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EUROPEAN COAL AND STEEL
COMMUNITY

THE HIGH AUTORITY

PROGRESS IN STEEL PROCESSING

STEEL CONGRESS 1965

Luxembourg October 26–29, 1965

No. 58

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NOTE

As in 1964, we are devoting a whole issue of the «Bulletin» to the International Congress on Steel Utilization, the theme of which this year was «Progress in Steel Processing».

The Congress had as its Chairman Mr Franz ETZEL, formerly Finance Minister of the Federal Republic of Germany and sometime Vice-President of the High Authority, and was attended by more than 1,100 delegates from 44 countries.

The following pages give an outline of those aspects of the Congress which are of general interest.

A full record of the Congress proceedings, which took place in Luxembourg October 26 to 29, 1965, is now in preparation, and will be published by the High Authority in five languages at a later date.

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NEW VISTAS FOR STEEL

By Dino Del Bo, President of the High Authority

The Treaty of Paris establishing the European Coal and Steel Community requires the High Authority to promote the development of the European iron and steel economy, and thereby to further basic industrial expansion, higher employment and the levelling-up of living and working conditions throughout the Community.

Progress for steel means two things : better production and better utilization.

With these twin ends in view, the High Authority has continually striven to work up constructive contacts and co-operation among the bodies and individuals directly concerned with steel production and utilization-industrialists, engineers, researchers, architects and representatives of local and national entities.

One outstanding point in this ongoing meeting of minds was the High Authority's first Steel Congress in Luxembourg in October 1964, on progress in steel construction. This was no mere academic debate. It was a forum at which producers and consumers put suggestions to the High Authority for the furtherance, more particularly, of the industrialization of the building trade. From these have stemmed a series of new Community departures and decisions : funds have been set aside for scientific and technical research, especially on steel consumption; an international competition on housing design has been organized for the purpose of drawing attention to the advantages of steel as a building material; suggestions have been drawn up for the Governments as to possibilities for lining up building regulations; and so on.

This year, with similar intentions, a Congress has been convened on progress in steel processing.

Full weight, in the High Authority's view, must undoubtedly be given to the demands of industrial design in the drive to open up new uses for steel. But it also feels the time is ripe for carrying into practical effect, on a broader scale and in more general applications, the new possibilities that have already been tried out with regard to cold-forming of steel, to surface treatment designed to afford effective corrosion-proofing, and to such processes as welding, bending and bonding.

Given this concentration on progress, in conjunction with the promising movement of technological development, the Congress is surely certain of major and lasting success.

That success, the High Authority is confident, will extend beyond the borders of the six Community States. Representatives of over forty countries are taking part; special prominence is being given to the theme «Steel in Tropical Climates». In this aspect of the Congress we may discern, not merely pictured but mirrored, a great, dominant fact – the fact of the interdependence, the «one world» approach that has come to characterize the steel sector and today demands of our steel industries a giant campaign of adaptation and innovation.

OFFICIAL OPENING SESSION

in the presence of Their Royal Highnesses
the Grand Duke and Grand Duchess of Luxembourg

THE CARRY–OVER FROM THE FIRST TO THE SECOND CONGRESS

by Dino Del Bo, President of the High Authority

Your Royal Highnesses, your presence here at this second Congress organized by the High Authority of the European Coal and Steel Community to promote steel utilization is for us a very clear sign of your interest for this initiative taken for the first time last year.

Your Royal Highnesses, Ladies and Gentlemen, it seems to me that this is the moment to stress the links between the subjects to be treated at this year's Congress and those examined last year.

The chief aim remains the same. It is to render steel, one of the principal basic industries, ever more competitive in face of new competing industrial products and in particular to help it to contribute increasingly to raising living standards, to the creation of new activities – in short, to make it the main motor of collaboration between peoples, a work of peace and progress.

Last year, we concentrated our efforts on the possibilities of increasing steel utilization in the building and construction sector. In this context the chief problem to be tackled was to accelerate the rate of construction of houses and other buildings in the Community through the use of steel and in particular through a much greater recourse to prefabrication methods. The studies carried out by the Congress have helped to identify the means which should make it possible for the building industry to become more industrialized and to develop beyond its present artisanal methods. The construction industry could thus join the ranks of the major industries, on an equal footing with other production sectors.

However, last year's Congress, at which certain fundamental aspects of steel utilization were examined, made it clear that other problems remained to be solved. In particular the ways of employing steel in an industry such as building which, like many others, can be considered as in effect a steel processing industry. This is why we have thought it necessary to hold this Congress on a subject which logically should perhaps be considered preliminary to last year's discussions, even though chronologically it is taking place after them.

What are the basic characteristics of steel? What are the possibilities for it in the construction of industrial installations, of capital goods and of consumer goods? How can steel not only defend the position it has already achieved but also in the future maintain the primacy which today classes it as the basic material for processing in most industrial sectors?

Such is the theme which is today submitted to the scientists, technicians, representatives of public utilities and administration, architects and all those, directly or indirectly concerned with the production or the use of steel, who have responded in such large numbers to our invitation to take part in this second Congress.

We give you all a warm welcome and thank you for coming.

We would like to greet and to express our thanks in particular, now at the beginning of this second Steel Congress, to the representatives of the Press – representatives of the political Press as well as those from the technical Press – who by their invaluable support have once more shown the interest they attach to the High Authority's initiative of last year, now renewed today.

The Steel Utilization Congress is on the way to become the most important single public meeting held by the High Authority. To give it still greater significance and importance, the High Authority has this year decided to ask Mr Etzel to act as President of the Congress. As member and Vice-President of the High Authority in the past who still today holds important public responsibilities, Mr Etzel has given more than ample proof of his qualifications to act as President of this Congress. In accepting he shows once more his support for the High Authority as well as bringing us the benefit of his intelligence and experience.

We are very grateful to Mr Etzel for having accepted our invitation and very pleased that he has been able to take the Chair at this second Steel Congress.

In conclusion, I may permit myself to make some general remarks of a political nature. It should be known that, at an uncertain stage in Europe's economic integration, the High Authority is concerned to show by this second Steel Congress that it, like the two other Commissions in Brussels, is of the opinion that the best way to contribute effectively to solving the vital problems which face Europeans today is to respect scrupulously both the letter and the spirit of the Treaties which govern us. This second Steel Congress is wholly in line both with the letter and the spirit of the Treaty of Paris which requires the High Authority to promote, amongst public opinion in the Community and throughout the world, an interest in all the new utilizations for the products for which we are responsible.

THIS CONGRESS IS A MAJOR CONTRIBUTION TO «RAPPROCHEMENT» AMONG OUR COUNTRIES AND OUR PEOPLES

by Henry Cravatte, Deputy Prime Minister and Minister of the Interior of the Grand Duchy of Luxembourg

First of all, I must convey to you the apologies of our Prime Minister, M. Pierre Werner, who very much regrets that he is not able to be present to address the official Opening Session of your Congress as he had intended. Since he has had to travel to a neighbouring capital to attend an important European meeting (1); he has asked me to welcome you on behalf of the Government.

This is the second time that the High Authority of the European Coal and Steel Community has organized in our city a great Congress of this kind, an outstanding occasion as regards both its general theme and the standing and number of those taking part.

Our cordial respects to you all, our most welcome guests. A special word of greeting to your Chairman, Herr Etzel, who has frequently given token of his sincere friendship for this country. His presence in the Chair will undoubtedly shed additional lustre on your proceedings; possessed as he is of all the attributes of a first-class chairman : authority, ability, experience and adroitness, he will ensure that all goes to perfection.

I have no wish to make us sound presumptuous, but I do feel that no other country could more reasonably aspire than ours to the honour of serving as the venue for your Congress. Our economy was for many decades based entirely on the production of iron and steel, and despite the fairly marked industrial diversification of recent years this sector is still, and will remain, easily the most important. It is pre-eminently the socio-economic factor on which depends not only the level of employment of a large part of the population, but the general material wellbeing of the country. The whole Luxembourg community is affected, immediately or less immediately, by variations in the volume and conditions of steel production and steel sales.

No country can be more keenly concerned than ours with the thems of your Congress. No country can more ardently trust that your deliberations will be followed by the opening-up of new uses for steel, that aristocrat among materials, the combined product of raw metal, technological ingenuity, enterprise and human toil.

A still more cogent argument for regarding Luxembourg as the right place for the International Steel Congress is the fact that the European Coal and Steel Community has had its headquarters here since its inception.

Your Congress is one of the Community's most notable efforts of recent years.

Faced with many difficult problems, the Community has drawn its strength not only from the Treaty on which it is based and the powers vested in its supranational Institutions, but also on indisputable successes which have caught the attention of Europe and the world. It has been duly mindful of one of the dominant elements in the Treaty of Paris in seeking to promote and expand steel consumption and to popularize the use of steel, with

(1) Refers to the October 1965 Meeting of the Council of Ministers of E.E.C.

the aim of raising the standard of living of the 180 million Europeans for whose benefit it was set up. The slogan of your Congress, «Steel Creates the Future», has grown to be a positive obsession with the emergent countries of the world.

I pay this tribute to the work of the High Authority in order to emphasize how much we welcome the growing-up around this important Institution of a great corpus of activity, thought, study and research.

Last year's Congress had a special, individual character of its own. The present Congress has one likewise, in two regards.

First, the technological and economic matters you will be discussing are placed against a very wide international background which is given a distinctive touch by the special links with Europe. I feel your recognition of this will be a source of inspiration to you and will add a particular and powerful momentum to your discussions.

The other point about the Congress is its broad and varied composition. There are among your number not only technologists and scientists from plants and laboratories, but also engineers, designers, architects, economists - all fellow-workers with whom you can exchange your findings. This communication and exchange of knowledge will throw up new ideas leading to the evolvement of new uses for steel in all kinds of fields.

Another thing : this Congress is, I feel, a major contribution to *rapprochement* among our countries and peoples. The series of developments during the second half of this year have made it clear that Europe is at present passing through a crisis. The immediate outlook is regarded by many as gloomy.

Yet surely we have reason to continue confident in the sense and realism of the men who at this juncture have the heaviest responsibilities to bear.

For this Congress, the countries represented at which extend so far beyond the confines of Little Europe, offers a striking glimpse of the realities of to-day and of to-morrow. It is, after all, embarking on the study of matters of the highest importance to our countries, which can be successfully dealt with only on a basis of close international co-operation.

For its ultimate objective is to institute a co-operation and understanding ranging well beyond the Europe of the Six, which let us hope will be succeeded at no very distant date by a wider Europe still more in line with the underlying desires of our peoples.

Your debates will find an echo outside this continent of ours, since among other subjects you are to discuss the problems of steel utilization in the emergent countries.

Political oppositions and contradictions cannot persist for ever in the teeth of economic realities. It is economic realities that ensure human wellbeing by extending to mankind the benefits of a production with a tremendous future before it.

In conclusion, I wish your Congress the fullest success in achieving the aims of its organizers. And above and beyond that, so far from giving rise to barren rivalries and jealousies, may it open the way to further expansion in the paths of peace.

TECHNICAL AND ECONOMIC ASPECTS OF STEEL PROCESSING

by Roger Reynaud, Member of the High Authority

In asking me to address the Opening Session of this second Luxembourg Steel Congress, the High Authority has done me an honour, but an honour of whose attendant risks I am well aware.

Whereas our first Congress dealt with progress in steel construction, a subject closely related in several respects to our every day concerns and considerations, the programme of this second Congress bears a different and at first glance indeed somewhat surprising aspect, that of a mosaic of extremely varied and highly specialized studies.

This stems from the very nature of the steel-processing industry, which covers a great many different production lines and an enormous variety of techniques and processes.

In point of fact, our programme comprises three separate groups of questions. The first concerns a number of processes and techniques, most of them of recent development and some of them daring new departures, selected from the immense range in use in the steel-processing industries. This is the portion of the Congress dealing with : – surface treatment, – cold forming and – assembly methods.

The second group is centred on the concept of industrial design, usually though perhaps not quite accurately rendered in French as «esthétique industrielle».

The last category is connected more particularly with the manner of application of the techniques and processes to very specific situations, the use of steel in the emergent countries.

I make no claim to offer a general conspectus of such a mixture of subjects, but I should like, if you will allow me, to make a few points concerning them, taking as my basic theme the extraordinary variety of means that can be employed to achieve the same end.

The range of materials, techniques, processes, agents and forces that can be deployed with technological satisfactoriness is now so wide, so flexible and so varied as to be positively disconcerting.

Whether the problem is to give a product the geometrical shape best suited to its technical, economic or aesthetic function, to give its surface the strength and finish needed for it to do its job reliably and well while remaining attractive to see and handle, or to assemble the components of a product technically or economically impossible to design or make initially as a single whole – whatever the problem, there are all manner of possible answers, necessitating constant imaginative thought and objective study in order to make a choice. Three general criteria may be mentioned as having to be borne in mind in this regard : economic remunerativeness, aesthetic appreciation and the time factor as regards ultimate introduction.

To take the first criterion first. Given alternative means of achieving a single end, the criterion of remunerativeness is a matter, basically, of the comparative costs of different raw materials, different techniques, different methods and different combinations of them. There is, of course, a certain choice. This does not depend only on time and progress : it also depends at any given stage in technological development, on the characteristics of the product and on local economic conditions.

Take first of all the equipment product relation. In this connection I may perhaps try to analyse broadly some of the groups of processes to be discussed during the Congress.

Choice among the different cold-forming techniques, for instance, would seem to be dominated primarily by three parameters - the lenght of the production run concerned, the size of the product, and the degree of precision required.

Thus cold forming by explosive shockwaves, is a discontinuous process, and hence, in the final analysis a slow one. On the other hand, it can be used to form large-sized products, and is therefore suitable for short production runs, in which the equipment must not be too costly in relation to the product.

Magnetic-pulse and electric-discharge forming resemble shockwave forming in many respects, but they do allow to some extent of automation, which makes the process speedier and more suitable for use on longer production runs, though even these runs will be a good deal shorter than in the peculiarly favoured field of die-stamping. At the same time, this does mean that only products of smaller size can be made.

The specific capital expenditure involved is considerably lower than for the traditional die-stamping process, but higher than for explosive-shockwave forming.

Machining by electrical discharge allows still more advanced automation : it can be employed for long production runs, and has the advantage of comparatively low initial capital outlay, particularly in respect of equipment. However, though products of highly complex form can be turned out by this method, it does not seem capable of affording any great degree of precision.

Up to a point, the comparison of these three processes corresponds to the traditional comparison between manual, reversible and continuous rolling, with «length of production run» replacing «hourly or yearly production» as a factor in the calculation. As both increase, the employment of differently-designed plants, larger and larger, dearer and dearer in relation to the product, but more and more productive, is successively seen to be the economically most appropriate answer to a given technical problem.

It would be mistaken, therefore, to attempt to establish a definite merit rating among different processes. This would conflict with the relativity I referred to a moment ago. What I have just been saying was rather intended to outline the fields of application for the different methods. As the technologists present are aware, technical descriptions of processes are incomplete unless accompanied by a few brief economic indications.

It would therefore be worth-while for those sections of the Congress dealing with the surface treatment of steel and with methods of assembly also to dwell a little on these technico-economic aspects. Some attempt to do so has been made on other occasions for the more usual machining, forging and casting techniques.

This approach would have the further advantage of bringing out also the effects of local circumstances.

Admittedly, as in the cases I have instanced, a technique suited for short production runs and large product sizes is economically unsuited for long production runs and smaller product sizes. Nevertheless, the choice among techniques is not absolute, either for the basic or for the processing industries, since it is influenced by the costs of the production factors, namely raw materials, energy, labour and capital, which themselves vary according to local availabilities.

So I am particularly glad that the Congress is being attended by specialist from countries where the cost structure is quite different from that in the industrialized areas of Western Europe.

This aspect will doubtless be the focal point of the Special Committee's discussions. Now there are two potential difficulties to be overcome in this connection. The first is the idea that the arrangements that have turned out best in the wealthy countries – for industry in general and the metal-producing and metal-processing industries in particular – are ipso facto suitable for direct transplantation to the emergent countries. In the emergent countries, for the most part, capital is scarce and there is a glut of unskilled, together with a shortage of skilled labour, in addition to varying degrees of poverty in foreign exchange and in energy resources.

On the other hand, it would be equally wrong to suppose that the emergent countries should disregard modern techniques which are commonly, though not invariably, bound up with a high degree of capitalization and technological development. There would be no sense whatever in expecting them to traverse the same long and stony road to industrialization as our own did, starting from rough-and-ready techniques and only adopting new ones after many years of research, development and assimilation.

On the contrary, it will be quickness in taking over techniques, and the fact of being in a position to make an informed choice in line with local conditions from among a wide variety of alternative possibilities, that will offer the emergent countries one of their chances to speed up their process of industrialization and enrichment.

The criterion of which I have been speaking amounts in effect to seeking the lowest cost. This is the economic aspect in the narrowest and most restrictive sense of the term. Nevertheless, in certain of the coming discussions, particularly in Working Party I and doubtless also in Working Parties II and IV, there is by hypothesis another criterion, the criterion of aesthetic appreciation.

Aesthetic appreciation is of its nature intuitive and subjective. Intuitive in that, notwithstanding the canons of a particular time or fashion, beauty has never yet been pinpointed by equation : it is something that is happening afresh all the time, always showing a new face, appearing in a hundred different incarnations. And the multiplicity of personal tastes, expressive of subjectivity, is the other pole of the aesthetic approach. Surely this dual character is the inherent riddle of aesthetics.

Any tendency to over-abstraction in the purely rational and mathematical attempt to raise material well-being to the highest possible level is thus corrected by reference to human sensitivity. Though design does have a market price, the aesthetic criterion cannot be measured. It is because it touches the deeper chords in the spirit of man that I am pleased to see the subject of *l'esthétique industrielle,* industrial design, placed at the top of the Congress agenda.

This dualism between the concern for cheapness and the concern for pleasing design has too long been regarded as a conflict. Let us trust that a feeling for attractiveness will set limits to the concessions creative thought must make to the question of profitability associated with mass production. Well-being amid ugliness is but a barren postulate.

Whether opposed or aligned, the criterion of remunerativeness and the criterion of pleasing design are indissolubly linked in the continuous striving for perfection. It is the technologist's duty to satisfy both. Where the pleasing and the rational do coincide, is this the exception, the effect of chance? It is not rather the result of inspiration, that inspiration that itself springs from a committed, absorbed approach? The answer is obvious. Yet nothing can ever be taken for granted : the evolution of motor-car design is an interesting case in point, in which the calculations of the technologist and the market specialist are continually sustained, and occasionally disrupted, by the ever-changing movement of consumer preferences.

In this connection, I was struck by the point made in one of the first papers on industrial design, urging that the extractive and the processing industries combine, despite their apparently conflicting interests, to support research on industrial design for the purpose of opening up new fields of utilization for all materials generally.

It may be that this suggestion will be taken up : may I say that, if so, steel has nothing to fear, for two reasons. First, steel is not expensive. Doubtless for a particular purpose another material or combination of materials may well be used instead, but, though this arrangement may in some cases be more satisfactory if the cost factor is ignored, it will usually work out pretty dear. Secondly, as the importance of the design criterion increases, steel's prospects become still more promising, in view of the unlimited variety of jobs it can perform and shapes it can take. For, in Valery's incisive phrase, steel will «whet, cut, split, drill, bind, file, pierce, grip, plane, saw, thread, bore; it vibrates, it magnetizes; it tautens and slackens; contains, retains, sustains...». What infinite scope for steel!

But industrial design must extend beyond the product to industrial equipment in the most comprehensive sense. The first stage of the Industrial Revolution suggested that the machine in bringing new material satisfaction might at the same time maim human life. It is time to react, to put our received ideas and habits through a searching examination.

Are we doomed to monstrous industrial overgrowth as the outcome of unjustified confidence in the omnipotence of economies of scale?

Is out-and-out standardization really inevitable?

The great majority of the techniques with which the Congress will principally be dealing are advanced techniques. Many of them were devised only a few decades or even a few years ago, and some are even now only in the blueprint or the semi-industrial stage.

How long will it be before they are everywhere known and employed, those of them which prove worth introducing?

It is hard to say, but in all probability the time needed for their development, publicity, financing and adoption will be shorter than it was for their predecessors, not only by reason of better methods of communication and dissemination, of larger capital resources and of the stimulus of international competition, but also because those in charge, in their different capacities, of the production process and its future course are more alive to the importance of innovation, research and development.

From this brief commentary on the subjects which the Congress is to discuss, it will be clear that we have with us the time factor in a new form, a speeding-up of inventions and of the structural changes resulting from them. Technique improvement, economic development, aesthetic resurgence, geographical diversification are proceeding so rapidly that we are living in a world in permanent flux.

This quickening of the pace of progress, this broadening of the range of alternative possibilities for the producer, the designer and the planner, raise a number of problems which I should like to mention for your attention.

First, there is the difficulty posed by the existence of older and newer techniques side by side. How is it to be overcome with the purpose, not of pointlessly seeking to preserve the past, but of avoiding waste and overlapping in capital investment and so ensuring that the passage from the old to the new goes through as economically as possible? In a free-market economy, the answer is the price mechanism and competition. But the hub of the problem is to settle the climate and framework in which competition can afford the optimum results for society as a whole. This difficult task needs to be tackled with due consideration for the technical and economic conditions pertaining to the different possible production points, based on a careful analysis of the various factors of which I have been speaking.

Secondly, there is the question of the region or town. This involves a different kind of juxtaposition, for the changes produced by this progress in the location and patterns of production, distribution and demand must be reconciled with the workers' right to security, stability and status. You are familiar with the High Authority's responsibilities and activities in connection with the industrial redevelopment necessitated by the structural changes which have been taking place in the last few years in the coalmining and iron and steel industries. The adoption of new techniques which are to be discussed at this Congress will involve perhaps less spectacular but quite as awkward problems with regard to industrial redevelopment and to resettlement and retraining of industrial personnel.

Thirdly, there is the problem of the adjustment of the individual. With the rapid changes in the degree and kind of knowledge and skills required and, in patterns of employment, ever-increasing importance will be attached to education and training, and in particular to occupational retraining with a view to redeployment.

It seems probable that the proportion of the working population which will have to change from an industry or speciality to another in the future in the course of a career will rise. And it is more than probable that the proportion of those, at whatever level, who will have more than once during their adult lives to absorb new knowledge, to learn techniques which did not exist in their early days, will rise steeply, to become indeed the large majority. From being the odd try-out here and there, retraining will become the general rule, one of the customary practices necessary to and made possible by the rapid spread of automated production.

Far from being an additional burden to man, this change in requirements as to knowledge and experience will come to be a source of enrichment, variety and satisfaction, as well as at the same time will serve more and more to create leisure.

These three points seem to me essential, since man, while guiding the acts of choice as consumer, is affected by them as producer. Just as his intuition, his inventive faculties and his aesthetic appreciation play a pre-eminent role with respect to matter and to calculation, so his ability to adapt as a user of techniques is a determining factor in progress.

It is agreed by all that many of these problems will be easier to resolve in the Europe we are now building, which as it advances towards greater cohesion among its different component elements nevertheless aims at maintaining and developing their several endowments and heritages.

That Europe — more varied, I might even say more «dialectical» than the giant continent-wide nations, richer than the newly-developing countries — is achieving a harmonious balance between the organized efficiency of the former and the passionate aspirations of the latter. It may stand as an example to many countries. It could be a pole of attraction to those who have to work out among themselves the paths to unity and prosperity. And it could be a powerful factor in promoting the development of a sounder and stabler world.

STEEL FOR THE WORLD OF TOMORROW

by Franz Etzel, President of the Congress

The science-fiction kings have up to now usually placed their previews of the future in the year 2000, a date they reckoned to be still far away, well beyond their readers' lifetimes. But we have now reached a point where only 34 years lie between us and the onset of the twenty-first century. Not all of us, but a good many, will see the turn of the millennium, though only as, I trust, hale and hearty old-age pensioners.

The course of human affairs as the second millennium draws to its close is like the course of an individual human life. The later years are harder going, fuller, more crowded and eventful than the earlier, and they slide by more swiftly. The originators of the science-fiction genre, the Jules Vernes and the Hans Dominiks, writing for entertainment and not as serious prophets, have turned out – unlike so many weather and economic forecasters – to be pretty well right. Though we shall not, even by 2000 – or probably ever – subdue the whole universe, we very likely shall be masters of interplanetary space. Incidentally, the term «space ship» was not coined by our contemporary technologists, but by those imaginative authors of early science fiction. Since their day, their dim conception of splitting the atom has evolved into a new source of energy, a great industry, and, alas, a sword of Damocles over the head of human kind.

By the year 2000 the whole aspect of our cities and countryside will have changed. The earth will have become smaller, and, let us hope, the sense of human interdependence greater. Transport, and particularly travel, as a vital human activity in the industrial mass society, will need to be organized at several superimposed levels for the volume of traffic to be contained. Intercontinental rocket vessels will fly about our planet, artificial satellites will keep the airways safe and provide a world network of instant telecommunications. Exploration and exploitation of the sea and the abyssal regions will open up new sources of raw materials and nutrition, of fresh water for the consumption of the great agglomerations and for the irrigation of arid deserts.

These are just a few of the more salient changes in the world of the early twenty-first century. We cannot know their full impact and complexity, for the three and a half decades still to come probably hold as much as the three and a half centuries behind us. I hope and trust that medical science will have succeeded in the course of these 34 years in ridding humanity of one of its greatest scourges, cancer, I dare say by that time a remedy will have been found against the common cold. At all events, means will have had to be found of feeding an enormously expanded human population and meeting its multifarious needs. The emergent countries in Asia, Africa and South America, already long murmuring, will begin to clamour : their cry must be heard and their demand to eat from the amply-stocked table with the rest accepted, for better and for worse.

The challenge to our generation is the economic and ethical conquest of a future which, as we know, has already begun, Economics and ethics, the Western ora et labora, man's material and spiritual weal, cannot stand in one another's stead. They are the twin poles of a world which, to live in peace and kindliness, must turn upon this axis, and not eternally upon the perilous axis of the ideological East-West antagonism.

I shall today be dealing only with the economic aspects, but I should like to suggest that at the next Congress a philosopher or theologian should be invited to speak on the world of tomorrow. As regards the economic side, its outstanding characteristic today is its fluidity. Between the economic structure and the swiftly-changing way of life in the industrial mass society there is close and constant interaction. In this process the function of the economy as a whole is to subserve and not to control. It is human nature to wrest advantage more forcibly and impetuously from constantly changing than from static circumstances. There are plenty of tumultuous historical movements to serve as lurid examples. As we well know, irresponsibility on the part of producers or consumers, buyers or sellers, employers or workers is exceedingly harmful even now : in a future economy, shifting, interwoven, intricate and sensitive, it could be doom to whoever may then be the weakest.

The world of tomorrow will produce practically everything industrially. A pair of boots Hans Sachs fashioned, a folio volume from the hand-press of Gutenberg will be at best obtainable only by eccentric wealthy collectors. Industrial production will be largely automated. But automation always involves investment. Industrial investment and financing in a fast-changing economic structure may become as hard as climbing the North Wall of the Eiger, unless we also have mechanization in management : I mean the systematic use of computers as an aid to business strategy.

The data stored for processing in these machines must be so prepared as to lend themselves to conversion into mathematical equations and patterns in accordance with the principles of operations research : the results can then be employed as a reliable basis for enterprise policy. The computer's work does not substitute a policy decision, but it facilitates it enormously, since it affords management fuller and more dependable intelligence to act on. The art of management is coming to consist not so much in solving the difficult problems involved direct, as in simply asking the right question at the right time. Though, of course, the computer cannot take over the human individual's responsibility.

Historians are accustomed on occasion – thereby showing that they recognize the economic associations of history – to designate periods of time according to the basic material of human society : the Stone Age, the Bronze Age, the Iron Age, the Steel Age. What lies ahead? Will steel still be the basic material of the twenty-first century? The answer hinges on the exertions which the steel-producing and, as will emerge in the proceedings of the next few days, the steel-processing industries are prepared to make.

Very considerable progress has been made by now in metallurgical research to improve the mechanical and technological properties of the different steel qualities : perhaps the most important advances for practical purposes have been the increases in mechanical resistance, as for instance the achievement of higher yield points, and in suitability for processing, for example better weldability. I am told that one outstanding success in this connection is the new weldable martensite hardenable steels with resistances of up to 200 kg. per sq. mm. and yield points as high as 185 kg. per sq. mm. But there have been other improvements too, in resistance to corrosion and in mechanical properties such as toughness and insensitivity to ultra-low temperatures. At the other extreme, for jet engines and gas turbines, for metal-cutting tools and high-temperature techniques heat-resistant materials are now used, in the form of high-alloy steels and ceramals. For nuclear reactors steel's natural imperviousness to radiation is an additional advantage – a property which can moreover be intensified by appropriate treatment. Other tangible results in this field include the artificial satellites now circling the earth.

Present research suggests that the thermal and mechanical efficiency of these «super-alloys» can be still further increased. What is currently feasible is not enough, for progress on supersonic flight, for instance, is still held up by the thermal behaviour of the materials. There is still plenty of scope for stepping up the resistance of steel : physicists have recently been claiming that steel's maximum possible resistance is incomparably greater than anything achievable today.

Alongside improvements to steel qualities must go improvements to the forms and shapes in which steel is employed. Latterly we have seen silk-slender steel fibres a few thousands and india-paper-fine steel foil a few hundredths of a millimetre thick. And as you all know there are other forms, less striking but just as valuable and efficient, elaborately-conceived products such as the cold-rolled sections, the extrusion profiles, the Euronorm sections, the galvanized and plastic-coated strip. All the same, we must not rest on our laurels : we must achieve the unachievable to offer steel tallying with the received ideas of it yet embodying what appear on the face of things contradictory properties, resistant yet malleable, wear-and-tear-proof yet not brittle, at the same time non-reverberant, light-admitting, colourful, gay and glamorous, warm and friendly and alive, hardly like a metal any more, and, on the top of it all, cheap.

The tasks ahead of us are so vast and many-sided that the steel-makers alone cannot hope to master them. What is needed is close cooperation and detailed comparing of notes with the processing industries - and the greater the amount of design and processing work in relation tot the amount of steel used, that is to say the higher the degree of technicization, the more vital that co-operation becomes.

Experts agree that as time goes on there will be fewer and fewer persons employed on mechanized production and a higher and higher proportion in the tertiary sector, and that, in parallel, the distribution of goods will be more and more linked with tertiary activities. As has been said, the consumer does not in reality need either a material, or a product, or goods of any kind : what he needs is solutions to problems. Which means that in the world of tomorroy, the marketing of steel and steel products will entail comprehensive and really competent services, in the form of technical counselling, research on new products and processes, and regular consumer consultation.

The Ancients and men of the Middle Ages saw the world as a three-tier unit, earth, heaven and hell. With the progress of science and technology in the nineteenth and twentieth centuries this conception was superseded. But the idea of a tiered world does seem to me to be a pointer to the future. We cannot appreciably increase the earth's habitable surface to make room for an expanding humanity. But we can organize such basic manifestations of human activity as home life, work and travel to take place at several levels one above the other. What was first done in the huge urban agglomerations of New York and Chigago – the building of soaring skyscrapers and the running of transport on overhead roads and underground – will have to be done elsewhere, with up-to-the-minute improvements, in many places in the world of tomorrow. And tomorrow's tiered world cannot be built without the aid of steel.

To feed a human race by then numbering several thousands of millions we shall need intensified and mechanized agriculture. Agriculture without steel equipment and machinery is unimaginable even now, and still more so for the future.

Steel used in the past to be regarded as a typical capital-goods material. Machinery, buildings, vehicles and installations were mainly of steel. But already it is apparent that large quantities of steel are also being used to manufacture for the consumer-goods market: kitchen utensils, furniture, gardening implements, camping and sports equipment, cans and other containers, motor cars and toys. If we make a real push it should surely be possible to stimulate this growing market to take even more steel.

At the High Authority's first Steel Congress here last year, the Chairman, Prof. Jeanneney, posed the question at the opening session whether competing materials – principally concrete, aluminium and plastics – were likely seriously to affect steel's future prospects. With an intelligence such as his, he declined to answer yes or no : he said it would depend on the effort we were prepared to deploy, now and later, on the competence and diligence of our personnel, and on the vision of our leaders. Prof. Jeanneney went on to refer to «saving inventions» - the big breakthroughs that one after another must open up the future. This shrewd comment is, I feel, highly relevant to the workd of tomorrow.

I may perhaps be apposite to quote here the Schuman Declaration of May 9, 1950. «Europe», Schuman said, «will be built through concrete achievements, which first create a de facto solidarity». It was in this spirit that the Coal and Steel Treaty was conceived fifteen years ago. Today that de facto solidarity has been established in the coal and steel sectors : the Congress for which we are now meeting bears witness to it. But the Treaty's object is not merely solidarity among producers. Those present at the Congress are, in the best sense of the term, a mixed company of consumers, processers and producers. We feel too, the fullest solidarity with our friends from the non-Community countries, whose presence clearly demonstrates that a mixed company is the reverse of a closed shop. We are looking, all of us, to the world of tomorrow and its changed economy. One of the great features of that future will be cooperation, horizontal, vertical and world-wide.

Today's, and still more tomorrow's market is becoming unmistakably the cause and production the effect. All the same, that is not to say we should wait for the impetus towards innovation to come from the end-consumer, and work back, slowly and time-wastingly, via the processer to the producer. No, the end-consumer, the processer and the producer must form a common front in the van of production progress, to anticipate the customer's wishes : vertical co-operation for this purpose will become an integral part of the market strategy of the future.

The true task of this second High Authority Steel Congress, on «Progress in Steel Processing», must therefore be to acquaint both partners in the field of steel technology, the producers and the processers, with the latest developments in processing techniques, and to stimulate debate between them. In taking this task upon itself, the High Authority is discharging a duty laid upon it by its establishing Treaty. The basic Articles of the Treaty require it to promote «the expansion of the economy, the development of employment and the improvement of the standard of living», together with «the regular expansion and the modernization of production and the improvement of quality». By holding this series of Congresses, it is creating a forum for the exchange of views and a starting-point for further progress and research.

The subjects for the four Working Parties – Industrial Design, Surface Treatment, Cold Forming and Jointing and Assembly Techniques – are, I think, happily chosen. They represent areas of steel processing which considerably influence steel utilization, and in which new advances both in pure and in applied research have recently been achieved.

The principles of industrial design can do much to make the industrial products, and hence the world of tomorrow a pleasanter and happier place to live in. This is true not only of the consumer goods in man's immediate personal surroundings, but also of the capital goods he employs, or even merely looks at. As we all know, iron and steel tend from past history to have grim associations with war and violence. But here I see a possibility of giving them a kindlier connotation, of ennobling their image among the public. Then again, for purely business reasons, we should pay more attention to industrial design, for sheer ugliness finds few takers.

Much the same applies with regard to surface treatment. In an age when summer after summer sees mass migrations to the Mediterranean beaches for the surface treatment of the human body, steel can hardly escape the trend! Some highly promising beginnings have already been made, of which we shall learn more from the specialist papers. But there is another reason why surface treatment is becoming indispensable - the trend towards lightweight steel construction. For lightweight building, as you know, the components are having to be manufactured thinner and thinner : any weakening of load-bearing members by corrosion could very quickly cause their collapse.

The themes of cold forming and assembly are also closely allied. The main problems relate to economic fabrications, that is, to lowering costs in processing. Suitability for cold forming and weldability are perhaps the two most important properties of steel from the processing standpoint, and it has long been the aim of metallurgists to increase them and increase them again. Technologically, both cold forming and welding are processes which lend themselves readily, and advantageously, to mechanization and automation. As we shall be shown in the course of the Congress, considerable progress has been made of late in this direction also. Working Parties III and IV will thus be dealing with questions needing to be approached from two angles, that of the material and that of the method.

As we have seen, in the world of tomorrow the emergent countries will be playing a very prominent role vis-à-vis ourselves. I am therefore particularly glad to know that the High Authority has taken account of this, and has arranged for the first time that the present Congress should include a discussion on the significance of steel in the developing countries.

May I say how much I hope that this second High Authority Steel Congress will come up to the expectations of us all - the High Authority itself as organizer, the rapporteurs who have so kindly agreed to serve, and last but not least yourselves, ladies and gentlemen, who have many of you come long distances in token of your interest.

For myself, I am deeply conscious of the honour done me in inviting me to be Chairman of this Congress. As the High Authority's one-time Vice-President, I have already a close connection with it and its aims, and am therefore particularly happy at this further opportunity to serve it.

May the results of the Congress help not only to afford fresh stimuli to steel utilization, not only to make possible further economic achievements but ultimately to make the world of today and the world of tomorrow a better and a happier place.

I hereby declare the second Steel Congress of the High Authority, on Progress in Steel Processing, officially open.

CONCLUSIONS OF THE CONGRESS

RECENT STEEL DEVELOPMENTS IN SUPERSONIC AIRCRAFT

by Warren E. Swanson,
Vice-President of the North American Aviation Company, Los Angeles

INTRODUCTION

Man's ability to predict new markets, to visualize new product requirements, and to temper this with the realities of the market place in terms of competition, costs, and profits, have always determined our technical growth and our economic vigor. It is therefore imperative that we constantly evaluate these abilities, and diligently strive to improve them.

The evaluation of what has been done in the past is accepted by historians as a valuable guide to the future, and such an evaluation can be made in a logical, methodical way. The evaluation of what can be done in the future is not so prosaic, and requires that the ingredients of imagination and courage be added to our historical knowledge. Perhaps the greatest test of all is not understanding what has been done, not understanding what can be done, but understanding what should and must be done.

Our participation in this, the Second Steel Congress, of the E.C.S.C. will contribute, at least in some small way, to each of these three areas of understanding.

The discussion of the significance of recent steel developments in supersonic aircraft will be based on the experience of North American Aviation with the XB-70A supersonic research aircraft program. The presentation will include major design considerations for the XB-70A, a discussion of stainless steel sheet, the application of stainless steel bar products, and will cover the selection and use of highstrenght alloy steel, H-11. An attempt will be made to relate the discussion to the steel producer interests, and to point out areas where specific XB-70A developments are being used in other new systems.

The XB-70A program

The XB-70A is a research program encompassing a multitude of technical developments which have culminated in two flying aircraft, designed to fly at 2000 miles per hour at an altitude of 70,000 feet. Like an iceberg, the significance of the program is not obvious from the visible portion of the two vehicles. The real importance is the contribution made to the technology in many areas for future progress. This program, in many ways, is a new generation in research, following the X-15 program, described by the American National Aeronautics and Space Administration as the most successful research program of its type ever conducted.

The first XB-70A was flown on 21 September 1964, and by August 1965 the two XB-70A aircraft had made 19 test flights. More than half of this time was at supersonic speed, including seven flights in which supersonic speed was sustained for more than an hour. Continuous speeds of Mach 2 and above were maintained for 50 minutes on three different flights. Maximum speed and altitude achieved in the test program thus far are Mach 2.85 (about 1900 miles per hour) and 67,000 feet.

After many refinements, the design became a delta wing configuration with a forward canard, and six side-by-side, aft-mounted jet engines with a combined thrust of about 180,000 pounds. To feed the engines required a fuel capacity equal to two railroad tank cars of kerosene-like fuel.

The XB-70A has a length of 180 feet and a span of 110 feet. The 250-ton craft is constructed of 80,000 pounds of stainless steel, 20,000 pounds of alloy steel, and 12,000 pounds of titanium alloy. The stainless steel is utilized in a unique structure of 22,000 square feet of honeycomb panels, combined into a fuel-containing unit by 9 miles of fusion welds.

The developments required to achieve the multitude of technical goals in the program were at first rather staggering to the imagination, and many of those who knew the problems first hand shouted that it could never be done.

A proper measure of the significance of any research program requires an historical evaluation, but already XB-70A developments have made a significant impact on other new programs. Examples can be cited in the fields of environmental control, lightweight engines, lightweight hydraulic systems, new fabrication techniques, nondestructive inspection, new materials, new types of structure, and many others. Several specific examples in the field of materials and processes are of particular interest.

Steel honeycomb panels were developed which exhibit very high structural efficiencies up to 630° F. These panels are comprised of facing sheets brazed to a honeycomb core formed from foil. This development has led to the application of similar panels on the Lockheed C-141, the Boeing 727, Apollo, and Saturn.

Metal removal by electricity and by chemical immersion has been developed which has made great advances in our abilities to fabricate parts from steel, nickel, and titanium alloys. These processes have been useful on the Apollo, the F-111 Aircraft, atomic reactors, and rocket engine components.

In the area of lightweight hydraulic systems, H-11 high-strength actuators, high-strength stainless steel tubing, and minimum-weight brazed and welded tube joints were developed to operate at 4000 psi and a temperature of 600° F. These are finding many uses in space vehicles and marine applications, as well as in proposed aircraft designs, such as supersonic transports.

The nickel alloy Rene' 41 was fabricated into the XB-70A engine shrouds and into structural fuselage areas surrounding the engines which has resulted in the development and refinement of forming, welding, heat treatment, and chemical milling processes. These developments will be of value to many future space and aircraft programs where heat resistant structures are needed.

Among many XB-70A developments in the technology of the fabrication of ultra-light titanium structure is the burnthrough welding process which efficiently joins thin caps and webs to form spars and beams. In this process, the welding head is automated to follow a predetermined path, melting through the cap of the assembly to fuse with the web. This development is already in use for the F-111 Aircraft and for the Saturn test stand.

The impressive list of nonmetallic developments made for the XB-70A includes the windshield. Its several panels total nearly 100 square feet in area, with the largest individual panel over six feet long. It is optical quality tempered plate glass, capable of withstanding a temperature of 500° F. It is laminated with a newly developed silicone interlayer. The developments made in heat resistance, optical quality, and methods of attachment will benefit many new programs.

The list of developments goes on and on, but the few examples given serve to explain the nature of the XB-70A program in the area of material and process developments.

Design considerations

Although the XB-70A is principally a steel airplane, the original purpose was not to design and build a steel airplane, or a titanium airplane, or an alumimium airplane, but to design and build a craft with an intercontinental range, and the capability of carrying a useful payload. These requirements of range and payload brought the conclusion that an optimum choice of conditions would be a speed of Mach 3 and a flying altitude of about 70,000 feet. With these parameters established, the problems of aerodynamic heating, efficient fuel containment, the control of personnel environment, and many others could be defined.

The speed of Mach 3 at an altitude of 70,000 feet was found by analysis and experiment to produce skin temperatures ranging from 450° F, with temperatures up to about 1000° F in the structural areas surrounding the engines. These temperatures virtually eliminated the use of aluminium alloys for construction of the airframe, and our attention was drawn to steel and titanium alloys.

The containment of very large quantities of fuel as a major requirement made the use of fuel bladders and other types of separate tankage schemes far too inefficient from a weight standpoint. This directed the design to fuel-containing structure, and made weldable and brazeable materials essential for these areas.

An evaluation of the structural requirements for the airframe revealed that the compressive strength, tensile strength, stiffness, fracture toughness, and corrosion resistance were also important factors in the selection of materials. Because of the flight load spectrum for the design mission, it was found that once the static strength and stiffness requirements were met, that adequate fatigue resistance was also achieved.

A detailed analysis of the temperature problems pointed up two basic requirements. One was that the fuel had to be kept below a temperature of 300° F for proper engine operation, and that this could be done by the use of a paneltype construction with thermal insulating properties. Mechanical refrigeration was not feasible for this purpose. The second point was that in the forward fuselage, a suitable temperature for the crew and the electronic components could not be achieved by insulation alone, but would require mechanical refrigeration. The studies also indicated, that once committed to refrigeration in the forward fuselage, that insulating panel construction would not benefit weight.

The design evolved to one requiring insulating panel construction for fuel-containing areas and skin and frame construction for refrigerated areas. Other areas of the airframe where the control of temperature was not required incorporated either panel construction or skin and frame construction based on the minimum weights obtainable.

For supporting structure and for landing gear, stiffness and high static strength at the various temperatures mentioned were primary design parameters. Again, fatique strength was adequate when these other performances values were satisfied.

Material selection

Early in the design definition phase, it became apparent that the panel construction should be brazed honeycomb and that the core and facing material should be a high-strength stainless steel. Several alloys of the general type were available, but none which retained a high-strength up to the anticipated flight temperatures for the panel areas of 630° F. At this time, steel producers and research organizations were consulted, and were asked to develop a material to do the job, and also to predict the strength values which they felt could be met if the alloy developments were successful. Although this approach probably seems quite impertinent, the entire program was sufficiently advanced in concept that the approach to materials and process development was approximately parallel to the methods used to solve the unknowns in aerodynamics, structural characteristics, human factors, and other fields.

The stainless steel proposed for panels was assigned a target room temperature tensile strength of 240,000 psi as a design minimum value and several candidate alloys were developed and evaluated. The best of the new alloys were Armco Steel Corporation's PH15-7Mo and Allegheny Ludlum alloys AM 350 and AM 355. The PH15-7Mo material appeared to most nearly meet the stringent requirements for sheet and foil. This alloy was not suitable as a bar and forging alloy, and, since the honeycomb panel designs beginning to come off the design boards required detail parts made from bar forgings as well as from sheet and foil, a major obstacle was reached. Understandably, it was difficult to find a bar alloy which could be welded to the sheet alloy, and which, after processing, would offer the required strength and corrosion resistance. With some compromise, the AM 355 alloy could be used for this application, and it was selected as the best candidate. Alloy development continued beyond this point in time, resulting in three new alloys : 15-5PH, PH13-8Mo, and PH14-8Mo. These developments, although not widely used for the XB-70A, were a direct result of XB-70A and will have an important impact in future steel applications.

For landing gear and various types of substructure, alloy steels with tensile strength levels approaching 300,000 psi with elastic moduli of about 30,000,000 psi had been in use for applications similar to those for the XB-70A, with one major difference; service temperatures had always been well below the commonly used tempering temperatures of about 500° F to 700° F. A search for a suitable alloy was made, with target properties of 300,000 psi tensile strength, a modulus of elasticity of 30,000,000 psi, and good hot strength up to 1000° F. The search led to H-11 tool steel, a 0.40-percent carbon-5 percent chromium grade offering nearly all of the target attributes when tempered in the range of 1050° F.

Although our interests in this discussion are directed to steel, some comments regarding the applications of titanium may be of interest for comparison purposes. The forward 60 feet of the fuselage are characterized by comparatively light loads, crew containment, and electronic system containment. These factors indicate that the temperature levels required cannot be achieved by insulation alone, as mentioned earlier, and must be air conditioned. The light load level indicated that, from a structural standpoint, neither the strength of steel sandwich nor the strength of steel skin and frame were required. Titanium, with a tensile strength level of about 170,000 psi and a modulus of elasticity of about 16,000,000 psi, then becomes the optimum choice of material, using a skin and frame construction with glass wool insulation. It was found that the titanium 6A1-4V in use at that time could be heat treated to provide the properties required, as could the newly developed alloy titanium 4A1-3Mo-1V. Much of the titanium alloy development leading to these choices was accomplished in a major titanium sheet rolling development effort sponsored by the United States Government.

Stainless steel sheet and foil - Fracture toughness

One of the major factors in the selection of a stainless steel alloy for brazed honeycomb panels was the capability of reliably providing high strength with adequate fracture toughness. The PH15-7Mo composition is a precipitation hardening grade designed to be capable of heat treatment to tensile strengths up to about 250,000 psi. The heat treating cycle consists of cooling from above 1400° F to obtain the transformation to martensite, followed by reheating above 900° F to obtain the precipitation hardening reaction. The hardening mechanism of the alloy is based on the precipitation of Ni 3A1 and Ni A1 intermetallic compounds in a loy-carbon matensitic matrix. The composition includes chromium for corrosion resistance and molybdenum for hot strength in the hardened condition. It is balanced with carbon and nickel to provide the desired austenite to martensite transformation characteristics. This alloy development was based partly on an alloy that has been in production for many years, 17-7PH. The compositions of 17-7PH and PH15-7Mo are shown below :

Element	17-7PH %	PH15-7Mo %
Carbon	0.09 Max	0.09 Max
Manganese	1.00 Max	1.00 Max
Phosphorus	0.04 Max	0.04 Max
Sulfur	0.04 Max	0.04 Max
Silicon	1.00 Max	1.00 Max
Chromium	16.00-18.00	14.00-16.00
Nickel	6.50-7.75	6.50-7.75
Aluminium	0.75-1.50	0.75-1.50
Molybdenum	-	2.00-3.00

The evaluation of many production-sized heats of the PH15-7Mo alloy showed a remarkably reproducible response to heat treatment. For any of several selected heat treating cycles, it was found that the tensile strength range could be controlled to within 30,000 psi, and that varying the precipitation hardening temperature by 10° F provided a sensitive control.

It was found that material heat treated to the higher tensile strengths, over about

220,000 psi, displayed a reduced resistance to stress corrosion cracking and a lower fracture toughness.

The fracture toughness requirements for the PH15-7Mo panel facesheets were established by first evaluating the capability to detect cracks by methods most likely to be used in service depots. It was found that cracks shorter than one-fourth inch were not readily detected, so an assumption was made that such defects could be present in flying panels. Test panels were then fabricated, and one-fourth inch long cracks were induced in them. The aircraft load spectrum was applied to these panels, and it was learned that panels heat treated to a tensile strength over 220,000 psi failed at some number of cycles short of the anticipated aircraft life. Test panels at tensile strength levels at or below 220,000 psi successfully withstood the required cycle life without failure.The maximum permissible tensile strength was therefore established at the 220,000 psi value.

For structural analysis not involving fracture toughness, some minimum predicted tensile strength was also needed, and the value closest to the 220,000 psi maximum value would be, of course, the most efficient. With the capability to adjust the strength level by varying the precipitation hardening temperature, the question became how narrow a range in tensile strength could be predicted and achieved, considering that the answer is influenced by the variation in chemistry from heat to heat of steel, the variations in the heating equipment and controllers used in panel processing, and the differences in cooling rates caused by a variety of panel configurations. Here, the remarkable chemistry and process control achieved by the steel producer, and the great versatility of this composition became apparent. It was decided that the control of tensile strength under all foreseen conditions could be controlled within a total spread of 30,000 psi, permitting the range to be established at 190,000 to 220,000 psi. The alloy is a metastable composition with a complex hardening mechanism, produced in 70-ton electric furnaces. It is believed that the achievements of its development and production to such precise limits is an outstanding accomplishment in the field of metallurgy and steel production.

Stainless steel sheet - Corrosion resistance

The corrosion resistance of the PH15-7Mo was carefully examined because the chromium content is lower than that in alloys such as the 18 chromium 8 nickel family where the resistance to atmospheric corrosion is well known. In the precipitation hardening types, chromium suppresses the martensitic transformation temperature and, therefore, must be balanced with the elements which tend to stabilize the austenite (carbon, nickel, manganese, nitrogen and copper). The alloy designer made a very critical selection of the chromium content, knowing that perhaps 18 percent chromium was desired for corrosion resistance, but that something less had to be selected to provide the desired transformation characteristics. The selection of the 14-16 chromium percent range for PH15-7Mo seems to be an ideal compromise.

Corrosion resistance is a relative thing, and its discussion should include the specific corrosive media involved, the time over which the corrosion occurs, the stress in the material, and the unit of measurement of the corrosion, Three types of corrosion are of specific interest, namely, stress corrosion, cracking, pitting corrosion, and general rusting. It was felt that the best way to evaluate the corrosion resistance of this material was to compare it with a similar material which has exhibited satisfactory service life. This comparison can be based on a number of accelerated tests, such as beach exposure, salt spray cabinet exposure, alternate immersion into liquids, and others. For aircraft applications, 17-7PH sheet makes an excellent baseline for comparison, since it has given satisfactory service life for well over 10 years. For marine service 17-4PH has served well, and makes a good reference material. Interpretation of accelerated test results requires a great deal of judgement, since the test conditions are arbitrary, and may not properly simulate service conditions. It should also be recognized that a material which appears to be inferior to a known material based on accelerated test results may still be adequate for the intended application.

A figure which will appear in «The Congress Proceedings 1965» illustrates a stress corrosion comparison and shows PH15-7Mo in two conditions, compared to 17-7PH. Here, the materials were under a continual stress of 60 percent of their respective yield strengths, and exposed at both the 80-foot lot and the 800-foot lot at Kure Beach. This comparison shows that PH15-7Mo precipitation-hardened at 1050° F is equivalent to 17-7PH, and that PH15-7Mo precipitation-hardened at 950° F is inferior to 17-7PH.

Stainless steel sheet and foil - Tolerances

The use of steel in aircraft structure immediately focuses our attention on the greatly increased density of the material over that of the conventionally used aluminium alloys. This in turn means that thickness tolerances become more critical because the design must be based on the minimum thickness of the material, and any tolerance over this figure is unwanted weight. An example of this factor can be shown by assuming an increase in tolerance of 0.001 inch for steel honeycomb facesheets for the XB-70A panels. This results in an increase in skin weight of 2000 pounds. Experience shows that such a weight would become several times greater in the actual vehicle weight because of its influence on structural factors, engine performance, and fuel consumption.

Means to achieve the smallest possible thickness tolerances were studied in detail. For sheet products the best available tolerances were one-half AISI values, produced by conventional cold finishing and roller or stretcher leveling. Since these tolerances were unacceptable, a thorough study of methods to reduce thickness tolerances was made. Belt grinding chemical milling and precision rolling were the possibilities with the most promise. As a result of the study, belt grinding was selected as the method to be used because chemical milling could not meet the tolerances needed, and equipment for precision rolling sheet widths was not available. Subsequently, a sudden development changed the situation. The successful operation of a newly installed 50-inch Sendzimir mill was announced and PH15-7Mo precision-rolled sheet in widths up to 36 inches became available. This width capability was later increased to 44 inches. Rather remarkable tolerances have been guaranted and met for the entire XB-70A program.

Gage (Inch)	Tolerance (Inch)
0.006 through 0.009	± 10%
0.010 through 0.019	± 0.001
0.20 through 0.100	+ 0.000 − 0.002

Note : For widths up to 44 inches.

The honeycomb core required the use of PH15-7Mo foil in nominal thicknesses of 0.001 to 0.004, with 0.0015 the most often used. A weight tolerance for honeycomb blankets was necessary, and this was established at ± 8 percent. To meet this, allowing for variations in cell geometry, and overall dimensions, it was necessary to assign a foil thickness tolerance of ± 5 percent, Sendzimir mills were routinely producing various alloy foils with a ± 10 percent tolerance, to gages down to 0.002 inch.

The new requirement of producing foils down to 0.001 inch with a ± 5 percent thickness tolerance required an intensive development effort by the foil producers. Although a maximum width of about 4 inches would satisfy the requirement for core height, the foil has been supplied 24 inches wide. This has been accomplished by pregrinding cold-rolled strip to remove nearly all of the crown, and rolling tolerance on a Sandzimir mill, using a dry hydrogen annealing operation.

Cell Size (Inch)	Foil Thickness (Inch)	Core Density (Pounds Per Cu Ft)
1/8	0.0010	8.3
1/8	0.0015	12.5
1/8	0.002	16.6
3/16	0.00075	4.2
3/16	0.001	5.6
3/16	0.0012	6.7
3/16	0.0015	8.3
3/16	0.002	11.2

As a matter of general interest, approximately 750,000 pounds of PH15-7Mo foil were produced for this program.

Brazing of honeycomb panels

Precipitation hardening PH15-7Mo stainless steel is particularly well suited to the fabrication of high-strength brazed assemblies. In these applications, thermal cycles are adjusted to permit concurrent brazing and heat treatment. The standardized process for heat treating this grade calls for austenite conditioning at 1750° F, air cooling, transforming at - 100° F, and precipitation hardening in the range of 900° F to 1100° F. Two brazing alloys, a silver-copper and a copper-manganese-nickel, were developed which permits concurrent brazing and austenite conditioning in the range of 1715° F to 1765° F. The tooling mass required for panel brazing varies with panel size and, of course, does not permit the cooling rate achieved in air cooling a sheet metal part. Various cooling rates are used depending upon panel size. Cooling rates from the brazing temperature down to about 1000° F affect the response to heat treatment because of carbide precipitation. In this temperature range, cooling times to 1000° F as long as 150 minutes are used. Slight adjustments in precipitation-hardening temperatures and times are used to compensate for the effects of these various cooling rates. Slower cooling rates also reduce the austenite stability and simplify the processing somewhat. For example, panels cooled to 1000° F within 30 minutes must be cooled to about − 100° F to produce transformation, while panels cooled to 1000° F in 150 minutes will transform when cooled below + 50° F.

Tensile strengths are controlled within the range of 190,000 to 220,000 psi by this process, and fracture toughness is controlled to close limits. Test bars run with each panel have shown that in producing several thousand panels, comprising many mill heats of material, reliable and reproducible response to heat treatment can be predicted.

Stainless steel bars and forgings

The applications of stainless steel bars and forgings were very specialized, because it was necessary to have high-strength detail parts which could be brazed as an integral part of honeycomb panels, to which subsequent weldments could later be made, and which, for other applications, could be welded in the fully heat treated condition to brazed honeycomb panels. Of course, the various other necessary characteristics, such as fracture toughness and corrosion resistance, concurrently had to be achieved in the weldments as well as in the parent metal. It was learned that the AM 355 material was marginal in its resistance to stress corrosion cracking when heat treated to strength levels above about 200,000 psi, accomplished by precipitation hardening at temperatures ranging 850° F to 950° F. At a more modest strength level, about 180,000 psi, accomplished by precipitation hardening at 1050° F, improved resistance to stress corrosion cracking was obtained. Emphasis on the development of stainless steel bar alloys toward two specific goals was continued. One was to develop a bar alloy which could be heat treated or brazed with PH15-7Mo sheet material, while producing strength and corrosion resistance superior to that of AM 355. It should be pointed out that the PH15-7Mo composition is not suitable for bars and forgings because of inadequate ductility in the transverse direction. This problem is associated with the delta ferrite phase present.

The second goal attacked was to develop a bar and forging alloy with a transverse ductility superior to that of 17-4PH in heavy sections. The problem in the 17-4PH is also associated with the delta ferrite content of the alloy.

After a concerted effort, both objectives were achieved, and PH13-8Mo became the the new companion alloy for PH15-7Mo sheet, and 15-5PH became the improved version of the 17-4PH grade. Both new alloys demand an extremely close balance of ferrite forming elements and austonite stabilizing elements, and require that conventional arc melting be replaced by vacuum induction melting. The nominal chemical compositions of the four stainless steel bar alloys mentioned are shown below :

Alloy	17-4PH	15-5PH	PH13-8Mo	AM 355
Element-Percent				
Carbon *	0.05	0.04	0.04	0.12
Manganese *	0.8	0.8	0.8	0.9
Silicon **	0.8	0.8	0.8	0.3
Chromium **	16.5	14.5	12.8	15.5
Nickel *	4.0	4.5	8.0	4.5
Aluminium **	–	–	1.0	–
Molybdenum **	–	–	2.0	2.9
Others	4.0 Cu * 0.3 Cb**+Ta**	3.5 Cu * 0.3 Cb**+Ta**	–	0.1 N*

* Austenite Stabilizers.

** Ferrite Formers.

High strength alloy steel

The adaptation of H-11 as a high-strength structural alloy for the XB-70A was a blend of two areas of technology. Our structural and producibility knowledge of this type of material was based upon 5 years of usage of 4340, and similar compositions, heat treated to tensile strength levels up to 280,000 psi. Our knowledge of high-strength, heat-resistant steels came from many years of experience with tool steels. The family of tool steels which appeared to best fit our structural and producibility requirements appeared to be the AISI H-11 chromium hot work tool steel. This grade is a 0.40 carbon, 5.0 chromium, air-hardening type.

The criteria for selection, in addition to the resistance to high temperature were : a) high strength, b) high stiffness, c) good weldability, and d) adequate toughness. The H-11 steel was being produced by conventional air melting practices in ingots up to about 9 inches in diameter for wrought tools and die blocks, and as-cast die blocks, Its obvious shortcoming for structural applications was the very poor toughness when loaded in any direction except compression. No one knew how much improvement in toughness might be achieved. Since no other alternate approaches to a new material were found, a determined effort was launched to improve the toughness of the H-11 grade, while maintaining a tensile strength range of 280,000 to 300,000 psi.

Early evaluations of consumable electrode vacuum-melted material indicated that a large improvement in toughness was feasible. The controlling factors were found to be close chemistry limits, reduced freezing segregation in the ingot, and improved cleanliness. Additional experience showed that our selected course of action was sound, and that consumable electrode vacuum melting could produce a toughness in H-11 equal to or better than that of the 4340 type alloys used previously. The minimum guaranteed properties established and achieved in consumable electrode vacuum melted forgings and air melted forgings compare as follows :

	Die Forgings	
	Vacuum Melt	Air Melt
Tensile Ultimate	280,000 psi	280,000 psi
Tensile Yield	245,000 psi	236,000 psi
Elongation	10.0%	4.5%
Red. in Area	30.0%	7.5%

The availability of vacuum melted H-11 was at first nonexistent, but in the period of two years, changed a great deal. The status for three specific years indicating this improvement, all based on XB-70A requirements, is as follows :

	1959	1960	1061
Sources	2	5	9
Mill Production (Lb/Yr)	25,000	800,000	Over 1,000,000
Useable Billet Size (Max) (Lb)	8,000	16,000	24,000
Cost/Pound	$ 2.05	$ 1.55	$ 1.20

The H-11 steel landing gear of the XB-70 is comprised of two main struts, each fitted with a main beam carrying four wheels, and a forward strut carrying two wheels. One of the most spectacular application of H-11 steel is the main beam which is machined to precision dimensions from a 13,000 pound forging.

A major structural application of a sophisticated nature is the H-11 truss section, which carries wing loads through the fuselage. This truss is comprised of streamlined tube sections welded to machined end fittings. Analyses showed that this structure is lighter than the alternate design in titanium.

The successful application of H-11 at this strength level demands careful attention to many detail characteristics of the alloy, and inattention to them would invite unexpected fabrication costs and structural failures.

The H-11 structure includes many types of parts, among which are large welded frames with thin webs and caps. Many parts require threading, straightening or grinding. Each process is a potential source of trouble. A few of the necessary limitations are given below:

1. Threads, when made to the Specification MIL-S-7742 configuration, they must be rolled. Acme, Whitworth, or «radius root» threads may be rolled or ground.
2. Welding, preheat and postheat treatments are required. Welds are made while the part is maintained at 600° F. Weldments must be fully annealed before heat treating.
3. Cold straightenings, when applied to heat treated parts, cold straightening must be followed by stress-relieving at 925° F for 2 hours.
4. Rough edges, burrs, deep scratches, and rough edges must be removed before the part is heat treated.
5. Grinding, care is required to prevent checking, and all grinding must be followed by stress-relieving at 925° F for 2 hours.

Corrosion protection is provided in several ways, depending upon function of the part and service temperature. Sprayed aluminium coated with a silicone resin is used for some parts with service temperatures up to 900° F. A nickel-zinc electroplate coated with a silicon resin protects other parts for the same service temperatures. Vacuum-deposited cadmium is used for some applications where service temperatures do not exceed 500° F.

Today, consumable electrode vacuum melted H-11 is being produced in ingot sizes up to 32 inches in diameter, mainly for applications as tools and die blockes. It has been learned that the H-11 product developed for the XB-70 gives tools with increased life, and has resulted in the production of other tool grades as a vacuum melted product. The improved performance of these tools is attributable to the improvements in chemistry control, reduced segregation, and improved cleanliness, the same reasons for the improved toughness for the XB-70 applications.

In summary, it can be said that the XB-70A H-11 developments have given us the capability to design and use structural parts at tensile strength levels up to 300,000 psi, and have led to the production and use of improved dies and tools from greatly increased ingot sizes. Most human achievements bring us to a plateau from which we can reach upward, and so it is with H-11. The successes reviewed here have provided a basis to push on, equipped, we hope, with the wisdom to approach new problems with the proper balance of ingenuity and caution.

The future of high-strength alloy steels

In the area of improved fabrication characteristics, the high-strength 18 nickel maraging steels should be mentioned. These grades are strengthened by a simple aging process, and have many of the attributes of H-11. A comparison of the design properties of the 300 grade maraging steel was made with X-11 for the XB-70A, and where a penalty in both modulus (E) and shear strength (FSU) could be accepted, it very nearly met or exceeded the H-11 capabilities. Had the 18 nickel maraging steels been available sooner, a number of H-11 parts for the XB-70A would have been changed to take advantage of the simpler processing and the greater fracture toughness.

Property	H-11 (psi)	18Ni (Maraging) (psi)	% Change
Ftu	247,000	234,000	−5
Fty	200,000	209,000	+4
Fcy	227,000	235,000	+3
Fsu	164,000	130,000	−20
E	27.0×10^6	24.0×10^6	−11
Elongation	8% (Typical)	7% (Typical)	−12
Reduction in Area	20% (Typical)	35% (Typical)	+75

A comparison of the processing sequences required for welded assemblies in H-11 and 18 nickel maraging steel, (above), demonstrates the processing advantages of the maraging grade. The next goal in high-strength steels is beginning to take shape in the 400,000 psi tensile strength range, demonstrated by the development of the matrix alloys by the Vasco Metals Corporation. Typical properties for two of these grades are reported to be as shown below:

	M-A	Matrix II
Tensile Strength, 1000 psi	361	404
0.2 Percent Offset Yield Strength, 1000 psi	292	363
Elongation, Percent	6	6
Reduction of Area, Percent	20	18
V-Notch Charpy Impact, Ft-Lb	9	5

Other developments such as ausforming and shock hardening are also gaining in importance, but all share two major limitations, which are the difficulties in fabricating useful parts, and the means to achieve adequate toughness.

Generally speaking, the very-high-strength steels do not have the required fatigue life for many designs. For applications such as a supersonic transport landing gear, for example, better fatigue resistance can be obtained from conventional alloy steels heat treated to lower tensile strength levels.

Our knowledge of the factors controlling toughness and fatigue, and our abilities in new ways to fabricate parts, are rapidly increasing. Keeping pace is our knowledge of better steel melting and mill processing. These factors, combined with the greatly increasing need for high-performance materials, will lead to higher strength steels in the future, and an ever growing usage.

Conclusion

Our discussion has described the XB-70A program, and has outlined the more important aspects of design materials and types of construction. The applications of stainless steels were discussed, and the design features and fabrication methods for brazed honeycomb panels were covered. The structural use of H-11 high-strength steel was explained, and examples of parts were given.

The importance of the many technical developments in this program was emphasized, and examples of new programs benefitting from them were given. A repetitive theme occurs in the discussion to emphasize that new markets for steel products in high-performance vehicle construction are based upon the abilities of the supplier to meet exacting and very specialized requirements.

A logical conclusion from a review of steel developments is that certain technical advancements have easily recognized impacts on new markets. One of these is increased ingot size, such as that achieved with vacuum melted H-11 steel. Larger ingots result in removing many limitations on the sizes of finished products, thus expanding the market for a product into new applications. Larger ingots likewise reduce production, inspection, and handling costs which again expand the market because of the improved cost effectiveness of the mill forms offered to potential users.

Perhaps some technical developments have somewhat less easily recognized impacts on market expansion. In this category is what we might call «alloy engineering». We have discussed the precise balances of chemical compositions required to meet specific performance objectives. To achieve this precise balance we have developed new skills in melting methods and equipment, new skills in the very close control of the content of critical chemical elements, and new methods in analytically determining our success in controlling this alloy balance. Further, we have demonstrated that the steel producers and users can develop the technical skills to exploit these melting advancements by the use of precisely controlled processes in developing mill forms and vehicle components with sophisticated properties. Each factor in the improvement in alloy engineering increases our abilities to develop new generations of alloys with even higher performance capabilities and better cost effectiveness, increasingly expanding the market boundaries.

Another example in this category is the attainment of very close thickness tolerances. This can result in the elimination of processing steps otherwise required of the user which can reduce costs and flow time for part fabrication, placing a product in a better competitive position. Such improvements can open new markets, as well, by making a product applicable to a greater number of processes and products than would otherwise be possible.

The challenge to the steel industry is clear. New technical developments, singly and in combination, are the key to market development, and if approached with vigour and imagination can result in an explosion of steel market boundaries.

CONCLUSIONS OF WORKING PARTY NO. I «STEEL AND INDUSTRIAL DESIGN»

by Misha Black,

Professor at the Royal College of Art, London

That this Congress should have made industrial design one of the subjects of its discussions is an indication of the maturity of that new profession.

Those of us who are designers are consciuous of the relatively small scale of our work. The design of a domestic refrigerator, a sewing machine, a hospital bed or even the body of a locomotive seems unimpressive when compared with the majestic problems of the design of supersonic aircraft or of a bridge, such as that elegant structure which is just being completed here in Luxembourg.

But we take comfort in the knowledge of our concern with the needs of men and women, in our contribution to the daily life of ordinary people when they eat a meal from a saucepan which we have designed, or ride to work in a bus in the design of which we have participated. They may find their working day more agreeable because we have improved the ergonomics of a machine tool or the efficiency of a domestic vacuum cleaner.

The profession of industrial design is still comparatively young and much of our discussion therefore inevitably revolved round the problem of definition. We attempted to clarify exactly what the function of the industrial designer is, how his work relates to that of engineers and where he fits into the whole industrial complex.

The designers who addressed the meetings combined humility with self confidence. Their rôle, as they understood it, was to be concerned with the relation of the product (be it an automobile or a pre-fabricated dwelling) to the men or women who would eventually use it. It was the industrial designer's function to ensure that the product was not only efficient but that its outward form should clearly express the efficiency of its operation and manufacture; that it was easy to use, easy to maintain and beautiful within the limits imposed by mass production and by the caracter of the object.

These desiderata of efficient function, the fulfilment of human needs and elegant appearance are not achieved by industrial designers working in isolation. The discussion soon established that the designer can only work effectively as a member of the product development team, sharing responsibility equally with engineers and with management. The product development team, it was concluded, is incomplete if it does not contain an industrial designer amongst its other expert specialist.

Our discussions covered the whole range of human artifacts. We were shown examples of consumer goods and of capital goods in which proper collaboration between industrial designers and engineers have produced results which proved that our civilization has the capacity to use our industrial skills to fashion raw materials into objects which we can proudly compare with the handicraft work of previous generations. If, it was said, the best that we were shown could become the normal standard for design in industry instead of the exception, as it still remains, then we could be less worried about the environment which we are creating in this second industrial revolution.

We discussed the problem of automobile design where the role of the industrial designer is most clearly expressed. Vehicles, it was said, are the symbol of our epoch, the motor car is our «beloved monster», its design reflects our capacities and our weaknesses. We lavish millions of tons of steel each year on the production of vehicles, we need the best skills and creative abilities of our engineers and industrial designers to make our transport worthy of our civilization.

We were shown how designers are working for the railways to revitalize our more traditional transport systems, how they are equipping passenger ships and how their work on the interiors of aircraft can make air travel a pleasure instead of a penance.

The last session of our working party discussed pre-fabricated structures. Is is here that the greatest potentiality for development resides. We were shown steel structures which matched the spider's web in their lightness and strength. We saw how prefabrication can produce homes and schools and factories in quantities, and at a speed and at a cost, which could eliminate overcrowding and make us contemplate population growth without foreboding.

Our speakers came from nine countries but if they did not share the same language, they shared the same attitude of mind. Industrial production is only of value if it fashions raw materials to meet the needs of people, design is an attitude of mind which engineers and administrators share with industrial designers. The industrial designer has been trained to make human hypotheses from technical and analytical data, he can be a link, between scientific and technical research and development, and the needs of our society.

But we remained conscious of our lack of experience before the vast responsabilities which face us, responsibility for creating the environment in which our children will grow to manhood. It was argued that more fundamental research needs to be undertaken in the education of industrial designers, in the techniques of their work and in the best use of raw materials and production processes. It was suggested that the High Authority might consider the establishment of research awards so that fundamental research projects could be undertaken on a European basis to support similar work which is already being done in some individual countries.

We reached no resolutions and even our conclusions were only partially defined, but those who participated in our working party are satisfied that we leave the Congress with more knowledge and with greater understanding. We return to our work more capable of doing it efficiently and for that we are grateful to the High Authority which made our meetings and discussions possible.

CONCLUSIONS OF WORKING PARTY NO. II «SURFACE TREATMENT OF STEEL»

by Albert Denis,

Directeur de la sidérurgie au ministère de l'industrie, Paris

Steel is a cheap and plentiful metal with a high modulus of elasticity, and so usable for a great many purposes. But exposed to the surrounding atmosphere and temperature it is liable to corrosion by damp, taking the form, mainly, of rust, or at higher temperatures of scale.

Some gaseous, liquid or igneous media can have stronger corrosive effects.

In addition, steel's actual employment gives rise to other processes which impair its surface, such as grinding and binding. Hence the need for surface protection of steel used in such conditions, to enable it to retain its serviceability for as long as possible.

Corrosion-proofing

Until the last few years, corrosion-proofing was largely by rule of thumb. Nowadays, however, scientific methods are being used more and more, especially those based on the electrochemical approach to corrosion. The protection devices which we have heard described are of three main kinds.

1. Protection by replacing the surface of the steel itself by a more resistant coating, either of metal or of another material :
   - metal coatings discussed included in particular tin (notably tinplate),zinc (galvanized steel), aluminium and chrome;
   - non-metal coatings discussed included enamel, plastics, paints and hydrocarbons.
2. Cathodic protection, which can be done in a number of ways :
   - in the case of galvánized steel and tinned iron it plays an important part in the event of damage to the coating;
   - a separate magnesium or zinc sacrificial anode can be used;
   - it is also possible to provide direct cathodic protection using an external source of current.
3. Passivation, which brings the metal's own self-protecting properties into play, either spontaneously (stainless and passivable low-allow steels) or by oxidizing surface treatment (priming coats, chromates, phosphates).

The discussions served to emphasize

– that the surface of the steel must be carefully prepared before treatment (involving checking at the plant) by fettling, sand-blasting, shot-blasting, nickelizing, decontamination (in the case of stainless steels), etc.;

– that to obtain certain protections and certain forming properties the quality of the steel must be right : points mentioned included low carbon content, at any rate at the surface, the use of alloying elements (e.g. chrome, nickel, copper) as corrosion controls, and the use of titanium to help the enamel to cling.

Individual techniques were discussed in varying detail; the Working Party did not, however, dwell on methods in very common use, such as electrolytic chroming and nickelizing, or lead-coating.

With flat products in particular, which allow of continuous treatment, the processes employed necessitate special pre-protection, assembly and forming measures which were described in detail and discussed.

Speakers evinced a general tendency to favour the use of two or more protection processes in conjunction, in order to make good the deficiencies of each separately, notably galvanization prior to the final coating.

Protection against grinding and binding

High temperature spraying with either metals (chrome) or metalloids (carbon, nitrogen, sulphur) is the principal means of giving the surface of steel the resistance to grinding and binding which it does not naturally possess.

The Working Party did not go into the extent to which the state of the surface affected the mechanical properties (brittle fracture, fatigue).

Conclusion

Thanks to the rapid technological advances resulting from the scientific approach to the problems, it is now possible to use thinner steels with thinner coatings, obtained by continuous or mass production.

In many cases, especially in building, the higher cost of properly corrosion-proofed steel is offset by the lower maintenance costs during service.

It is most desirable that producers, processers and consumers should co-operate, notably in order to get the properties required of the material precisely in line with the needs of the function it is ultimately to perform.

It was urged that specialists should be put in touch with consumers to impress it upon them that steel could be the answer to most of their problems.

The institution of a classification of testing methods established as being in line with the properties required in service was also felt likely to be extremely useful.

CONCLUSIONS OF WORKING PARTY NO. III «COLD FORMING OF STEEL»

by René Palmers,

Président de la fédération des relamineurs du fer et de l'acier de la Communauté,
Directeur de la S.A. Phenix Works

In continuation of its campaign to promote the use of steel, the High Authority has this year invited us to discuss various aspects of «Progress in Steel Processing».

In so doing, it has gone to the heart of the matter by stressing those aspects of steel's utilization that serve to make it economic, durable and pleasing.

My own Working Party's subject, «Cold Forming of Steel», has attracted a great many people, doubtless as raising new points in connection with fundamental problems which are too seldom aired and debated.

The papers and discussions have shown the immense value and importance of cold forming, both by the traditional bending and deep-drawing processes and by the more recent high-powered techniques using, for instance, the effects of explosive shockwaves and magnetic impulses.

Hot and cold extrusion and drawing methods also merit attention, having the particular advantage of turning out new steel products and processing large amounts of metal.

Considerable advances have been made in the last few years in the study of the characteristic of steel plate and sheet for forming, resulting in substantial improvements in fabrication.

This research will undoubtedly enable us to gain a better understanding of the processes involved in the deformation of plate and sheet, to improve the quality of these products, and to expand their sales - a highly desirable consummation in view of the problems by the increase in world capacity in this sector.

All matters relating to cold forming are, incidentally, coming more and more to the fore in technology. Having learnt to produce steels of greater and greater ductility for all kinds of uses, the steelmakers will need more and more accurate means of regulation and verification to ensure that these remain absolutely reliable in quality.

Demands are being made for an ever-widening variety of uses upon the metal's ability to assume given, sufficiently reproducible characteristics through cold forming : the fact that it can do so has undoubtedly much to do with the constructional and civil engineers' tendency to insist on increasingly ductile steels, even for such everyday products as concrete reinforcing rods.

A number of valuable points came up in the discussions with regard to the use of various cold-forming techniques, and there was evidence of a new and forward-looking approach in a sector which had been in something of a rut for a good many years.

It was noted that building components made of cold-hardened metal would give a better performance, and that stricter and more scientific calculation would make products considerably more efficient and economic to use.

We now have an iron and steel industry which has notably extended the range of its products, as regards both the physical properties of the metal and the nature of the product itself, from the slenderest wire to the most enormously heavy beams and plates, and we have a processing industry which has radically renewed and added to its equipment, thereby opening up unlooked-for possibilities. Both have an interest in joint research on the quality of the product appropriate to each forming technique, and indeed to each individual application.

We all know that direct contact between steel suppliers and their customers is a means of dealing with these problems in a spirit of free competition, but at the same time, alongside this direct approach, our discussions have indicated the value of a more systematic exchange of information on progress in processing and in the goods processed.

To sum up, the Working Party would like to see the High Authority give practical support to the research going on in the Community on cold forming, cladding and the improvement of the metal's characteristics by cold working.

There are a great many points to be dealt with, including the changes needed in the regulations and accepted practice with regard to building in steel : this has got to be eased away from outdated rules and modes of calculation to enable steel to compete, as do the more recently-evolved building materials, on entirely new bases, taking advantage of the latest advances in civil engineering.

The High Authority could organize regular meetings of the specialists who are at present working on their own in the different countries; it could promote joint research in promising fields, and assist in disseminating their findings to the industrialist directly concerned. Publicization, through specialized journals and popular treatises, of advances achieved would help to make generally known the techniques whose employment is calculated substantially to increase both steel's uses and its competitive capacity. In this way the High Authority would take a long step further the process begun by the 1964 Congress, which first indicated the kind of co-operative action that could be taken by all those wishing to secure the most effective use of a material which lends itself to continual improvement and can be adapted to meet the most varied requirements.

The High Authority is to be congratulated most warmly. Its organization of this important occasion over which it has taken such care has been an illustration of the words put by Paul Valéry into the mouth of Socrates (1) :

«It is fair to maintain that the works of man are designed either for his body, which is the principle we call utility, or for his soul, which is what he seeks under the name of beauty. Yet he who builds or creates, since he has to do with the rest of the world and with the processes of nature, ever acting to dissolve, to corrupt or to overset what he has achieved, must recognize a third principle that he must endeavour to infuse into his works, embodying the resistance he wishes them to offer to their destinated end of extinction. He seeks, then, solidity, duration.»

(1) Eupalines, ou l'Architecte.

There you have the very subjects of this Congress, a Congress placed in its true perspective by a mental approach according with the highest human thought.

Surely a happy augury. All credit for it to the organizers of this assembly : all credit and our very warmest thanks.

CONCLUSIONS OF WORKING PARTY NO. IV
«MODERN JOINTING AND ASSEMBLY TECHNIQUES»

by Ugo Guerrera,

Vicepresidente dell'Istituto italiano della saldatura

The subject of Working Party IV as you know, was «Modern Jointing and Assembly Techniques».

The time allotted was of course very short for covering this wide and complex field, but the judicious selection of experiences described gave everyone a good idea of the countless potentialities of steel jointing and assembly methods, and especially of the evergreen viability of the method at present most widely used, welding, thanks to which steel construction has done better than would otherwise have been remotely possible.

The number of welding processes which have been evolved to overcome the immense variety of problems presented by the increasing complexity and boldness of building design is very considerable : there are as many as forty to fifty. Naturally we could not deal with them all, but the Congress did offer us the opportunity to pinpoint those of practical importance to the majority of constructional engineers.

I must also mention the other jointing and assembly techniques of which we were given such interesting accounts, namely adhesive bonding, the latest bolting methods and hooking, which in many cases can undoubtedly be extremely valuable.

One matter came up on which quite a number of researchers and technologists have been working for years, the implications of the brittle fracture which has tended to occur at low temperatures under comparatively slight stresses in some big welded constructions carried out before and during the war.

The substantial improvement in the properties of steel thanks to unremitting research, and the adoption of specific precautions, have greatly reduced the danger of brittle fracture in welded structures, so that this is now extremely infrequent, but since the question is still very much exercising many of our technologists and scientists it was only to be expected that it should be brought up at the present Congress, where it was the subject of two interesting papers and a lively debate.

A well-known problem which was further emphasized in the course of this debate was the diversity of criteria as regards the properties required of steel in relation to the design and purpose of the structure concerned. It is not really surprising that there should be these differences, since despite often very large-scale experiments, and much study and research by eminently qualified specialists, we still have not entirely plumbed the mysteries of brittle fracture in steel structures.

It is agreed by all that standard criteria in this connection would be most desirable, particularly as the trend is towards bolder and bolder design, stronger and stronger steels, and greater and greater permissible stresses.

Since basically these differences of view stem from continuing fundamental uncertainties, I feel it is important to step up pure research on the subject. Such research is already going on hard all the time, and each year at the annual meeting of the International Institute of Welding leading technologists and scientists discuss the matter very thoroughly in one of the Institute's working parties. As a further stimulus to this research, E.C.S.C. might usefully organize at fairly long intervals, say every three years - perhaps jointly with the Institute of Welding - a symposium or seminar to serve as a forum for progress reports in this connection.

The present Congress has undoubtedly proved of the greatest interest to those taking part. All the same, it is felt that perhaps its terms of reference were too wide, at any rate in the case of Working Party IV, and accordingly my Working Party have urged that at future information Congresses of this kind attention should be concentrated on particular fields of application for steel, such as for instance the chemical and petrochemical industry, which is regarded as an especially worth-while sector to discuss.

Also, it was recommended that longer time should be given, to permit of really full discussions on the subjects dealt with.

I personally should like to suggest that in selecting the theme there should be consultation with other international bodies, and more especially with the International Institute of Welding, so that we shall not find ourselves with two organizations discussing similar subjects within a few months of one another. Because, inasmuch as the E.C.S.C. Congresses are focused mainly on steel, the moment they touch on its practical uses the subject of welded joints is bound to crop up to some extent of its own accord.

In conclusion, I should like to say how glad we all are that the Congress was held, and to thank the High Authority for organizing this most interesting occasion and for the generous hospitality it has extended to us.

CONCLUSIONS OF THE SPECIAL COMMITTEE «PROBLEMS OF STEEL UTILIZATION IN EMERGENT COUNTRIES»

by G. Thorn

Président de la «Commission pour la coopération avec des pays en voie de développement» du Parlement européen

Our Committee was asked by the High Authority to consider the subject of steel consumption and utilization in tropical countries, and in emergent countries generally. The High Authority was, of course, aware that we could not deal in detail with all aspects of this matter. I imagine that what it wished us to do was to review, or rather to take stock of all these, to make a wide general survey, and this our special Committee of technologists, politicians and economists duly did. To my mind the great item to the High Authority's credit is that this year for the first time it has instituted a dialogue with the authorized representatives of the emergent countries. It is perfectly natural that these questions should extend beyond the purely technical into the economic and political spheres.

To start with, on the technical side, we did of course touch on the subject of corrosion, though this was dealt with on a much more expert level by M. Denis's working party. It was naturally recognized that corrosion is not a problem peculiar to tropical countries, but, as was pointed out in one paper, since in Africa in particular the major cities, and hence the largest centres of steel consumption, are usually near the coast where the air is especially humid and salt, corrosion there tends to be particularly fast and intensive. Also, as the emergent countries do not produce their own steel, the iron and steel products needed for use have to be stored for long periods and so are exposed to corrosion some time before they are actually employed, with the result that the corrosion effects are a good deal more serious still.

We also discussed a good many other technical problems, concerning which I propose to give only a brief outline. One subject dealt with was the tremendous impact produced by an earthquake on constructional steelwork in certain tropical areas, and it was noted that for the exceedingly accurate calculations which this made necessary work was now in progress on the drawing-up of international rules to ensure sound constructions and indicate the permissible stresses and forces in the light of the earthquake hazard. We were also greatly pleased to hear that Prof. Naka, to give us all the benefit of his extensive experience, was leaving a record of his work with the Congress organizers for later study in detail. We then turned to the economic aspect, which we discussed from the angle of the development drive; every one of us, I think, felt and wished to emphasize that there was no conflict between the needs of the European or other highly-industrialized countries wishing to export and the desires of the underdeveloped countries seeking to industrialize.

It was the view of us all that the solution lies in close co-operation between the industrialized and the emergent countries. We noted that some Latin American and African countries in some ways complement our own, since they have substantial labour reserves and so can concentrate on labour-intensive industries, while the industrialized countries are relatively short of labour and are thereby obliged to rely more on capital-intensive industries. Some steel-processing industries would be particularly suitable for the introduction of the kind of co-operation referred to by Prof. Quintana, provided certain factors could be got over, such as the economic difficulty of having a wide range of iron and steel products available in the countries concerned, the high cost of components needing to be manufactured or imported in unduly small quantities, and the use of complicated assembly techniques making too great demands for the existing technical level of labour and equipment. Accordingly, we think it would be desirable to have a very thorough study carried out – if only within the High Authority – of possible ways and means of simplifying, if not actually standardizing, the construction and even the basic principles of certain machine tools so as to reduce the number of different parts used to make them, and simplify their manufacture, assembly and installation.

Co-operation of this kind would not reduce the industrialized countries' export potential – far from it – since all progress in industry necessarily means increased requirements of iron and steel, which the industrialized countries' export potential will be able to meet.

To conclude, we were not able to discuss all the aspects in detail, nor, in particular, to consider appropriate ways of furnishing the capital and capital goods so essential to the emergent countries. Since this question is altogether bound up with the much wider subject of industrialization, our Committee would have been departing from the terms of reference assigned it by the very fact of its organization as part of a primarily technical Congress.

At the same time, we owe a debt of gratitude to the High Authority for enabling accredited representatives of the African authorities to establish contact on this occasion with industrial and other circles from the more industrialized countries, in order to start things moving among all those concerned. We feel that, on this year's showing, the High Authority could well go further and arrange for a Committee of more clearly-defined scope to embark at the Congress next year on a fuller discussion of the various problems which on this occasion we could do no more than briefly and incompletely enumerate.

CLOSING ADDRESSES

ADDRESS

by Franz Etzel, Chairman of the Second Steel Congress

Your Excellencies, ladies and gentlemen,

The Second Steel Congress is over.

We have three days crowded with work behind us, but three days crowded, too, with human contacts, three days of generous hospitality.

And so I think I must begin my closing address by expressing appreciation. First, to my Colleagues the Chairmen of the Working Parties and of the Special Committee. You, gentlemen, more than anyone else have borne the real burden of the proceedings : you sifted and clarified and summarized the lengthy, detailed debates, the proposals, the suggestions, the exhortations.

My thanks go next to the rapporteurs, whose preparatory work laid the foundations for the Congress, the initial basis without which the discussions—those in many cases refreshingly lively discussions—could not have got under way. And in thanking the rapporteurs I must also thank all those who took an active part in those discussions.

But I am sure that, in particular, I speak for you all when I emphasize to the High Authority itself, and more especially to you, Mr. President, how deeply and sincerely grateful we are for this outstanding occasion. The second Congress, like the first, was your own personal idea, and it must rightly be a satisfaction to you to see what favourable response it has evoked.

We were honoured by the presence of the whole High Authority at the great reception yesterday, where many new bonds of friendship were formed and existing ones renewed. Mr. Linthorst Homan of the High Authority and the panel of judges at the Film Parade on Wednesday brought it home to us how in steelmaking today man and plant stand in a new relation to one another, and can bring betterment to whole regions. We owe a debt of gratitude too to M. Reynaud, whose observations on the technical and economic aspects of steel processing traced out the basic concepts of our work here. And we must thank Dr. Hellwig and the High Authority's Working Party on Market Questions, who were responsible for the organizational side.

Again, I would pay warm tribute to all those helpers, including the Luxembourg public servants here at the Congress and in the background, and to the man in overall charge, Director-General Peco, who have so admirably succeeded in organizing and running the intricate machinery of an international and multilingual technical Congress.

The Grand Duchy and the city of Luxembourg, in which the European Coal and Steel Community has been happily settled for thirteen years, have taken a keen and friendly interest in our activities, as was most notably demonstrated by the gracious presence of their Royal Highnesses the Grand Duke and Grand Duchess at our opening session.

The Luxembourg Government, too, most kindly held an imposing reception in our honour, which offered an excellent opportunity for making one another's personal acquaintance. And it was a special pleasure to me to see in our midst at the official opening M. Joseph Bech, Prime Minister of Luxembourg until his retirement a year or two ago, and a founding father of the Community : he stands, with Robert Schuman and Jean Monnet, Alcide De Gasperi and Paul-Henri Spaak, Dirk Stikker and Konrad Adenauer, as one of the men who with boldness and vision laid the foundation for the unification of Europe. They were the leading statesmen of an important period, who took coal and steel as a start for the buildings of Europe.

Even a technical Congress such as this is ineluctably called upon to make its own substantial contribution to the political unification of Europe. I do not look upon it as simply an advertisement for steel. You spoke, Mr. President, in your opening address of a public demonstration of «European community» or «European togetherness». I feel that now at this time, when frost has formed not only in the physical world around us but in the field of European politics too, the High Authority's second Steel Congress is giving fresh proof that the will to European agreement and co-operation is still very much alive.

We know that the world of tomorrow, with space travel, supersonic flight, nuclear power, automation, has made the earth so small that only the union of Europe can save us from turning into an underdeveloped and declining area. The present Congress has given concrete expression to the resolve of many Europeans to create new basic facts by working together in co-operation, to pool our knowledge, our skill, our strength in order to win our way into the future. And only by going on creating such basic facts whall we succeed in progressing towards our goal.

We have at the Congress 1,100 delegates from 44 countries. These are impressive figures. I am particularly glad to see the younger generation so strongly represented. They are the ones who will have to carry on our work.

But to me the measure of the Congress's success is above all the tremendous number of discussions and contacts. Since the subjects of the Congress were of two kinds – the specifically technical subjects of surface treatment, assembly techniques and cold forming, and the comprehensive theme of industrial design – these contacts have resulted in a most valuable cross-fertilization of ideas between the steel production and processing technologists and the designers.

It was not the object of the Congress to move resolutions, issue manifestos or formulate purely philosophical reflections, but to spur the producers' imagination, to convey new insights, and so to open up wider horizons for steel. Obviously, all the specialists present would know their own particular jobs backwards : the great point was to enable a host of technologists and researchers normally working on their own to open up to one another and to evoke a mutual response.

As for the Special Committee, its proceedings clearly indicated that the technical problems posed by the use of steel in tropical climates were not so very different from those in our own. Very much more important to my mind is how to set about promoting the use and consumption, in a word the natural acceptance of and familiarity with steel in the countries now about to embark on industrialization. A number of sensible points were made to the effect that it was not a matter simply of constructing a blast-furnace, converter and rolling-mill on the equator (an aspect with which the Congress was in any case not concerned) : what was needed was a broad-based drive to accustom the people and the economies of these countries to steel so that they would be able to benefit by our own standards of technology.

Perhaps the High Authority will consider what can be done to meet this urgent need for elementary technical knowhow. For only when it is met will steel be able to fulfil there too its function as a basic element in human progress.

I shall not attempt to recapitulate and evaluate the individual findings the Chairmen of the Working Parties have just outlined for us. I am not a technologist. But remembering the first day and what Mr. Swanson told us about the advances in knowledge obtained through American space research, I cannot but feel Europe will have a harder and harder job keeping up with the technological, and hence the economic progress of the United States. For financial reasons alone we shall have to join forces if we are not to become an underdeveloped area. The Americans are setting their sights higher than we are. In thinking big, the headaches are big - but the results are big too. We have got to listen to the voice of common sense : not, for us, war as the begetter of all things, but systematic, large-scale joint research. And that includes space research, the results of which can be turned to very great account in quite different and often remote technological and economic fields. Instances have been given us here of the ramifications it can have right into articles of everyday use.

I confidently entrust the many suggestions adumbrated at the Congress into the hands of the High Authority. They may not all mature. The High Authority has to select and decide within the context of the possibilities open to it. I would urge that it follow up the ideas that have been mooted and cultivate the contacts that have been established, both with individuals and with organizations. After all, it is impossible to get along without organizations in this administration-ridden world of ours.

Another point which has been borne out by this Congress is that real progress is still today the work, as Prof. Jeanneney has said, of individuals - I would add, and of individual groups. Team work is quite obviously essential also in such connections as the new methods of market strategy, as has been emphasized to us, among other things, by Working Party I.

I do not propose to offer any recommendations, But everything that has been said in the Working Parties seems to me to indicate that the continuity of the work begun last year should be ensured. It will remain for the High Authority to institute the proper machinery for handling this multifarious and growing task,

If now at the conclusion of the Congress, Mr. President, you ask me whether the occasion has been a success in this respect also, I feel certain all those who took part will support me when I say, unquestionably, yes. And if you ask me how the High Authority can best act for the furtherance of steel consumption, I will tell you in two words : «Carry on.»

ADDRESS

by Dino Del Bo, President of the High Authority

At the conclusion of the first Congress last year, the High Authority was a trifle afraid that-to use a steel men's term-the whole idea of holding such congresses was an unduly brittle structure, and that to prepare a second was asking for trouble.

We have carefully followed the proceedings on this second occasion, we have listened to the technical findings, and in particular we have weighed with care the summing-up the Chairman has just given us. We feel we can fairly conclude that from the High Authority's point of view the second Congress represents a successful outcome to its endeavours and an encouragement to continue.

Since it falls to me to express the thanks which are due also, for its part, from the High Authority, may I first and foremost express them to you, Your standing in political affairs, your knowledgeability on the various sectors of the economy, above all your humanism, have helped to impose on this Congress-which may passibly have appeared at the outset rather too composite-the genuine unity which, by the time of its successful termination, it possessed.

We are grateful. For the rest, I would simply underscore what you have said as to the debt of gratitude we owe to Their Royal Highnesses, to the Government and administrative authorities of the Grand Duchy of Luxembourg, to the Press, who have given and are giving us their understanding and, where necessary, their active co-operation : to all those, in a word, who have, with ourselves, created the requisite background for the Congress to prosper.

But one word I would say of special appreciation, and on my side indeed warmth, to the staff of the High Authority so many of whom are present here today.

During the past year, the High Authority itself has striven unremittingly, as it must, to fulfil its many and demanding constitutional obligations, difficult and sometimes politically delicate though these are. And during that year the entire staff, from the Directors-General-and especially the Director-General for Steel-down to the executive grades and to our long-suffering secretaries, have for many months given hour upon hour to the preparation of the Congress. I feel their devotion is evidence yet again of a true European-mindednes to which they unfailingly respond. With the merger of the three Executives drawing near, I would here formally state that those in charge of the future single European Executive must bear in mind the inalienable rights of the High Authority staff, and honour these as is their due.

Our Congress this year has been attended by representatives of non-European countries, almost all of them countries in process of economic development, and many but lately arrived at political and national independence. None of them ranks as a major steel producer, although many are enthusiastically working and planning for the installation of adequate steelmaking capacity for their people too. The Chairman of the special committee on this subject has rightly emphasized that in this field political and economic problems take precedence of the purely technological side. And since such constructive contact has been established at the Congress between technologists and producers from the industrialized and representatives of the emergent countries, I would urge the former not to feel the least disquiet at seeing the newcomers forging, for the most part irreversibly, towards industrialization, and more particularly in this instance towards the construction of their own steel plants. Even within highly-industrialized countries we have seen how the industrial working-up of the more backward regions, if carried out with tact and sense, accrues also very practically to the good of the rest.

In my view, the industrialization of the emergent countries offers us and those coming after us in Europe the prospect of many years of financial activities, economic co-operation and technical assistance to ensure that alongside the betterment of conditions for the emergent peoples will go solid economic benefits to the producers of the countreis already industrially developed. For that reason I feel this first encounter, serving mainly an exploratory purpose, should be carried further, here and elsewhere, to the end that the non-European and especially the emergent countries may profit by the High Authority's discharge of one of its regular duties, that of helping, by assembling and disseminating all possible relevant information, as the Congress now ending has clearly shown, is closely bound up primarily in the six member countries, but also by so doing in every country in the world.

And speaking of information-one of the High Authority's most binding tasks-I would emphasize that we plan to press ahead on this, while fully aware that at a certain level the work of information, as the Congress now ending has clearly shown, is closely bound up with the work of research.

Research, which may be divided under the two main heads of «pure» and «applied» research-or, if you prefer, of scientific and technical research-is today one of the great focal issues for the statesmen of Europe and for all those who recognize that, if democratic Europe is to retain a leading rôle in political councils, it must, it must make up without delay, technologically and industrially, the leeway between itself and certain of the major industrialized countries beyond its borders.

To revert to the theme of the present Congress, I think I may add that the Directorate-General for Steel should be given definite instructions by the High Authority to initiate, promote and co-ordinate applied research, this being after all the form of research which more immediately concerns those present at this Congress and, in particular, more coincides with the High Authority's own aims and functions. I do not mean that the High Authority could or would seek to take the place of the big research centres and university science foundations of which the Europe of the Six has happily so many : I mean simply that its job is to try to see that the mass of research activities and projects do not clash or compete but complement one another, in order that European research may have the greatest possible impetus and the greatest possible prospects of success.

The point has been made that this Congress is not an end in itself, but like its predecessor must prompt the High Authority to further action. Some steps, as delegates are aware, have been taken, but they will have to be followed up by others, since, as Mr Etzel has urged, they are to lead on to a third Congress.

The complexities and inevitable difficulties attaching to this will require further study by the High Authority, but-since our decisions are necessarily taken collectively-for my part I engage to propose to my colleagues that we officially decide that the second Congress shall be followed by a third, and that Luxembourg shall remain the regular venue for such occasions, wherever the merged Community Executive may ultimately be installed.

At the present Congress we have sought, by setting going exchanges of views which may on occasion have taken a polemical, or at any rate an argumentative turn, to establish all possible contact between researchers, technologists, producers and, in particular, consumers.

We felt this to be the best composition for the Congress, since not only did it bring the co-operation of a wide range of individual energies, but also it was the basis most calculated to help achieve the essential aim of a steady increase in the use of steel in Europe and in the world. This is a point to be borne in mind in settling the theme of the third Congress. The chemical and petrochemical industry has already deputed its distinguished representatives to ask that the next Congress should deal particularly with the use of steel in this immensely important sector of basic industry. I consider this a suggestion meriting most careful thought, though of course it must be remembered that there are other major industries - transport, for instance, and agriculture - in which steel is being employed more and more, and in which wider and wider possibilities are opening up for its use in new connections. So it may well be that the third Congress will note the existence of manufacturing industries where expansion is in full swing and making for a sustained increase in the use of steel; it may well be that the third Congress will deal with steel utilization in the growth sectors. Among other advantages, this would enable us to have the steel consumers still more fully represented. Such is after all our main aim : we want the steel consumers to be in the closest possible contact with the High Authority, at least as close as are the producers through their national representatives; we want them to stand not, as they appear to do, as merely marginal operators in this sector, but in the centre, as consumers of that indispensable product by which the iron and steel industry, so basic to the economy, can continue ever to the fore.

Such, to my mind, must be the legacy to us of the second Congress - a legacy we are bound to view in the light of the political developments, not all of them happy ones, through which the Europe of the Six is now passing. Since reference was made just now to the work of Paul Valéry, may I too paraphrase some lines of this greatest of modern French poets.

This occasion we have organized, and all the other acts of high endeavour by our own and by our sister Communities in Brussels, are intended to show to the world that, though the wind of this Community crisis is blowing, the Communities are out to live; they know that their vitality will carry the day against the uncertainties of men, the polemics of politicians, the resentments of nation-States, they know that their labours of love and faith will in time be the starting-point for renewed and ever more constructive progress. I think that, entirely irrespective of nationality, both the Europeans and the non-Europeans present agree with us that the active survival of the Communities is indispensable if Europe, having already achieved economic integration, is to turn that integration into a genuine unity and to take that unity as the basis for subsequent political integration. However, this is perhaps taking us beyond the scope of what I am here to say. I think we can end here, each of us returning to his own responsibilities - the researchers to their centres and universities, the producers to their plants and workshops, the consumers to their industrial and business activities, and we ourselves, with our staff, to the pursuit of our Community task. All of us, each in his own place, can claim to have done and to be doing our part toward getting over this undoubted bad patch.

As this second Congress draws to its close, our thoughts go also to one who was here with us last year, Paul Finet, a Member of the High Authority from its inception and for a while its President, who died some little time ago.

I think it fitting that we should recall the example of a man who, having given his youth and middle age to the democratic organization of working men, spent the last years of a great-hearted life directing and taking part in the activities of the High Authority.

I would also pay tribute, along with him, to those others of our number, at all levels, who are with us no more. I do not think this is a melancholy note to strike : it is, after all, one of the facts of human existence, which we have no right to seek to evade. However, since life must go on, may I say, Mr Chairman, that the High Authority will very shortly, in all probability at its next meeting - on November 10, if I remember rightly - take cognizance of the findings of the second Congress.

You may rest assured that it will take full account of the points which have been urged upon it yesterday and today, and that your rightful expectations will not be disappointed : the third Steel Utilization Congress, so far from being a «brittle structure», will be if humanly possible a completely sound and solid one and an outstanding success.