new alloys and new uses are the key parameters in this equation.

To return to the Conference - What has emerged is the tremendous value of computerized process control and optimization. In the paper on stainless steel and the papers on furnace control, the success is self evident. What did not emerge so clearly is the importance of developments in instrumentation. One can control only what one knows, and one can know only to the extent to which one has measured intelligently and correctly. The philosophy behind the success of optimization in industry is the importance both of improvements in existing processes and of the implementation of new processes. The latter normally require a large capital investment, relatively high risk, and long waiting periods before the dividends arrive. The former imply smaller capital investment, lower risk, and quicker returns. Any industry would be well advised to invest in both approaches.

It is becoming apparent that we still have a long way to go in our detailed understanding of what happens inside a submerged-arc furnace. When one author emphasizes the importance of the reactance component in the impedance and another ignores it, one begins to realize that there is still much research to be done both in theoretical modelling and in the pilot-scale type of research described by Yoneka.

Of the ideas emerging from this Conference, one is intrigued by the suggested direct production of crude stainless steel from material at the surface of the Great Dyke of Zimbabwe. It seems an obvious approach, but an estimate of the overall economics should be made as soon as possible.

It is somewhat disappointing that no one talked to us at this Conference about plasma technology, especially as a considerable amount of work has been reported from the UK, Canada, and Sweden, for example. In South Africa we are embarking on a programme with particular reference to the reduction of chromite fines without prior agglomeration. As many of you know, the basic idea in plasmasmelting technology is to produce a continuous electrical discharge in a compact chamber, either as a transferred or non-transferred arc. The raw materials are normally fed in from the top in the form of fine particles, and the transfer of energy takes place both in the hearth of the furnace and during the transit of the particles through the plasma-arc region. In addition to not requiring an agglomeration step, plasma smelting has further interesting potential advantages in its greater flexibility and enhanced capacity for control. A decrease in energy consumption can, unfortunately, not be predicted at this stage. The ferro-alloy world should certainly examine this new technology.

More detailed insight will have to be gained of the reduction process in a furnace. An examination of the contents of a frozen furnace is helpful, but because freezing takes such a long time, one does not know whether the scene is representative of what existed at the moment the power was cut off. A three-pronged attack is required: dig-outs of frozen furnaces, experiments on pilot and laboratory scale, and theoretical modelling. Thermochemistry above 1 500°C in this area is still a partly veiled subject.

Physical properties such as electrical conductivity, thermal conductivity and viscosity of furnace burdens and products require much more research because the problems are truly complex. A load consisting of a mixture of materials that are partly crystalline and partly amorphous, partly liquid and partly solid, and partly semiconductor, partly conductor, and partly insulating, is enough to daunt anyone, but, if pyrometallurgy is to move into the area of a

true science (as distinct from a technique) with its concomitant optimized technology, such investigations will have to be undertaken. Much has been accomplished, but much remains to challenge researchers in the ferro-alloy industry.

To conclude: As this Conference nears its end (although the technical tours are still to come), I for one can look back on a memorable and most enjoyable occasion, and I feel sure that my enjoyment was shared by all of you.

Thanks are due to many people who played a part in the organization and in all the hard work that went into this successful Conference, and it is my pleasant task to mention them by name. In doing so, I hope that I do not inadvertently leave anyone out. If I do, please forgive me, for it will be only an oversight on my part, I assure you.

Firstly, I must thank Rolf Björklund and his organizing committee - Mr. P. Lugagne, Mr. G.R. Barrow, and Mr. S. Oleinikoff. They had to do the planning and the organizing, and they had to make the decisions and take the gamble to hold the second Infacon. How right they were, is proved by the attendance figure of some 400, which surpasses the attendance at the first conference.

Second on my list is Miss Denise Chastellain, on whose willing and capable shoulders has fallen the full burden of making all the arrangements for the Conference. No words of mine can describe just how much she has done or how much the success of this Conference has been due to her. She was involved in absolutely every aspect of it.

Thanks go too to her willing and able assistants (and here I may inadvertently omit a name or two) - Mrs. Annette Thommessen, on loan from Elkem, Miss M. Malaval, on loan from SOFREM, Mrs. M. Steffen, and Miss M. Niewmunster. We all certainly appreciated the patient dedicated efforts of our interpreters. They did an excellent job, often under difficult circumstances.

Then there are those whom we can term "the outsiders" - Mr. R. Charbon, the organizer in the Palais de Beaulieu, and his secretary Miss Muri, and all the staff here, Mr. C. Novet, who organized the exhibition outside this hall, Mr. J.L. Panchaud who, as retired Director of the Congress Service of the Lausanne Tourist Office, organized the ladies programme, the scenic excursion and the trip to Evian, and his assistant, Mrs. D. Hirschi, as well as Mr. R. Dafflon, Ritschard Voyage, who organized the technical tours.

Almost at the end of my list of thanks are the authors, without whose months of hard work there would have been no conference, and the chairmen of the various sessions, and the members of the panel that we listened to a short while ago.

While it is true to say that there would have been no conference without the speakers and, of course, without the organizers and helpers, it is equally true that all their efforts would be in vain were it not for the presence of the delegates. Therefore, to each one of you I have a special word of thanks, for taking time off from your normal activities and for coming here and sitting so attentively through it all, thereby making this conference the success it undoubtedly was.

So we have come to the end of this, the second Conference, but not to the end of Infacon. Let me for a moment or two go back in time, to the first Conference, in 1974. It, too, was a success, being the first of its kind ever - such a success, in fact, that the organizers and many of the delegates wanted to see

the Infacon idea perpetuated. As a result there was formed the International Committee on Ferro-Alloys, whose purpose it was to look to the perpetuation of Infacon. After many setbacks, which I shall not detail here, IPFEO accepted the Committee's invitation to host the Second Conference. And now the Committee has looked to the third Conference, and an invitation has been extended to Japan. I am happy to announce that the invitation has been accepted and so, barring unforeseen happenings, the next Infacon will be held in Japan in 1983. The International Committee hopes that you will all be there.

I now declare Infacon 80 officially closed.