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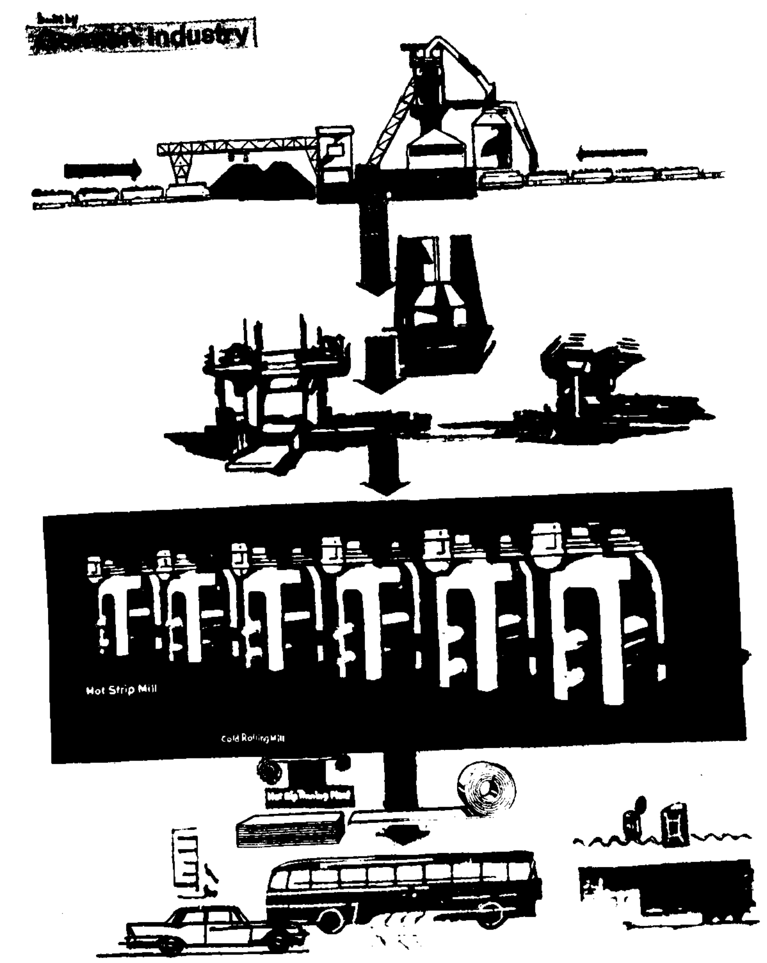

Journal of Iron & Steel Engineering

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£ 165,000 INDIAN ORDER FOR BRITISH WIRE

India's Iron and Steel Controller, acting on behalf of several Government departments, has placed contracts worth approximately £ 165,000 with William Bain & Co., of Coatbridge (Scotland) and London, wire manufacturers and constructional engineers. The orders are for 1,900 tons of galvanized mild-steel barbed, fencing, strand, and telephone-line wire.

Mr. Colin C. Smith, London director of the firm, told a correspondent that the wire was now being manufactured at the company's Coatbridge plant, and he hoped it would all be in transit to India by the end of June. He said the company, now celebrating its 101st birthday, has had trading relations with India for the past 50 years.

Iron & Steel Industry in India—new phase of expansion

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HAVING established itself well despite a few teething troubles, the Iron and Steel Industry in India has now entered a new phase of expansion thanks to the continued foreign collaboration on a massive scale. It is a well-known fact that our indigenous production of steel is far below our requirements and we are importing more than one million tons annually and it is likely that our requirements will be growing still further during the coming years under the Third Five-Year Plan. The three steel plants in the public sector, viz., Bhilai, Rourkela and Durgapur will be stepping up their capacity by 1.5 million, 8 lakhs and 6 lakhs tons respectively and besides, the two plants in the private sector have also launched their expansion programmes. Again, work is well under way regarding the erection of the fourth plant in public sector at Bokaro, the preliminary project report of which has been received even last year.

Though the initial estimates had fixed the cost of the three steel plants at about Rs. 300 crores, when they had been completed the actual cost had amounted to almost double the original estimates. Hence, we are now confronted with the problem of exploiting these plants to their full capacity and make them yield quick returns in view of the heavy investments we have made. Looking at the development of steel industry from this angle and taking into consideration the inevitable initial problems to be tackled with reference to availability of raw materials, transport facilities etc., it should be carefully examined whether the proposed fourth steel plant should be taken up immediately or deferred for a few years.

In this connection, it is heartening to recall the remarks of Minister for Steel, Fuel and Mines, Sardar Swaran Singh, while inaugurating the Annual General Meeting of the Institute of Indian Foundrymen at Bombay recently. The Minister said that they had reached the "break-through stage" in steel industry in the country and added that the steel plants had started producing saleable steel worth about Rs. 130 crores and the country would be producing soon 4.5 million tons of saleable steel.

One important feature that augurs well for the future of the steel industry, is the gearing up of railway transport to meet adequately and in time the coal requirements of the steel plants, the absence of which was hotly discussed both on the floor of the Parliament and the press in recent times. It is stated that the Railway Administration has taken steps to provide 5,000 wagons a day on an average for transhipment of coal from the Bengal—Bihar coal-fields of which 1,500 wagons are intended for the five steel plants. It is also gratifying to note that the National Coal Development Corporation under the dynamic leadership of Mr. R. C. Dutt, Managing Director of the Corporation has acquitted itself creditably in increasing our coal production. We have achieved a rate of production of 13.7 million tons a year during the last quarter of the final year of the Second Five-Year Plan as against the target of 13.5 million tons.

Mention must be made of the remarkable way in which the wastes have been utilised and by-products recovered in the Rourkela Steel Plant thanks to the advanced techniques adopted by West German experts which should serve as a model for other plants. Besides the various by-products like pitch, tar, wash oil, napthalene etc., which are being turned out by the by-product plants in the project, special mention must be made of the fertiliser plant estimated to produce annually 600,000 tons of Ammonium Nitrate and the power plant run exclusively by waste gases which will have a capacity of 75,000 KW.

BRITAIN'S PRACTICAL TRAINING FOR OVERSEA ENGINEERS

Two Indian engineers were among 106 post-graduate engineers from 28 countries who attended a dinner in London on April 11 given by the Federation of British Industries (FBI). All are training in British industry under scholarships administered by the FBI and jointly financed by the British Government and the firms with which they are placed.

The Indian students attending were Mr. M. Lal, of Patiala, who is training with the Electricity Council in London, and Mr. K. D. Puri, of Delhi, who is training with the General Electric Co. Ltd. at Erith, Kent.

Tributes to the opportunities the scheme offered them were paid by the scholars in after-dinner speeches. A Peruvian army engineering officer and metallurgist said: "The scheme is working silently without any boast and without any propaganda among the scholars and getting remarkable results. This scheme also allows people from all corners of the world to meet, exchange ideas, and realize that a human being is exactly the same, no matter what his colour, beliefs, or religion."

441 SCHOLARS TRAINED

The chief speaker, Sir Richard Powell, Permanent Secretary at the Board of Trade, described the scheme as an example of the close relationship and co-operation between industry and the Government. "The scheme began in 1950 in a small way, he said, "but it has grown and 441 scholars have come here from 37 different countries—181 from the Commonwealth, 184 from Latin America, and 76 from the countries of the Middle East and Far East and from Europe."

He went on: "This form of help to developing countries seems to me to be particularly well suited to the circumstances of Great Britain.... We are very rich in technical skill, experience and knowledge, and this we can pass on so that the countries to whom it passes will have knowledge of how best to help themselves. This is just as necessary as hard cash to countries that are struggling to develop their own strength."

Among the distinguished guests at the dinner was the High Commissioner for India, Mrs. Vijaya Lakshmi Pandit.

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Photo shows the beautiful port of Genoa in Italy. Genoa is located on the Italian Riviera and tourism is of great importance. Industry is busy, too. Recently, a major Italian steel company, located in Genoa, ordered industrial locomotives from General Electric (U.S.A.) to help raise its production.

Story of Steel at Durgapur Exhibition

Some interesting information regarding the latest industrial focal point in West Bengal has been highlighted by the Durgapur Steel Project authorities in the exhibition being held at Durgapur in connection with the A.I.C.C. Session.

An indication of how fast the steel township, which four years ago was a stretch of jungles and fields, is taking the shape of a sprawling city, is available from the 1961 census figures which put the population of this steel town at 35,000. This population added to that of the adjacent colonies of the sister projects and the private colonies outside the steel town makes Durgapur an important link in the Howrah-Asansol-Dhanbad industrial belt.

The Steel Project authorities are now completing 10,300 houses besides the present target of 3 High Schools, 8 Primary Schools, 2 Community Centres for workers, shopping centres and hospitals.

The Plant, which started production at the end of 1959, sold steel products worth Rs. 13.6 crores upto March 1961.

The Project's role in relieving unemployment problem is reflected in the employment figure which stood at 10,881 at the end of March 1961. Besides giving important data, the pavilion tells the story of steel beginning from the ancient times when steel was mentioned in the Atharva Veda and later when Indian steel was used in the Ashoka Pillar and in the famous Damuscus sword. The narrative runs through post-Independence development, the birth of Hindustan Steel and terminates at production and marketing of steel by Durgapur Steel Project, the youngest of the Steel Plants in India.

The process of making iron and steel has also been clearly explained for the laymen through models and charts. The pavilion being educative and attractive, is drawing a large number of people everyday from Durgapur and its neighbouring areas.

The exhibition will remain open till June 14, 1961.

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STEEL IMPORTS TOP EXPORTS AGAIN

Imports of steel into the United States in February exceeded steel exports for the third month in a row, the Commerce Department reported. U. S. importers bought 152,000 tons of foreign steel during the month, compared with 145,000 tons in January. During February U. S. firms supplied 147,000 tons of steel to overseas customers, up 15,000 tons from the month before. The February exports were valued at $31.6 million, compared with a value of $ 20.9 million for imports.

* * *

SHEFFIELD SILVERSMITH DESIGNS DURGAPUR MEMENTO

VIP visitors to the British-built Durgapur steelworks in West Bengal will receive a memento of their visit designed by a 23-year-old Sheffield silversmith. He is Mr. Ian Rodger, a student in the silversmithing department of the Sheffield College of Arts & Crafts. This is Mr. Rodger's fifth year at the Sheffield College, which he leaves in September to begin a three-year course at the Royal College of Art.

The college was asked if its students could produce a suitable souvenir in silver, the design having some stylized visual connexion with the basic structure of a rolling-mill. Mr. Rodger produced an acceptable prototype in the form of a small paperweight.

A presentation version has been made by an Indian silversmith, and the first replica was presented by the Managing Director of the Indian Steelworks Construction Co., Ltd. to the Indian Prime Minister, Mr. Jawaharlal Nehru, when he visited the Durgapur steelworks recently. (ISCON is the consortium of British firms which has built the Durgapur steelworks.)

* * *

IRON AND STEEL POURED INTO PLUMBING INDUSTRY

Plumbing fixtures, water heaters and boilers take a lot of iron and steel. Over 272,000 tons of carbon steel were used by makers of domestic storage water heaters in 1957, and more than 110,000 tons by makers of steel heating boilers, according to the Building Materials Division of the Business and Defense Services Administration in Washington. Meanwhile, the plumbing fixture industry received over 87,000 tons of carbon steel, over 3000 tons of stainless steel and 236,872 tons of pig iron and scrap, according to government data.

PRECISION MACHINE TO MAKE PELLETS FOR SHOT BLASTING

A compact precision machine, which will enable firms to make pellets for shot blasting from high-tensile steel wire, has been produced by a U. K. firm. The manufacturers, already producing a wide range of sizes of cut, high-tensile, steel wire pellets for shot blasting, estimate that to a firm which has to import pellets the new pelletizer would cover its cost after producing the initial 50 tons.

The unit, powered by a 1½ h. p. electric motor, produces pellets ranging in size from 0.020 ins. to 0.064 ins (0.5 to 1.6 mm.), accurately without tolerances, specifically for use in shot blast cabinets. It can be used to replenish hoppers as required and can be modified to suit any requirements in this field.

With compactness as a design feature, the firm are producing two models, one requiring a floor area of 7 ft. × 2 ft. 6 ins. and the other an area of 3 ft. 6 ins. × 1 ft. Each machine is supplied complete with up to five gears to individual users' requirements and it is a simple operation to change the gears to produce different size pellets. Additional gears are supplied at extra cost where a user needs more than five sizes. Pellets are produced in lengths equal to the wire diameter. This is achieved automatically by the pre-determined speed of the hardened steel rollers. As an example of their capacity the machines are designed to cut fine wire at speeds sufficiently high to give an average production of 28 lb. (12.7 kg.) of pellets an hour. Sizes of more than 0.040 ins. (1.02 mm.) up to 0.064 ins. (1.63 mm.) can be produced, but the wear on cutting blades is considerably higher.

* * *

WORLD'S LARGEST STEEL SMELTING SHOP DESIGNED

The World's largest steel smelting shop has been designed at the Ukrainian State Institute for Designing Metallurgical Works.

The new gigantic shop which will occupy an area of 40,000 square metres will have super-powerful arc furnaces whose volume will be 150 per cent larger than that of the furnaces now in operation in the Soviet Union.

All latest achievements of Soviet metallurgical engineering have been taken into account in the design of these powerful steel smelting units.

The furnaces will be equipped with original mechanisms which will make it possible to quickly lift and turn the bell of the furnace, to incline and rotate its hearth. These improvements will help to cut considerably the duration of smelting.

Special induction devices will be used for stirring liquid metal and pumping off the slag. A cybernetic installation will calculate with absolute accuracy the composition of the charge and also determine the most rational thermal regimen of steel making. A 165 cubic metre bucket has been designed for conveying the ore to the furnaces. It is transported to the furnaces by the overhead crane of 300 tons capacity. Such mechanisms are being created for the first time in world practice.

* * *

U.K. FIRM TO SUPPLY MARINE GEAR TO INDIA

McKie & Baxter Ltd., the Paisley (Scotland) marine engineering firm, has secured an order valued at £ 155,000 from India. The company is to supply propelling machinery and ancillary equipment for two twin-screw steam tugs being constructed by the Mazagon Dock Ltd., Bombay, for the Visakhapatnam Port Authority. Mr. P. S. Millington, a director of the firm, said the order was for two marine boilers, twin-screw triple expansion engines, deck machinery such as windlasses, auxiliary machinery, propellers, and shafting and fire-fighting equipment for the tugs.

* * *

DURGAPUR STEELMAN STUDIES U.K. FACTORY'S WORKING

In Britain to study refractories in steel melting plants is Mr. I. B. Saha, of Durgapur, West Bengal. Mr. Saha is an assistant foreman of refractories at the Durgapur steelworks, built by a consortium of British firms. He arrived in Britain in February, and is now studying at the large steelworks of Stewarts & Lloyds Ltd. at Bilston, Staffordshire. "The course at this factory is excellent", Mr. Saha told a correspondent "Although their furnaces are smaller than the ones at Durgapur, the firm has more than a century of experience—and it is that that counts."

The Development of the Use of Steel Sheet in the Federal Republic of Germany

By A Special Technical Correspondent

THE first half of this century has seen an increase in the use of steel sheet in the form of heavy plate, medium plate and thin sheet and of steel strip, which is still rising, with the result that in Germany nearly one-half, in the USA nearly two-thirds, of the total production of rolled steel now consists of steel sheet and strip.

In the short period between 1936 and 1938 the output of steel strip in the former German Reich rose from 2.9 million to about 3.7 million tons, that is to say, it had increased in two years by 800,000 tons. In the German Federal Republic production of steel sheet and strip increased between 1948 and 1957 from 1.3 million to 7.3 million tons, i.e. it rose more than five-fold in ten years. In evaluating this achievement it must be borne in mind what a serious setback the German steel industry had suffered through the effects of war damage, dismantlings, disintegrations of concerns, and territorial changes.

In the past year, approximately 7.77 million tons of steel sheet and strip, (including 2.6 million tons of thin sheet) were produced in the Federal Republic.

There are various reasons for this substantial development in the use of steel sheet. Today larger quantities and better qualities of steel sheet are available to the processing firms and, contrary to former times, the sheet manufacturing industry can now count on current supplies of adequate amounts of sheet material. Production capacity has been expanded by the installation of the wide strip mills. On one of the big German wide strip lines strip can be rolled in widths up to 1880 mm. and thicknesses up to 10 mm. Annual capacity has now reached nearly two million tons.

Apart from the general progress made in the technique of sheet and strip rolling, the improvement in the quality of steel sheet is largely due to the development of the cold rolling process. Improvements have been achieved in deformability and in surface quality. The importance of deformability may be illustrated by a recent report from a big automobile firm to the effect that, due to the improved deformability of the hot strip they used, they were now in a position to turn out in the same working time instead of three frames, twelve frames of superior quality for one of their car types. The kind of surface is particularly important, too, for the surface treatments which the steel sheet has to undergo. For instance, a roughening of the surface is required for enamelling, galvanising and tinning, while only a slight roughening or a smooth finish is needed for electroplating treatment. Today a wide range of various kinds and quality groups of steel sheet, especially of high grade thin sheet, are included in the production programme.

An essential condition for a rational use of steel sheet in many fields is the uniformity ensured by modern technique of its products, particularly in respect to permissible variations.

Finally, the progress made in hot and cold rolling technique has secured to stainless steel, and especially strip, a wide range of applications in the domestic sector and in vehicle construction. This development is already far advanced in the United States and in the Scandinavian countries and is presently getting into its stride in this country.

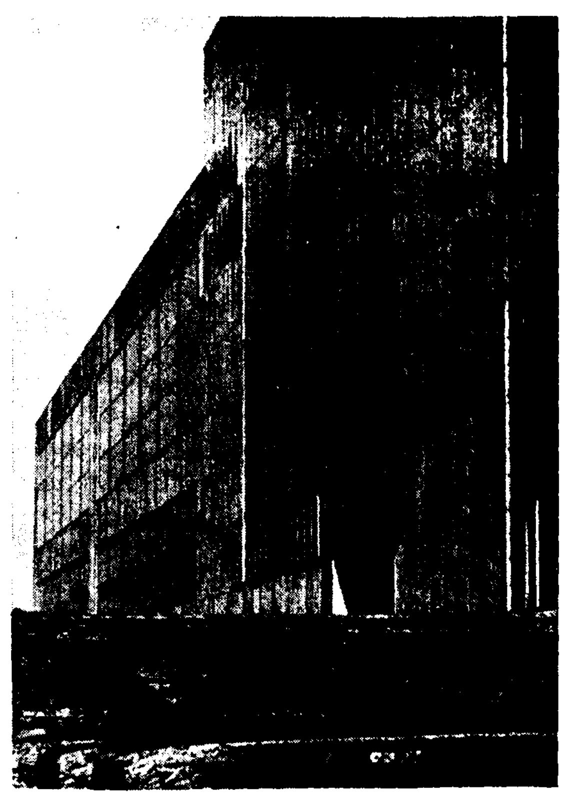
The modern methods of plastic shaping permit the fabrication of products from steel sheet in a way that, in its transformation possibilities, operational combinations and short working times, meets the universal demands of mass manufacture. On modern presses, folding machines and roll-rolling machines it is possible to produce structural elements in large numbers on a very economical basis. In view of the properties of the materials and the versatility of the mechanical equipment of plastic shaping the transformation possibilities of steel sheet are very great. It is impossible to indicate here all the mechanical equipment now available to manufacturers. The extent of mechanisation and automatisation, however, is revealed by the fact that in a newly equipped modern automobile factory which is capable of turning out 250,000 cars a year, 20 pressing mills with 225 heavy and lighter presses are in operation at the pressing plant. In addition there are three multi-stage presses, each of which represents a miniature pressing train, and 9 multi-spot-welding machines. Linked to this mechanical equipment are the many auxiliary units such as grabs, chutes, roller conveyors, swing lifts and conveyor belts, which move the steel sheet or the parts made from it as far as possible automatically without human aid and transport them from one manufacturing stage to the other. In view of the fact that in the manufacture of all-steel car-bodies the arising of baling scrap amounts to about 35 percent of the input weight, the plant which collects the scrap as it arises and feeds it automatically over underground conveyor belts to the baling press is also an important item of equipment. The economics of manufacture can be improved in plastic shaping if connecting operations are carried out by spot—and seam-welding with mechanical equipment such as presses and roll-rolling machines. For instance, two channel sections produced in a roll-rolling machine can be welded together to form a hollow rectangular section.

Of the various connecting methods used with steel sheet working the joining of steel sheet parts by welding is the most important. It may be said that the progress achieved in welding technique has largely contributed to the increase in the working and utilisation of steel sheet.

Apart from the general progress in welding technique, the improved quality of the seams and the higher welding speeds, the growing use of thin sheet has been due to the development of the aforementioned spot-welding machines which can perform as many as 580 spot-welds simultaneously in modern car-body manufacturing. Along with the automatic welding machines mention may be made of the acetylene cutting machines for steel sheet working.

A large number of connecting methods are available to the steel sheet worker: welding, brazing, riveting, screwing, folding and lamination. The most recent of these methods, metal-lamination, achieves a more uniform load transmission in the joints and in many cases is more economical than other processes. The development of the rabbeting method which does not involve heat development is important for those tasks in which the occurrence of stretching and distortions must be eliminated, or in which sheet and strip with pre-heated surfaces are to be processed. Special coatings have been developed for use where these steel sheets are to be welded, in order to replace the surface protective destroyed at the points of welding.

Improvements in the surface treatment have also contributed very substantially to the development in the use of steel sheet. This is important both in respect to the higher corrosion-resistance of the sheet material achieved by the surface treatment and hence to the greater stability of the manufactured goods and also in respect to the demands of taste. The reason for the certain disrepute sometimes attached to steel sheet lay largely in the fact that both small and bigger products made from it occasionally revealed inadequate surface treatment. Today, attractive buildings, both big and small, made from corrugated steel sheet, which appear appropriate in every kind of environment, due to suitable surface treatment, and also high-class household devices of steel sheet prove that such cases are things of the past.

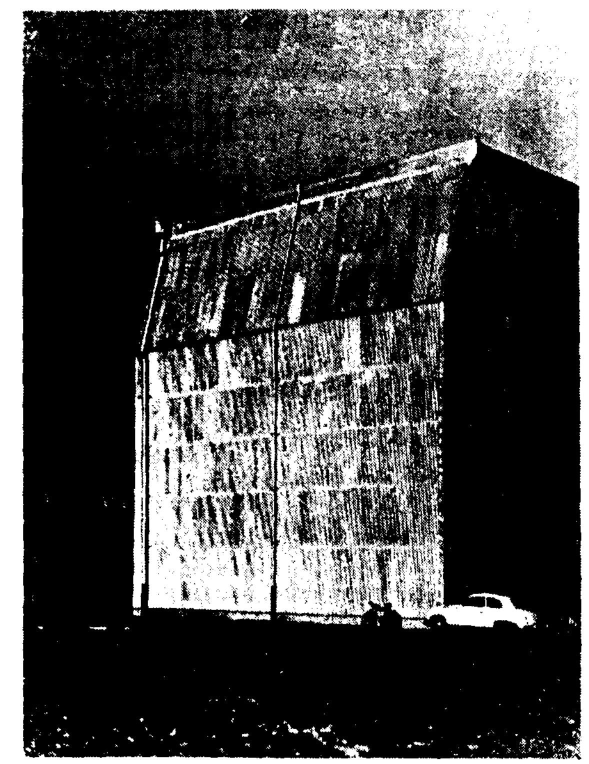


Plant building of August Thyssen-Hutte at Hamborn with steel sheet walls.

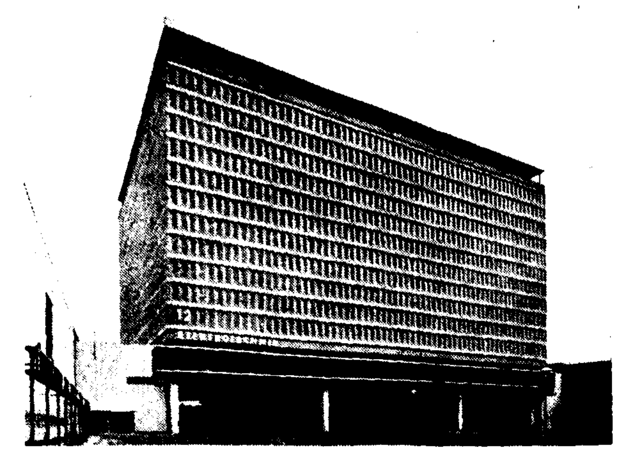
Steel is a material that is inclined to rust, but it can be relatively easily and reliably protected. This is

also the case with steel sheet. For constructions that are exposed to weather conditions protection against corrosion begins already at the drawing-board. Most surface-treatment processes suitable for steel can also be applied to steel products.

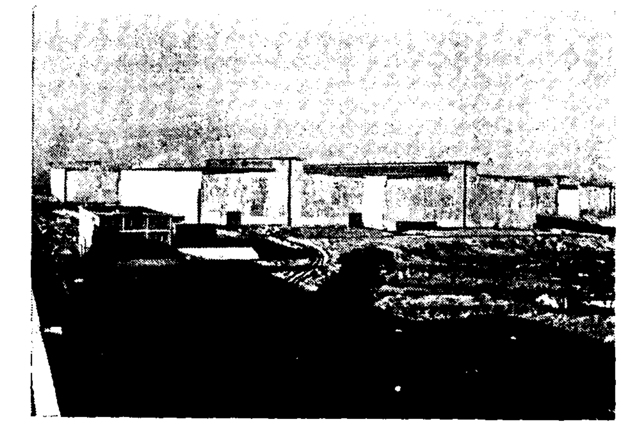
Building is a field for which the importance of the surface treatment of steel sheet is particularly evident.



Shop wall in steel sheet construction of Klockner-Hutte in Bremen.



Skyscraper at Hanover Fair with walls of galvanised and coated steel sheet.



Shop buildings with steel sheet walls of Klockner-Hutte in Bremen.

Today galvanised and coated sheet is finding more and more favour for wall and roof construction in great buildings. Enamelled steel sheet in many charming shades is widely used by architects as a novel material to create more cheerful and handsome walls of dwelling houses and administrative buildings.

In the domestic sector the level of present day enamelling technique, improved metal coatings, high grade baking varnishes, strengthen the position of these steel sheet products in trade and household in the competition against other materials and widen the scope of possible applications. Many of the methods of surface treatment that have been developed in the past few decades are extremely important for the working and application of steel strip. Reference need only be made to the electrostatic lacquering of mass-fabricated goods or to the spray galvanising of large-surface steel sheet constructions, as for example in hydraulic engineering, with automatic spraying devices.

There is growing interest, too, in steel sheet and strip that is supplied in surface-refined finish by the processing firm.

The working of surface-refined steel sheet is advantageous, and even essential, if certain products cannot easily, if at all, undergo the desired surface treatment after completion. In many cases it may have economic advantages. The well known and well proved hot galvanised steel sheet has been supplemented by the continuous hot galvanising of steel strip. The continuous hot galvanising of steel strip has the advantage that the zinc layer obtained by this method is very ductile and does not crack or peel off during subsequent transformation.

Phœnix-Rheinrohr Skyscraper in Düsseldorf, under construction. The shell walls consist of enamelled steel sheet plates and plate-glass. The plate-glass has the full height of the storey.

Hot galvanised steel sheet, tinplate, is produced not only in the form of plates but also as strip. Continuous tin-plated steel strip was produced before the war and used on a large scale to make thin sheet packing material, office articles and similar products. There still exist plants for the continuous production of lacquered thin sheet strip. All these plants are being constantly improved to achieve greater efficiency and to eliminate irregularities and defects.

An important part is played by the roll-weld plating of the steel sheet which permits it to be widely used in the fabrication of mechanical equipment and apparatus for the chemical and food industries.

A new development concerns the plating of steel with plastic layers. This must not be confused with the process of surface treatment by lacquering with plastic lacquers and by dipping in plastic baths. Skin-plated steel sheet may be regarded as a new material. It is already used a great deal in America and will soon be more widely used in this country.

In connection with the surface treatment of steel sheet two further sectors may be mentioned which may have had some influence on the use of steel sheet. One is the creation and development of insulating materials without which the sheet could not serve as walling plate. Sound-proofing materials promote the use of steel sheet in vehicle construction and in mechanical engineering.

Final reference may be made to the use of perforated and ribbed sheet which has been increased by the fact that exhibition architecture and interior architecture, especially, too, the illumination industry, are using this material to a growing extent.

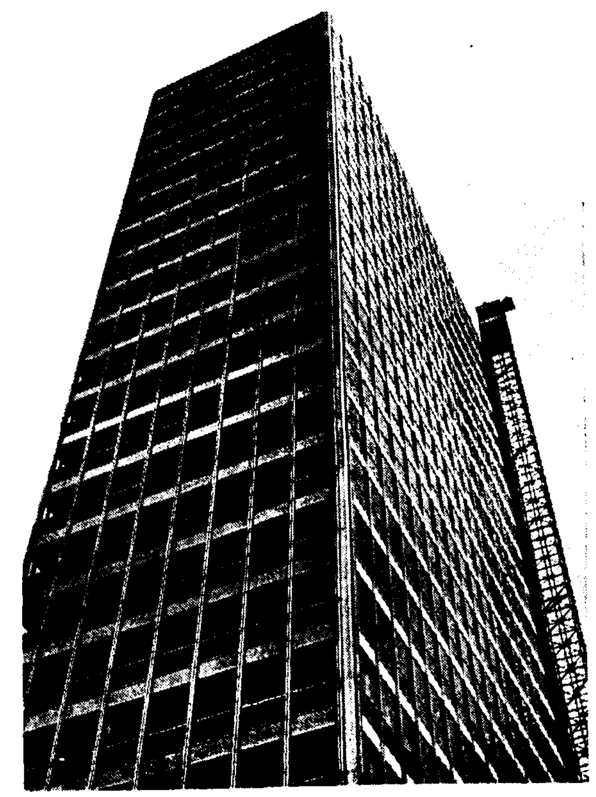
The "solid-mindedness" of the engineer that dominated his constructive work in the past century yielded very slowly to the taste for light construction. In 1906 the English civil engineer Scott Russel, inspired by a paper lampshade, decided in favour of having the cupola of the main building of the World Exhibition in Vienna constructed by the firm of Harkort in Düsseldorf as a light steel construction. Most engineers, however, still objected to the proposal to cast a machine housing, for instance, in material— and weight-saving ribbed steel design instead of in solid construction.

Light steel construction technique received its first inspiration from vehicle and aircraft building. The all-steel car-body was intended not only to increase safety but especially to reduce weight. The principles of light construction were carefully studied 25 years ago in Germany with the aim of economising material. The position of steel in competition against other materials was strengthened by improvements in light steel construction technique and protection against corrosion. Due to its favourable elasticity modulus and its good weldability steel would appear to offer in many cases the best possible solution as a light structural material. As a "thin-walled material" with high strength and elasticity properties, steel sheet permits the execution of light constructions with a minimum expenditure of material. Large areas can be covered with a low weight. The principles of light construction are realised today in all fields of steel sheet manufacturing, from typewriter frames to the housing of the drawing press, from the car-body to the wide-spanned steel bridge.

In view of the thin-walled property of much of the steel sheet used in light constructions, special importance must be attached to its protection against

corrosion. For this reason the advances made in surface treatment and in corrosion-resistance have a favourable influence on light steel construction.

The opinion is presently held that the task of the designer is not only to achieve technically and economically appropriate forms but also as far as possible a perfect and attractive arrangement from the aesthetic point of view. The smooth surfaces of pressed steel sheet bodies often create a particularly handsome impression.

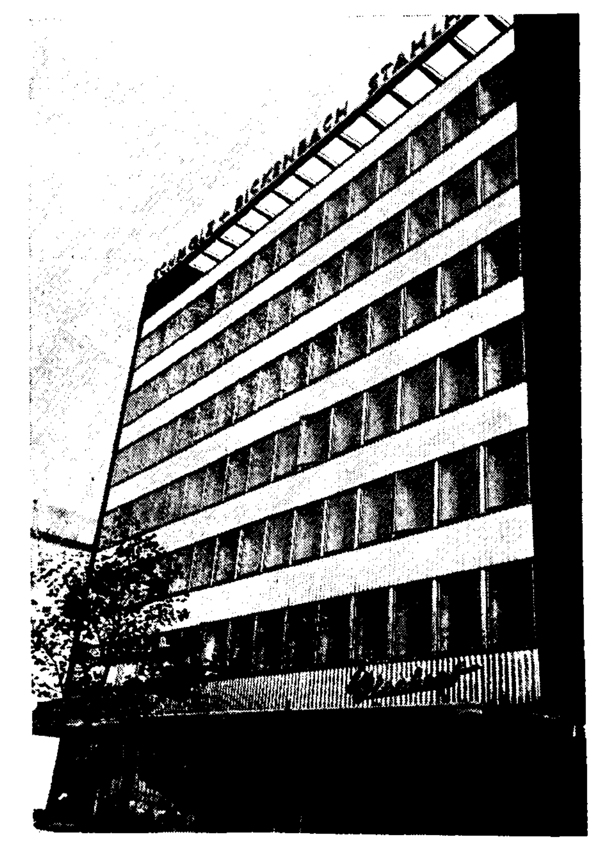


Mannesmann skyscraper at Düsseldorf, with shell walls of enamelled steel sheet walling plates.

In this respect where optimum results can only be obtained by co-operation between technicians and artists, remarkable progress has been made in the field of steel sheet fabrication in the past few decades and especially since the end of the war. This contribution to the promotion of the use of steel sheet should not be underestimated.

The following is a short review of the position of steel sheet application in the most important sectors, special consideration being given to new uses.

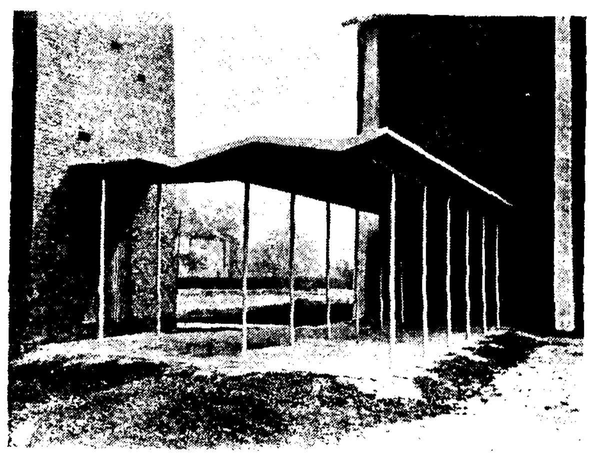
A new big sector, already far advanced in America, is now entering upon a steady upward development in Germany. It concerns the use of prefabricated walling elements made of enamelled, galvanised or stainless steel sheet in steel skeleton or reinforced concrete skeleton buildings. The shell walls replace the conventional masonry and are composed of walling plates. The walling plates referred to here have an external skin of steel sheet, which is usually enamelled but may also be galvanised and coated or may consist of stainless steel sheet. Between the outside and an inside skin, which is mostly of steel sheet, lies a heat-insulating layer. This use of walling plates permits a considerable gain in space as a plate of this type is only about one-tenth of the thickness of conventional masonry. This factor is extremely important in the centre of big cities where ground prices are high. The walling plates of enamelled sheet which can be fabricated in various sizes, finishes, and also in many attractive colours, meet the wishes of modern architecture for the breaking up of the surface areas and the vivid colouring of the buildings. Due to the glass-like character of the enamel, shell walls made of enamelled steel sheet possess great durability and are easy to clean. With their comparatively low costs they are suitable for many types of buildings and enable extremely beautiful effects to be obtained.



Office building on Berliner Allee at Düsseldorf with facade of special steel.

The shell walls are seldom fastened to the skeleton but nearly always to a supporting structure connected with it or with the projecting roof. Among the advantages of the steel sheet walling plates particular emphasis must be laid on the series fabrication and also on the possibility of rapid assembly from the inside without any scaffolding.

The facing walls serve the exterior facing of masonry which usually consists of light building bricks. These



Protective roof of steel sheet over a church porch.

Department store with shell walls of enamelled steel sheet walling plates.

walls are composed of steel sheet whose surface can also be enamelled or galvanised and coated, or they may consist of stainless steel material.

Facing panels of enamelled or stainless steel sheets are frequently used for the partial covering of a house facade, of a shop front, for instance. The use of walls of galvanised and painted sheet demands relatively low investment costs and comparatively large-surface elements may be used. Special paints have now been developed which, combined with a foundation also created for the treatment of galvanised sheet and the zinc layer itself, ensure absolute durability and an excellent appearance of the buildings. As a result, galvanised steel sheet, either corrugated or flat, is being increasingly used for fabricating walls both in very small buildings and in maximum-size industrial constructions. Here the wall is formed by the surface, made of the galvanised corrugated sheet panels, mounted on a supporting structure either alone or combined with an additional wall consisting of heat-insulating structural plates. During recent years a great number of hall buildings of excellent architectural design have been erected, using walling elements of galvanised corrugated sheet. In a Fair skyscraper that aroused marked interest in architectural circles, the sheet walls consist of galvanised embossed and trapezoid-shaped sheets, which are 2.33 m by 1.10 m and 2.23 m by 0.5 m in size. The walls were given a shiny coating of a bluish shade which, together with the plastic effect of the surface structure, gives the huge, entirely windowless building an unusual but very attractive appearance.

Buildings with shell walls of enamelled steel sheet walling plates are to be seen today in many big cities. Special reference may be made here to the two administration skyscrapers of the Mannesmann and Phoenix-Rheinrohr companies in Dusseldorf, one of which is still under construction. In this latter building the breastwork part of the shell walls consists of a combination of enamelled walling plates with special-glass panels in front of them. There are also examples in Germany, including one at Dusseldorf, of the execution of shell walls with structural elements of stainless steel sheet.

As an important result of improved surface treatment and architectural formation, steel sheet is finding increasing favour and ever wider application for the construction of small special-purpose buildings of all kinds. A promising field is offered by the erection of petrol station buildings. Enamelled walling plates

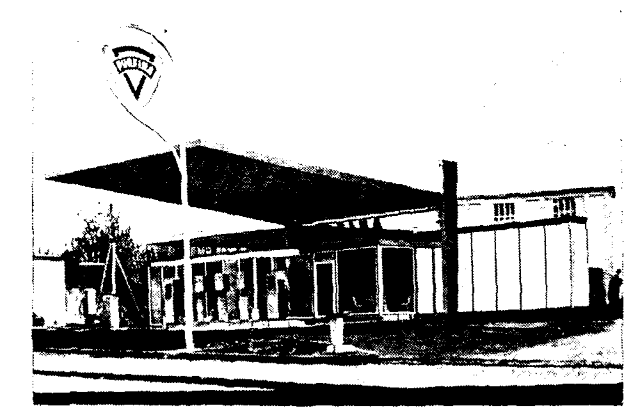
and facing panels are particularly suitable for this purpose. Galvanised steel sheet permits the attachment of large-area roofings. Buildings of galvanised and coated flat and corrugated sheet are found in considerably improved design as traffic facilities, waiting rooms and protective shelters. Today, when projecting roofs of this material are constructed on hotels, restaurants, railway stations, wharves, airports, and even on churches it would appear quite possible that at some later date they might also be used, in a tasteful form adapted to the town planning, as the arcades and galleries were in the old cities, to protect the passers-by or shopwindow gazers from the inclemency of the weather.

Prefabricated special-purpose buildings of steel sheet are often found in Germany as weekend houses or hunting boxes, though rarely as dwelling-houses as in other countries. The growing use of prefabricated buildings for industry (warehouses, canteens, first-aid stations, etc.) and for agriculture (machine sheds, stables, field barns, etc.) is essentially a question of economics and taste in design. An example of the efforts made in this direction is furnished by the new type of weekend houses and steel sheet garages. Steel roofing in the shape of galvanised roofing tiles and folded-edge sheet is used to a growing extent in rural districts, especially near the sea and in mountainous districts, A glance at the blocks of houses in the centre of the cities, however, also reveals a greater use of folded-edge sheet roofing made of galvanised steel sheet.

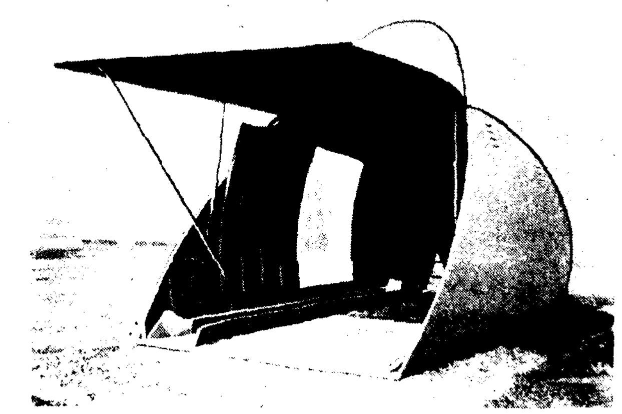
In the field of prefabricated buildings houses have been developed consisting of a skeleton of steel sheet sections. The walls may be built from sheet elements though other materials such as light masonry or structural plates of various kinds may also be used. Cold rolled steel sheet sections are particularly suitable for the construction of industrial buildings or hangars from prefabricated structural elements in light steel designs, and for all purposes of light steel construction in other sectors as vehicle building and in mechanical engineering.

For interior architectural purposes, such as, for instance, the construction of partition walls, elevator cages, etc., the plastic-plated sheet would appear to be particularly suitable. Walling plates of stainless steel are frequently used in reception or sales rooms to face entire room walls or parts of them.

In the domestic sector the introduction of the steel kitchen is extremely marked. Today these kitchens are already far more widely known in many other countries, especially in North America, than in Germany, but here too they are becoming increasingly popular. Their attractive appearance and their

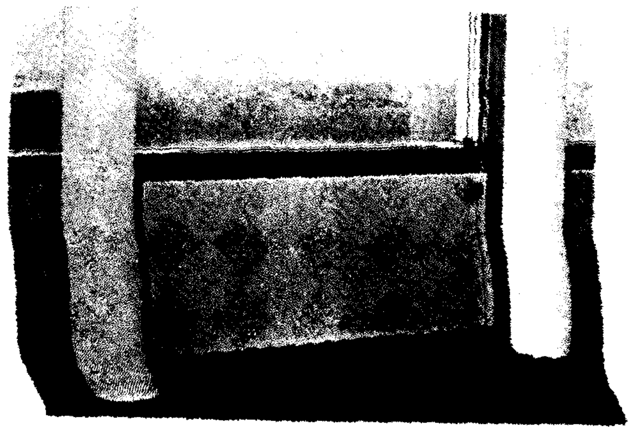


Fina filling station at Frankfurt/Main, consisting of prefabricated wall elements of enamelled steel sheet and roofing of corrugated steel sheet.

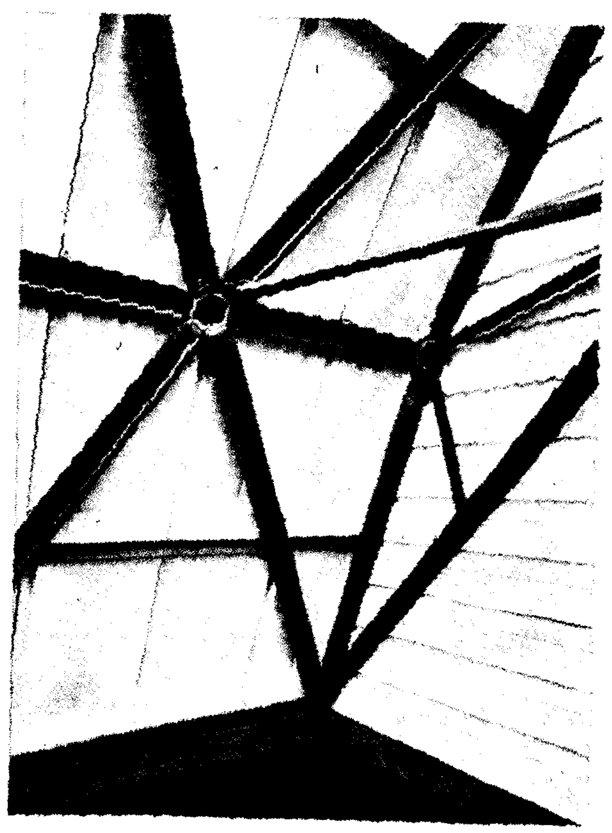


Modern steel sheet garage; one grip opens both doors; no foundations; minimum space requirement.

Hunting-box in all-steel design.



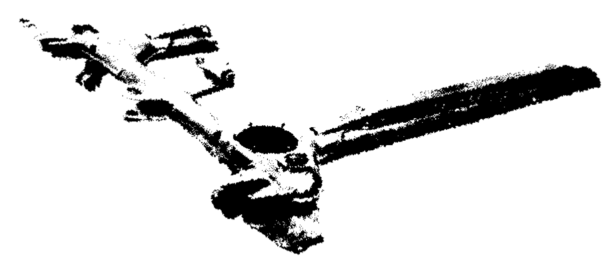
Modern plate radiator of steel sheet.



View of a novel type of building in light steel design.

stability, their unique hygienic advantages, easy cleaning, no smells, have won for them an ever-increasing number of friends.

Moreover, installations like gas and electric stoves, refrigerators and, more recently, automatic washing machines, all of which are now regarded as indispensable kitchen amenities, are likewise manufactured from steel sheet. At the present time some six million refrigerators are produced annually in the world. In the autumn of 1958 there were 21 electric refrigerators per 100 households in Germany, and this figure will undoubtedly rise in the near future for there are no signs of a saturation of the market. A concensus of opinion has revealed what importance the housewives of today attach to the fully-automatic washing machines. Along with these machines the built-in cupboards will find growing favour in the kitchen equipment. For both these purposes hygienic reasons alone indicate steel sheet as the appropriate material.



Welded steel construction for mechanical engineering.

Some thirty years ago a German firm switched over its manufacture of heavy-duty grinding machines to welded constructions in cellular design, and since then the use of steel sheet in mechanical engineering has substantially gained ground. In the advertisements of mechanical engineering firms references to the welded steel sheet construction are found again and again as being characteristic of up-to-date fabrication.

Among the advantages of the manufacture of major machine components in welded steel sheet are the following :

1. Saving in weight which may be substantial and consequently important for freight considerations in the case of oversea delivery and for foundation costs.
2. No dependence on a foundry or no need for own foundry operation. Shorter delivery times.
3. Possibility of meeting individual wishes in the manufacture of big machines for special purposes. New-type designs can be more easily tried out in welded execution.
4. The possibility of housing conduits, rods, shafts and other drive or control elements inside the construction. Where this is not feasable these parts can be covered with steel sheet casings. They are thus protected against damage and the men servicing the machine are also protected. At the same time the aesthetic advantage of a clear-cut design is given.

The development of the machine tool frame as a hollow box with reinforcing cellular walls permits the latter to meet very high demands for rigidity (as for instance in the afore-mentioned grinding machines). Trials have revealed that the same rigidity can be achieved in lathes by weldable light steel construction as by cast steel construction.

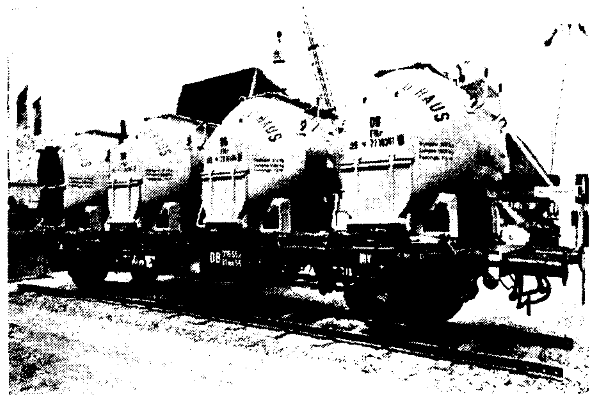
Smaller machine elements may be produced very economically from steel sheet with presses, rolls, or bending machines. Stainless steel sheet and strip is being increasingly used for machines and apparatuses destined for the food industry, especially for the use of butchers and bakers and for dairy equipment.

In the field of boiler and apparatus construction brief mention may be made here of the use of steel sheet in nuclear engineering. Here a new scope of application is offered for the processing of steel sheet and of corrosion—resistant sheet. Greater quantities of steel are required for the building of a nuclear power station than for a hydroelectric station of similar capacity. According to F. Bracht it may be assumed that 30 to 50 per cent of the steel used here in its initial form is steel sheet, 80 percent of which is represented by wall thicknesses of more than 10 mm. The items to be manufactured are primarily large-size containers (such as reactor containers) and pipeliners. What enormous tasks are involved in the boiler and apparatus construction sector may be judged from the fact that reactor containers are planned with a weight of more than 1,000 tons and that reactor protective containers for liquid—or metal-cooled reactors may have a weight of more than 2,500 tons. With the hydraulic reactor pressures of up to 140 atm. occur in the cooling circuit. The huge containers are welded together from bent or flanged plates on the building site, are annealed unstressed and the quality of the seams is tested.

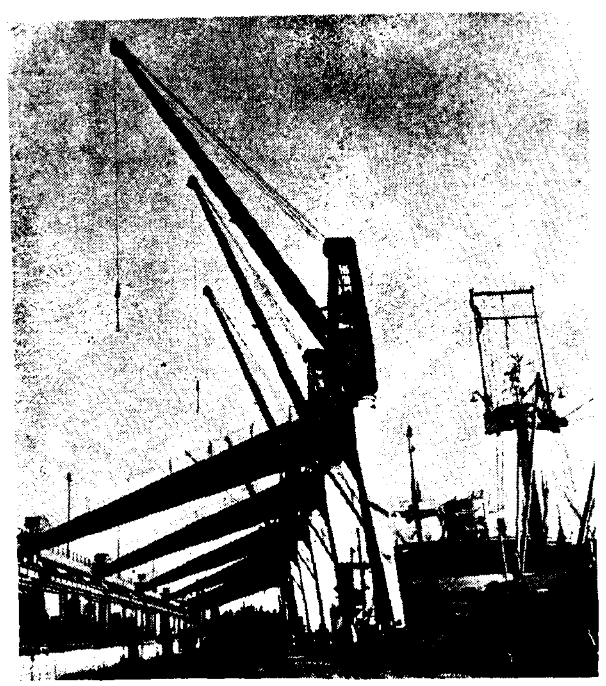
The flow of materials of all kinds and shapes offers further new possibilities of using steel sheet. The material flow starts with the winning of raw materials where, for instance, the wheel of the shovel-loader shoots the raw material onto a conveyor belt. An intermediate flow of material involves the movement of the product through the successive stages of manufacture from plant to plant and through the various departments. The flow of material ends where the finished product is received by the final consumer in the business office of a dealer, perhaps from an automation, or in the buyer's own house from the hands of a messenger or a postman. The flow of material also needs the equipment for the longer or shorter period of stocking the products on their way to the finished product, in the warehouses or even as a table beside the machine. Steel sheet plays an important role in the rationalisation and automation of the flow of material, in truck and crane, in chute, conveyor belt and conveyor worm, as piping for pneumatic transport and in the vibrator conveyor.

Here, however, special emphasis should be given to the contribution of steel sheet to a particularly important and up-to-date field of material flow, that of stacking technique and container traffic. This procedure involves the stacking of goods which are collected on stacking plates or in stacking containers and with the aid of forklifts or high-lift trucks are moved between the individual manufacturing points in the plant and the warehouse and then stacked as required in warehouses.

GEW-Werke (gasworks) in Cologne-Mülheim, spherical gasometer.



Steel containers for "house-to-house" transport of loose-weight goods.



Discharging rotary turret crane of modern design in welded steel sheet.

By economizing labour, the costs of transport and the flow of material are often substantially reduced and performance is speeded up. The available stocking space is better utilised and damage and loss of material due to frequent re-loading is avoided. The rationalisation of the flow of material makes it advisable not to restrict the "transport chains" to the plant.

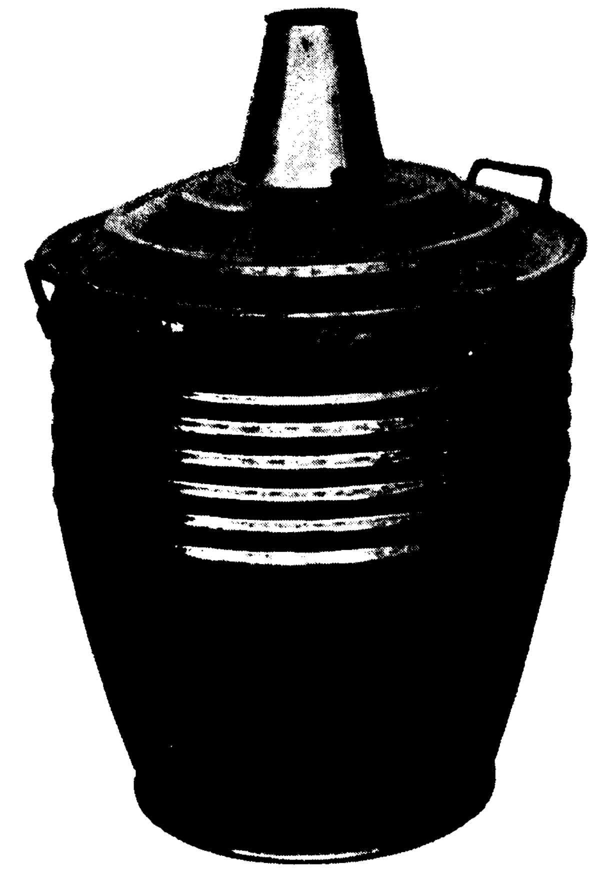
Machine parts, for instance, should be packed at the manufacturers in a container in which they can be delivered, without reloading, to the first operation in the machine factory. Steel sheet is finding ever

Chute for parcels in steel sheet design, a modern sorting device of the Federal Post Office

wider use in the manufacture of stacking plates and stacking containers and of containers for railroad container traffic.

Stacking containers and plates are made from steel sheet both for light and heavy duties, the required rigidity being provided by pressed-in or rolled-in beading. The advantages of using steel sheet consist in the strength and stability of the stacking elements. When the loaded stacking plates are weighed it is a

Stacking plate and stacking container of steel sheet at the exhibition "Construction in Steel Sheet".



Bottle basket in steel sheet, reinforced by beading.

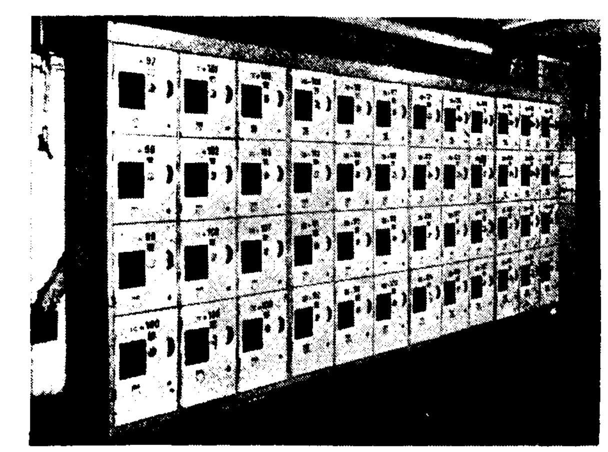
further advantage that the weight of the steel sheet can not be influenced by any moisture.

In 1958 the Federal Railway carried out 2.8 million transports in some 81,400 small containers and 478,000 transports in 16,300 large-size containers. The major part of the containers consisted of steel sheet. For the construction of larger, collapsible containers steel sheet is often combined with light metal. Collapsibility is important for the reduction of costs of unused return freights.

Steel strip is also finding wider favour as packing material. For instance, substantial savings are achieved in the transport of bricks if they are not treated as loose-weight goods but are bound with steel strip into parcels and then moved to the building site on suitable stacking plates.

In the field of thin sheet packaging steel sheet has maintained its position with an increase of some 8 percent per annum since 1950 though it has been exposed to a certain amount of competition from other materials, especially plastics. Improvements in surface treatment and shaping are essential factors in the maintenance and expansion of this branch of application. A tobacco-tin of tinplate, for instance, may be of a useful shape for keeping the tobacco fresh, a tea-tin of attractive appearance may be used for other purposes when its contents have been consumed.

The present transition from the increasingly endangered two-wheeled vehicle to the small car has a favourable effect on the use of steel sheet. The number of motorized vehicles continues to rise. In 1953 the number registered in North-Rhine-Westphalia was 915,705 and in the past six years the number has risen to 1,766,213, that is to say, it has been nearly doubled. This entails the need for more filling stations with their equipment, resulting in a constantly rising demand for steel sheet. For ships and railway wagons it is probable that partition walls will be introduced based on skin-plated steel sheet, especially as we now have materials at our disposal which effectively eliminate the noise of steel sheet constructions.



Luggage containers in steel sheet for railway stations.

Reference may be made here to a kind of vehicle which can only be included in the flow of material in the wider sense of the word. These vehicles also move materials, but not on their way to manufacture. They are the many light, heavy and very heavy scrapers, shovellers and excavators with which large-scale earth-moving jobs are performed. The importance of these machines, the production and application of which has not yet been fully developed in this country, may be recognised on perusing American technical journals. Although the possibilities of using these machines in the countries of the old world are limited, the opening up of many undeveloped regions will create such a heavy demand for them in the world market that every country with a major efficient machine industry must include them in their production programme. And this production will create a substantial demand for steel sheet.

Brief mention may be made of other sectors in which the use of steel sheet is already being developed but which could certainly be expanded.

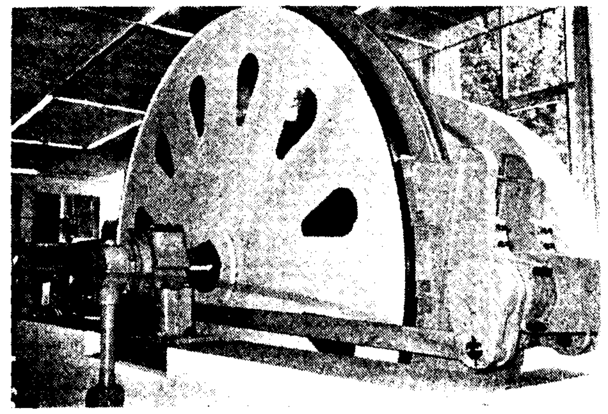
Oil heating demands the housing of fuel oil tanks in the ground or in the cellar. In underground installations the tanks are usually of steel sheet as any other material would be uneconomical. Oil stoves are filled from special canisters. Steel sheet oil stoves are also used for the heating of building sites, for instance, for the protection of vineyards against frost, etc. In air-conditioning, air ducts of galvanised steel sheet are built in the installations. Containers and pipelines of steel sheet form part of the equipment for the removal of industrial dusts and gases, the need for which is becoming more and more urgent and for whose manufacture major quantities of steel sheet are required.

There is a growing use of steel sheet radiators in the home, particularly of the new type plate radiators.

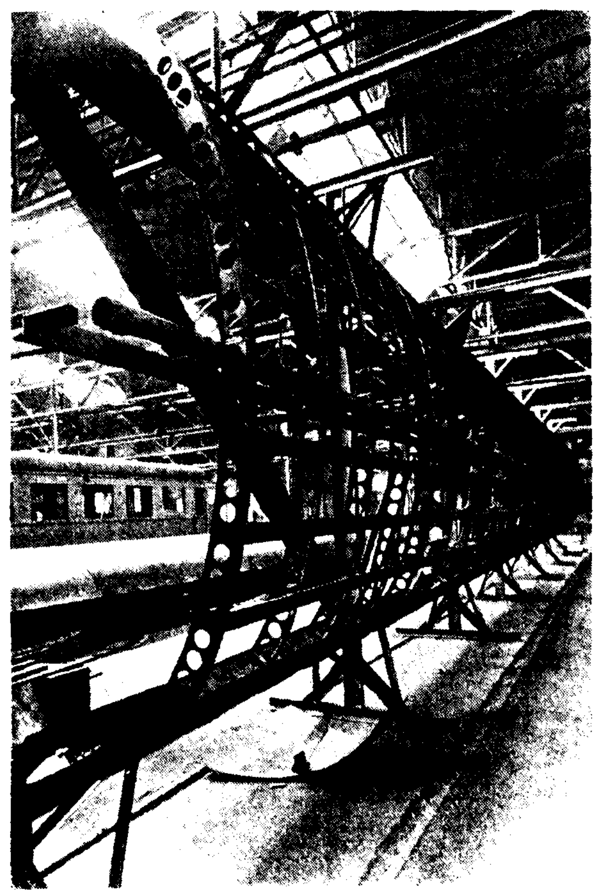
Today the refrigerator is regarded in ever wider circles of the population as an indispensable item of the household and similarly, the installation of community deep-freeze equipment is greatly increasing in rural districts. The new self-service luggage depositories at railway stations, house letter-boxes, the recently introduced house dust-bins, all these add to the demand for steel sheet. In addition to the automatic washing machines, air-conditioners for private dwellings offer a new field for steel sheet manufacture.

Steel sheet is also used to a growing extent in the furnishing and equipment of self-service stores where many kinds of goods must be laid out and foods and luxury goods must be offered to customers in a hygienic and appetising display, frequently in large open deep-freeze tanks. Automatons of all types, which consist mainly of steel sheet, are also more widely used.

The do-it-yourself structural sections are steel sheet sections with perforations which, cut in the required lengths, can be simply screwed together, on the principle of the Mecano building sets, to form items of

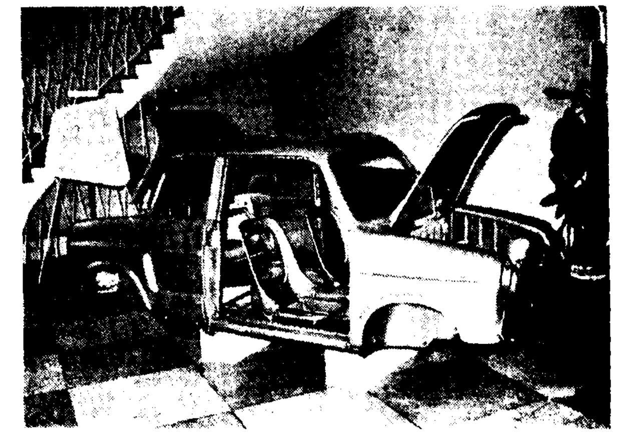


Hoisting machine brake in steel sheet.



Roof of a corridor train carriage in light steel sheet construction.

equipment of various designs, such as racks, shelves (also mobile shelves), side-tables, platforms, etc. and buildings such as sheds, roofs, etc., and can then be taken to pieces again and used elsewhere. It would be a useful idea for every business enterprise, major agricultural enterprise, and especially for every laboratory to keep a stock of these do-it-yourself



Steel sheet car-body of the new NSU-Prinz.

structural sections on the spot. They may even find their way into private households and gardens in the form of garden-houses and pergolas.

Illumination masts in light steel sheet designs are already being used in some countries on a large scale.

Cigarette and tobacco tins in tinplate. The left tin is tightly sealed by the screw top.

With the present supersonic speeds the airplane offers further opportunities for the use of steel sheet, though primarily in the form of special steel. It is also the appropriate material for the construction of the rocket, again primarily as special steel.

Finally, its should be remembered that today every state, unless it is prepared to rule out the thought of resistance and defence in a case of emergency and hence of appropriate military preparation, must give due consideration to the civil air raid and

Newspaper stand made from do-it-yourself sections.

View of self-service stores.

nuclear defence of its population. Here again, great quantities of steel sheet, particularly thin sheet, will be needed for the equipment involved. Corrugated steel sheet can be used to build air-raid shelters in the form of concrete-clad tubes. Steel sheet may also find a wide range of uses in the outfitting of existing cellars, in the construction of exits and entrances to air-raid shelters and in their interior fittings, partition walls, air-locks, doors, cupboards, and finally in the fabrication of furnishing items suchs as steel chaises, chairs and for the many kinds of containers needed for " iron rations " of food and drinking water.

An attempt has been made in the foregoing to review the main reasons for the increased production, fabrication and use of steel sheet and to consider the outlook for the development of the use of steel in a number of important sectors. It was impossible to give due consideration to many factors, such as the building of railway wagons, the use of steel sheet in the chemical industry, the development of steel sheet furniture, and the general use of steel sheet tubes. Some conception could be conveyed, however, by the present study of the scope and versatility of the use of steel sheet and of the wide range of possible developments and of the manifold tasks that lie before the manufacturers as steel sheet today and will face them in the future.

The importance of these tasks is confirmed by the great interest aroused by the mobile exhibition "Construction in Steel Sheet" which had been arranged by the Advisory Office for the Use of Steel and the Research Society for Sheet Fabrication under the scientific direction of Professor Kienzle in Hanover. In the twenty-five towns in which it has been shown to date, the exhibition has been visited by some 100,000 people.

[Photographs from the "Advisory Office for the Use of Steel", Düsseldorf.]

Italian Steel Production increases dramatically

On the Italian Riviera one might expect to hear nothing any noisier than the sound of the ocean or of happy vacationers. This is true of much of the Riviera but in Genoa there are other sounds—those of rapid industrial progress.

Then too, there's a certain sparkle in the eyes of the people here—a sparkle which reflects the confidence they are gaining from Italy's rapid postwar economic development.

Of major importance in this economic development has been the phenomenal growth of Italy's steel industry—much of which is concentrated in and around Genoa. From 1952 to 1958 Italy's production of steel climbed by over 44 per cent—the biggest gain scored by any Western European country.

The increase was large enough to put Italy ahead of Belgium as Europe's third largest steel producer.

An important factor in the Italian steel output gain has been the acquisition by the major steel mills of modern equipment which increases productivity. For example, one of the largest companies, Cornigliano S. p. A. of Genoa, bought a number of General Electric (U. S. A.) 65-ton industrial type diesel-electric locomotives in 1957 to speed the movement of raw and finished materials into and out of its plant. Cornigliano has just announced the purchase of four more duplicate units for use in its Genoa mill.

These locomotives will be used on a rail line which connects the mill with the bustling port—the largest in Italy. Shipment of the four new locomotives from the G-E plant in Erie, Pennsylvania, U. S. A. will begin shortly.

* * *

LOCOMOTIVES COMPLETED FOR INDIAN IRON & STEEL CO.

Officials of General Electric Company's (U.S.A.) Locomotive & Car Equipment Department recently inspected two completed diesel-electric industrial locomotives which will soon be shipped to India for use at Indian Iron & Steel Company's Burnpur mill.

The locomotives are part of an order of ten being made by G-E which are destined for use by IISCO. Altogether, the ten locomotives will supply 3,860 horsepower of " muscle " for the burnpur operations.

Scientific-Technical Co-operation between Socialist Countries

By V. SKRYPNIK

A HIGHLY important form of economic relations between the countries of the world socialist system is scientific-technical co-operation based on fraternal mutual assistance, equality and a reciprocal desire for a general advancement of all parties concerned.

Scientific-technical co-operation between the Soviet Union and the other countries of the socialist camp, begun in 1947, has been steadily growing and developing. It has taken the form of mutual and free exchange of technical documents, delegation of specialists to study and absorb the industrial experience and the achievements of each of the countries participating in such co-operation, and technical aid rendered to one another.

The Soviet Union has handed over to the People's Democracies more than 28,000 sets of technical documents, received nearly 18,000 foreign specialists who familiarised themselves with the achievements and production methods of our factories, and delegated to those countries about 2,000 experts of its own to render assistance on the spot. Soviet organisations, on their part, have received from the People's Democracies some 7,000 sets of documents, they have sent more than 9,000 specialists to study there and have received 140 experts who came to the Soviet Union to help us by their know-how.

EXCHANGE OF TECHNICAL KNOWLEDGE

In addition, Soviet organisations have supplied the socialist countries with school curricula, and samples of products, standards, patents and experts findings on more than 30,000 subjects and have received from them similar documents on almost 7,000 subjects.

The German Democratic Republic has taken over mainly Soviet experience in the development of the power industry and power machinery, ferrous and non-ferrous metallurgy, oil chemistry and chemical machinery, printing and textile machinery, instruments and radio electronics, construction and building materials, and farming.

In Czechoslovakia, Soviet technical documents and blueprints have been used to develop the aluminium industry and a number of engineering lines, to organise production of ferro-alloys, and to prepare for synthetic rubber production, as well as to appreciably raise the general technical standard of industry as a whole, including its mechanisation and automation.

As a result of scientific-technical co-operation with the Soviet Union, Hungary has established a new metallurgical base and mastered the production of bearings, tractors, self-propelled combines, mercury arc rectifiers, and raised the standard of its oil, coal, chemical, aluminium, machine-tool and electrotechnical industries.

The Polish People's Republic has been given aid in extending the engineering industry, particularly production of automotive and electrical machinery. The Poles have, besides, used Soviet experience in the development of the metallurgical, chemical, building and other industries.

With the aid of Soviet experience, Bulgaria is speedily developing a number of newly created industries, including metallurgy, engineering, fuel, power and chemicals. Rumania has developed production of farming, building and other machinery. Albania has set up a power industry and developed production of coal and oil, textiles, timber products and sugar. In the Korean People's Democratic Republic hydraulic coal mining has been developed, the building materials industry modernised, and new industries created.

But it is the Chinese People's Republic that is benefiting most by Soviet scientific-technical aid. Suffice it to say that hundreds of plant have been built and manufacture of hundreds of different types of machinery and equipment started, including some highly important ones, with the aid of Soviet blueprints. At present Chinese engineers, using Soviet experience, themselves design and build large metallurgical plants.

SOVIET ORGANISATIONS GAIN VALUABLE EXPERIENCE ABROAD

Soviet organisations, in their turn, have gained valuable experience abroad. Here are some examples.

The Stalingrad rope factory has adopted Czechoslovak methods in manufacturing trihedral ropes.

The Hungarian method of employment of short-delayed-action electric detonators has been applied in the Soviet coal mining industry. The Dzerzhinsky diesel locomotive works in Murom has used the Hungarian method of building industrial diesel engines with a hydromechanical transmission gear. The Zhdanov shipyard is employing the Hungarian method of unstressed trimming of sheet-iron constructions with the use of point bare electrodes with forced cooling, production of corrugated partitions, cold trimming of crankshafts, etc.

The Polish People's Republic supplied blueprints for the construction of a recuperator for the blast furnace of the Serov steel works. The Volknov aluminium plant has taken over the Polish method of producing alumina from marl and local slates. We have also used the Polish methods of mechanisation of unloading operations in farm produce processing factories built lately.

Of interest to the Soviet Union also are the Rumanian documents on the technology of production of tetrachlorated carbon and other products of chlorination of mathane.

The Soviet Union has also made use of valuable experience from Bulgaria, the Chinese People's Republic and other socialist countries.

Ever growing contacts are being established between research and designing institutes of the socialist countries. Already more than 300 Soviet and 400 foreign institutes are co-operating with one another. Having co-ordinated their plans, they are now jointly working on the solution of more than 3,500 questions of mutual interest.

The development of direct contacts between Soviet research institutes and designing organisations and related establishments in the People's Democracies aims principally at the solution of pressing problems in chemistry, metallurgy, fuel, power, engineering, automation devices and building.

The above instances of scientific-technical co-operation between the Soviet Union and the other socialist countries are convincing evidence of boundless opportunities for the further development of this form of economic collaboration between the fraternal nations.

Brazil's New Steel Mill Will Rank Second

Brazil's economy will be US $50,000,000 per year richer when the new COSIPA (Companhia Siderurgica Paulista) steel mill goes into operation in early 1962. This represents the savings in foreign exchange that will be realized when the privately-financed US $135,000,000 project begins making steel.

Located near its largest market, Sao Paulo, the new mill will be the second largest in Brazil. When it is producing its full capacity of 4,000,000 tons, it will increase Brazil's steel output 60 per cent.

The new mill will boost Brazil to 15th place among the world's steel makers. At present Brazil ranks 21st.

All of the raw material for steel-making will come from Brazil, except a portion of the coal, which is expected to be imported from the United States. Iron ore will come from Belo Horizonte, coal from Laguna, and limestone from Iguape.

To help speed the completion of the mill, COSIPA has purchased four universal-type diesel-electric locomotives from General Electric (U.S.A.). When the mill is ready to produce, the locomotives will pull freight cars loaded with raw materials and finished goods.

Hundreds of similar locomotives built by G-E have been put into use in Latin America. They can be used for switching, passenger and freight service. The COSIPA locomotives are of the U6B and U12C type and develop 700 and 1,300 gross horsepower, respectively.

The mill has been completely designed in the U.S. and incorporates all the latest technical advances in steel making machinery. It is expected to provide employment for several thousand Brazilians.

New Trends in the Use of Steel

By *Dr. Ing. H. ODENHAUSEN*
Düsseldorf

SLIMMING OF CONSTRUCTION

FOR many years a tendency to what may be called "Slimming" has been noticeable in the numerous fields in which steel is used, especially in those concerned with building and vehicle construction. In building construction slimming would mean a reduction in the material consumed, whether in relation to a unit of output, accommodation or volume.

In building construction the decisive move to slimming came with the introduction of rolled steel. With rolled steel the traditional, mainly natural building materials could to a large extent be progressively superseded, the consumption of material being correspondingly reduced. Another strong incentive to slimming came with aircraft construction in the first half of this century. In this field weight shedding was a primary necessity and the express objective of the designer. Whereas at the outset of this development weight reduction rested mainly on technical considerations, nowadays it is enforced by the hard facts of economics. In building construction yet another motive enters into account namely, architecture.

LIGHT-WEIGHT STEELWORK

In practice, slimming is exemplified by what is called light-weight construction in contrast to solid construction. In relation to steel we shall refer here to light-weight steel construction. The development yet to come will be called "ultra light-weight construction". Under the heading of "light-weight steel construction" we have also to distinguish between lightness due to the material and lightness due to its shape or design.

Light-weight material implies the use of grades of steel which in the proposed application show the most favourable properties with the least possible weight.

Light-weight shape or design covers all the study directed to ensure correct stressing, that is to produce a structure giving an even distribution of stresses with the most effective use of material (1).

THE IMPORTANCE OF THE MODULUS OF ELASTICITY

In examining a building material it is a very common mistake to consider the tensile strength exclusively. This over-rating of tensile strength often leads one to assume that two materials will be of identical efficiency provided they show equal resistance to tension. Other important properties such as deformation under load, durability, specific weight and even cost, to name a few characteristics only, are too often overlooked. In practice, tensile strength is undoubtedly the most important characteristic of a material, but other considerations also determine the suitability of a building material (2).

Light construction is also characterised by the fact that, besides the classic calculations for tension, compression, bending and torsion that are used in connection with heavy construction, calculations applying to collapse loading conditions, such as flange buckling, web buckling and torsional failure, have also to be carried out. Here the modulus of elasticity is the determining factor. Outstanding among all its other properties, steel is known to have the very high modulus of elasticity of 30,000,000 lb. per sq. in. (2,100 000 kg/cm^2). This high value ensures a great measure of stability and rigidity when steel is used for light-weight structures

THE IMPORTANCE OF SURFACE PROTECTION

Light-weight construction means in effect thinner metal with greater surface area. Steel sheet, tubular steel and steel wire are most used for preference. New products are also employed, for example, hot-rolled

(1) For complete definitions see Stahl im Hochbau, (Steel in Building Construction), 12th edition, p.639, also Leichtbau der Verkehrsfahrzeuge (Light-weight Construction for Commercial Vehicles), Vol.2, March-April, 1958, p.60.

(2) H. Odenhausen and G. Zessler, Die vergleichende Beurteilung von Werkstoffen im Hinblick auf ihre Verwendung (Comparative Judgment of Materials, in Relation to Their Use), Acier-Stahl-Steel, No.12, December, 1955.

light-weight sections—" economic " I—sections within the range of Euronorm 19 (E. C. S. C. standard) and what are known as cold profiles, these being purpose-made sections produced by cold methods out of strip or sheet. In all these cases the ratio of surface area to cross-sectional area is markedly higher than with the section heretofore employed. This relationship is shown in diagrammatic form in Figure 1. Here Point 1 applies to orthodox heavy structures whereas Point 2 is typical of modern light-weight structures.

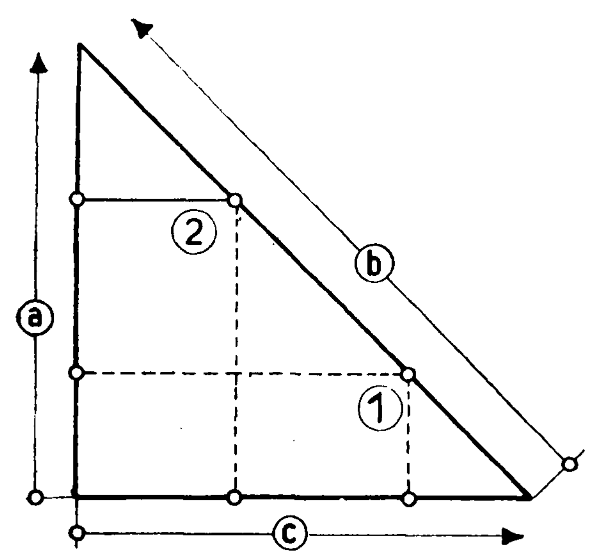


Fig.1. Diagram showing the relationship between metal thickness, surface area and lightness of construction.

a) Surface area. b) Index of lightness of construction.
c) Metal thickness.
1. Heavy Construction. 2. Light-weight Construction.

In view of this it is evident that surface protection assumes increased importance, not only in light steel construction, but in light metal construction generally. Stainless steel is, of course, excepted since in its nature it possesses exceptional resistance to rust by virtue of its chrome and nickel alloys.

Any rust attack would still further reduce the slight metal thickness and thereby seriously endanger the structure. For satisfactory surface protection well-tried treatments are now available. The problem lies, not so much in surface protection itself but in choosing the treatment most suitable for the work in hand. The most widely used applications nowadays are paint, galvanising and enamelling. Painting is primarily to be recommended when it can be done by mechanical processes and when its life is not shorter than that of the thing it has to protect. Zinc coating, and especially hot-dip galvanising, in conjunction with coats of paint gives lasting and resistant surface protection. It has particular advantages when the thing to be protected must stand for a long time and when any renewal of the surface treatment would entail interruption of business. Economic considerations will decide in any particular set of circumstances where the line should be drawn between these two surface applications. Surface protection by enamel is notable for its very great durability, provided that no impact stresses are expected. It has found fresh scope for employment, especially in architectural works. Panel units of coloured enamelled steel sheet for curtain walling or cladding have helped to give architecture a new look.

SUMMARY

We are living in a dynamic economy. Not only do new products appear on the market in rapid succession, but those already available are subject to definite laws which lead to new forms of construction and bring new factors to bear on the choice of materials. Such a law governs and prescribes the reduction in weight of buildings. In practically all fields of industrial production this leads, to light-weight construction. With this trend towards light-weight construction one characteristic of the material assumes great importance though in heavy construction it plays but a minor part, this is the modulus of elasticity. Here steel in its structural form where, in contrast to other materials, it possesses a number of valuable properties, is in the happy position of showing an exceptionally high modulus of elasticity. On the other hand light-weight construction relies heavily on surface protection.

It is the business of Steel Information Centres which exist in all industrialised countries of the free world diligently to follow new developments in the use of steel so that they may recognise these trends and governing factors as they make their appearance. By so doing they will be in a position to keep users and fabricators informed about the technical and economic advantages that steel, the building and industrial material which has stood the test of years, has still to offer to meet the changed demands of the present day.

Data Processing as related to the Steel Plant*

By HARVEY R. BERKE

Industrial Engineer, Bethlehem Steel Company, Bethlehem, Pennsylvania

STEEL plant operators have been exposed to an ever increasing volume of information in recent years on the subject of data processing. During the same period of time, there has been a significant surge of activity throughout the steel industry in the installation of mechanized systems.

In the decade following World War II, many factors were introduced which caused important changes in basic business concepts. Rapid technological development in electronics and allied fields was underwritten by the Government because of defense considerations. The growing complexity of weapons systems meant a tremendous research and development program, which in turn created quantities of devices of unprecedented reliability for control and computation.

In the early 1950's, many components were organized into logical systems which became the first generation of digital computers available for commercial purposes. While design philosophy differed, these computers performed six fundamental functions. These functions can be shown by examining the steps in the manual solution of a very simple clerical operation. Consider the job of a sales inventory ledger clerk. Each day he is supplied with a form which lists the previous day's sales by stock number. On the basis of this list, the clerk updates the inventory ledger by writing a new column to reflect the previous day's activity. *(At this point, the author showed a series of slides designed to illustrate the functions of a computer. The slides are described, in part, in the following numbered paragraphs).*

This admittedly over-simplified example does parallel the six functions of digital computing systems :

1. Input—the computer can accept both the data upon which it is to operate and a complex series of instructions, known as a program, which tell it what operations it is to perform on the data.

2. Arithmetic—the computer has circuits to do addition, subtraction, multiplication and division. Higher forms of mathematics can also be handled.

3. Logical Operations—the computer can compare, mask, branch, etc., where characters or bits characterize the elements being operated upon rather than numerical values as in arithmetic operations.

4. Memory—the computer has the capacity to store information internally, either at random or in sequence and to retrieve this information as it is required.

5. Control—the computer can direct the flow of information internally in the system. It interprets, executes and arranges computer instructions in sequence.

6. Output—the computer can organize the final or intermediate results of a program into a desired format for exit from the system. The format may be a printed report or in machine language, such as punched cards or tape.

The very organization of computing systems made centralization of data processing possible and, under some conditions, attractive. The most successful of the early applications of computers to business problems involved large scale clerical operations such as insurance premium billing. This led many people to think that the manufacturing industries could make significant cost savings in substituting computers for clerks. That has not happened. Few plants have large groups of isolated clerks performing a relatively common function. Mainly, the clerks are distributed throughout plant areas operating on data that is unique to the area or process involved. To date, there have not been large clerical savings, although there have been instances of small net gains.

Since clerical savings have not been significant in manufacturing industries, there must be other benefits that continue to intrigue manufacturing executives.

These benefits lie in the area of scientific management. Without getting into a discussion of specific mathematical and optimizing techniques, it must be apparent to plant executives that if all the data involved in plant operation were passed through a single intelligence center, many routine decisions could be improved. Careful analysis of common business situations shows that an overwhelming majority of daily decisions need not be intuitive. While intuition, based on judgment and experience, is used to make policies, the application of these policies to recurring situations is largely routine. Computers can make such decisions faster and more consistently than human beings. In addition, mathematical routines can be introduced which would be completely impractical with manual clerical systems, provided, of course, that management has done sufficient research in its operations to know what specific techniques would improve the operation.

Unfortunately, the builders of data processing systems can't start with these sophisticated systems. Unless they are lucky enough to work with a system that already has a highly disciplined control of the information flow, they must first guarantee the integrity of the information passing through the system.

Glowing descriptions of what can be achieved frequently ignore the painful detail of where we are now, and the many necessary steps that intervene.

Traditional steel plant data processing minimized the number of clerks and their qualification and produced an improvised system created by necessities. This information recorded was largely of immediate use and, with the exception of minor recapitulation, once its immediate utility was past it was buried in the system, retrievable only with difficulty and with exceptional cost. This situation caused a growth of management which, of necessity, leaned heavily on judgment and experience in decision-making. Obviously each company searches for the highest quality management it can get. It is equally obvious that well qualified individuals constantly seek to improve the information system which provides the facts that decisions are based upon. Today, we are faced with the possibility of providing these people with infinitely better information systems. Many companies have plunged headlong into the race for this worthwhile objective. Some have arbitrarily decided at the top management level to acquire large scale electronic computers, apparently in the misguided belief that the presence of such impressive hardware was a guarantee of reaching the objective or stimulating their people sufficiently to attain the goal. Others have made extensive feasibility studies which indicated that a computer could, in fact, do what was needed to reach the objective.

It is common knowledge in the business community that many companies have been disillusioned.

What caused these well intentioned failures? Mainly, because inexperienced people, blinded by the tremendous advantages inherent in electronic data processing systems, acquired computers before their companies were adequately prepared for the great impact of such acquisitions.

As is the case with most very large projects, there is probably no single right way to approach a companywide, totally integrated electronic data processing system. Usually, however, there are many fundamentals that are common to successful installations.

Once it is understood that systems design is no longer restricted by clerical limitations, it is apparent that a pure analysis of the information flow and needs of the company should be made—and that analysis should not be restricted by the consideration of any specific configuration of communications or data processing hardware. The results of such an analysis should be the basis for a companywide, long range system plan.

The actual installation of such a plan should be done in phases. Part of the plan must be a well defined priority restriction. Obviously, certain parts of the system must operate satisfactorily before other parts can be attempted. Practical limitations of time, money and staff also make phasing a necessity. There is no reason why work should not proceed on isolated parts of the system provided some precautions are observed :

1. All coding for the company should be common.
2. Codes should be sufficiently detailed for the most exacting company requirement.
3. Codes should be structured so that detail can be easily grouped into broad categories for less exacting requirements.
4. Specific information fields should have common meaning throughout the whole company.
5. Whenever possible, the decision-making process at clerical and supervisory levels in particular should be analyzed to determine the possible extent of mechanization.
6. Finally, and most important, this isolated part of the system should be integrated with the broad company plan.

For the purposes of this paper, we will pass over the order entry part of the sales-production cycle and devote our attention to the problems and benefits of automatic data processing in the steel plant. In passing, however, it should be noted that much of the information required in the plant regarding the customer and the product originates in sales, and should be captured in a mechanical form that will enable the plant to regenerate it as required.

The idea of putting information into machine language at the point of origin and checking it at that time, and then never writing it manually again or checking it again is a critical one. This is a generally accepted principle, yet compromises are common. These compromises are due mainly to inadequate systems work or to a narrow, departmentalized attitude on the part of individuals who lack a broad understanding of the total company problem.

Most American steel companies are now committed to formal system efforts. Many ideas related to these efforts have been exchanged freely by people working at the technical level on systems problems. In the following example of an operating system, I have drawn upon my own company experience. However, I do not want to imply that these ideas belong to an individual plant or even to my company. We have used ideas from other steel companies and from other industries.

For the purpose of discussion, there follows a description of a flat rolled, entry-production-shipping cycle. Parts of this system have operated for four years, parts are more recent and still others are in the planning or installation phases.

Our steel plants receive entries from a centrally located sales group in our home offices. Incoming orders are processed through this group and one of the results is a keypunched card for each item on every customer order. These cards serve many purposes :

1. They are used to collect and report summary information required for sales planning.
2. The preparation of acknowledgments and parts of the mill order are useful byproducts.
3. The cards themselves serve as working documents for the group that releases items to the mills for production.
4. The information contained in the cards is mechanically transmitted to the plants through part of our communications network.
5. These cards and the codes they contain were designed to be compatible with our plant systems and, upon receipt at the plant, enter the system described below.

The entry cards are matched to mechanical files which contain dressing information required to process the item to the point of shipment. Ordered weights are extended by expected yields and the result is a punched production card ready for the providing and scheduling functions, the most difficult part of the cycle and certainly the most rewarding.

In our company, as in most others, scheduling for this product is manual, but this statement needs qualification. The mill schedulers are now using mechanically prepared inventory listings and punched cards arranged in scheduling sequence to represent requirements. Their jobs no longer involve posting and reconciling records against in-and-out activity, reconditioning, scrapping, relocating stock and other detailed transactions. All of this activity is mechanically incorporated into the system.

Each morning, the schedule clerks are given new listings which reflect all of the previous day's transactions. Copies of these same listings are used by slab yard personnel since these comprise the only record of inventory. Manual scheduling before the introduction of punched cards meant unnecessarily high slab inventories with a relatively poor correlation between inventory and requirements; it meant duplicate records of the inventories being kept in different locations, posted from the same records but with the inevitable discrepancies that can be expected in manual posting.

The adoption of mechanical procedures forced a supervisory discipline that would have been unnecessarily strict under a manual system. Most mill production reports are designed with a high percentage of redundant information because errors are expected. If this were not so, all we would need would be an order number, machine number, quantity and date. The other items of information are used as "clues" in case the primary posting identity (such as order number) is in error. The experienced mill clerk, when posting from production reports to status records, checks the redundant information on the report against the record before posting. Number transpositions can be detected in this way and corrected.

While this procedure is an acceptable way to detect and correct errors in a manual system, it would be unthinkable in a mechanical system. Electronic storage and processing of data is too expensive to permit crutches. Several checking techniques are available to systems planners which are compatible with electronic data processing and are relatively inexpensive. Unfortunately, these techniques detect errors but can seldom correct them.

Long before the installation of a mechanical system, prudent management will examine the accuracy of the input information that the operators of such a system will be asked to use. Obviously the value of the output of any system is relative to the quality of the input. This fact has been ignored frequently and, as a result, otherwise well designed systems have performed poorly. In the example under discussion, statistical sampling techniques were used both to gain and maintain an input error level that was predictable and very small. The tangible benefits of such a program, aside from systems considerations, have been apparent:

1. The size of the semifinished inventory requirements has been significantly reduced.

2. Material handling is simpler and less costly.

3. The taking of physical inventories has been eliminated with attendant savings.

4. Mill delays due to scheduling errors have been eliminated.

5. The introduction of a highly ordered material flow improved the morale of both supervision and the labor force.

Quantitative measures of input quality have systems benefits too. Having such measures can eliminate much disagreement between systems planners and the mill line organization. Obviously, if it is agreed that 95 per cent accuracy of input is required to start a system, and sampling indicates an accuracy level of 80 per cent, the mill organization has a job to do before an installation date can be set.

A lot of work has been done to get an item scheduled on a hot mill, but the information now in mechanical form in the system is regenerated and used over again many times.

Unit schedules can now be assembled accurately, with a minimum of manual effort. Mechanized production reporting leads to timely and correct order status reports and to mechanical incentive computation. These in turn produce incentive evaluation reports, customer service evaluation, and other summarized or exception reporting for management control. Output in the form of loading unit tickets, shipping notices and input to mechanized billing completes the cycle.

While the immediate benefits of automatic data processing are apparent in those mills that already have successful systems in operation, the major benefits still lie ahead in the coming decade. The management groups that are sufficiently flexible to fully exploit the inherent possibilities of electronic data processing will reap these future benefits.

[*Presented at Philadelphia Regional Technical Meeting of American Iron and Steel Institute.]

Giant Ore-Dressing Establishment in the Urals

One building now under construction at the Kachkanar ore-dressing establishment, the mid-Urals, will be nearly 100 metres high, three-fourths of a kilometre long and 126 metres wide. This gigantic building will have natural illumination through a total of four square hectares of glass. The framework will be made of nearly 40,000 tons of structural steel.

The establishment will have high efficiency equipment capable of processing over 30,000,000 tons of ore a year. The Kachkanar ore reserves are large enough to last the plant for 130 years even at so high a rate of productivity.

The new establishment will start supplying the Urals steel plants with iron ore concentrates in 1962.

THE MECHANISED RAJHARA IRON ORE MINE

[The mechanised Rajhara Iron Ore Mine of the Bhilai Steel Works was inaugurated by Shri Jagjivan Ram, Union Minister for Railways on October 31, 1960]

IRON ore is the principal raw material required for the manufacture of steel. The Bhilai Steel Works receive their requirements of iron ore from the Rajhara Mine. Huge power shovels and drills have been erected on the top of the Rajhara hill. The mechanised mine will supply 7,000 tons of iron ore daily to Bhilai.

SOVIET EQUIPMENT AND TECHNICAL ASSISTANCE

Equipment for the mechanisation of the Rajhara iron ore mines, weighing about 2,700 tons, came from the USSR and was erected under the technical guidance of Soviet specialists.

So far, float ore was being raised by manual labour and it was a difficult task to ensure the supply of adequate iron ore to feed the two blast furnaces now in operation at the Bhilai Steel Works. Continuous manual raising of large quantities of iron ore, transporting them to Railway sidings and again loading them into wagons was indeed a very difficult matter. Moreover the third blast furnace of the Bhilai Steel Works, which also is expected to go into operation by the end of December 1960, will further increase the Plant's requirements of iron ore.

Rajhara, located 55 miles south of the Bhilai Steel Works, has already been linked with Bhilai by a broad-gauge railway line. The installation of the heavy equipment and the construction of the large crushing and screening buildings on the slope of the Rajhara hill have completely changed the landscape.

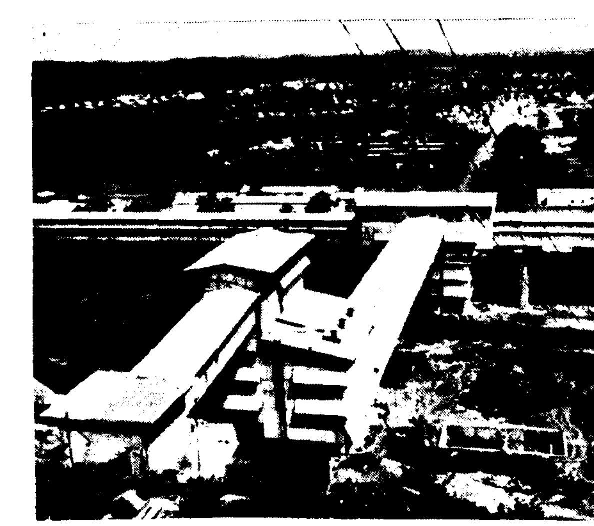
It is estimated that the Bhilai Steel Works will require about two million tons of iron ore annually for the production of one million tons of steel and about 300,000 tons of pig iron. These requirements will go up to nearly five million tons when the steel works are ultimately expanded to produce 2.5 million tons of steel annually.

The prospected deposits of iron ore in the Rajhara hills—which spread over a length of about four miles and go up to a height of about 1,920 feet above mean sea level—have been estimated to be of the order of 114 million tons. Besides, the Rajhara iron ore, with iron content ranging from 65 to 69 per cent, is considered to be one of the best ores in the world.

ELABORATE MECHANISATION

A rail line has been constructed right up to the massive iron ore deposits on the top of the Rajhara hill, thus enabling the blasted ore to be loaded straight into dump cars by power shovels and transported by rail to the crushing plant. After crushing and screening the fines, blast-furnace and open-hearth grades will be conveyed by belt conveyors to the storage yard, from where they will be loaded by power shovel into wagons for despatch to Bhilai, as and when required. Special type large capacity wagons have been provided for this purpose. The mines also include magazine for explosives, chemical laboratory, repair shops, etc.

The crushing plant comprises of two crushers—a jaw crusher and a cone crusher. The primary crusher will crush the big blocks of ore to 350



A view of the mechanised Rajhara iron ore mine that was commissioned on the 31st October, 1960.

millimetres size, and will have capacity to crush 560 tons per hour. The secondary crusher of the same capacity will crush the ore to 75 mm. size. The screening plant will screen the crushed ore into different sizes.

Smaller particles of ore will go to the sintering plant at Bhilai for making it into bigger lumps after mixing with limestone, dolomite and coke and heating by carrying it on a model conveyor through a furnace. The sintering Plant for this purpose is being erected at the Bhilai Steel Works itself.

AMENITIES FOR RESIDENTS

About 700 persons, including about 100 engineers and 475 workers and operatives would be required to operate the mechanised mines. To provide for the residential accommodation of the staff, a new industrial town with all the facilities of water, sanitation, electricity, hospitals, schools, shopping centre, etc. is being simultaneously built at Rajhara by the Bhilai Steel Project authorities. About 260 permanent houses out of the proposed 700 houses have already been constructed. A 30-bedded hospital has also been constructed here.

The town has been electrified and arrangements made to supply treated drinking water and water borne sanitation.

Provision has been made for a welfare building at the worksite with arrangements for a canteen, bath-rooms, lavatories, rest rooms and first-aid facilities.

Rajhara receives its electric power from Korba. The drinking water supply is drawn from a fully protected natural spring, and for industrial water supply a reservoir has been constructed to store the annual requirements.

RAJHARA MINE INAUGURATED BY Mr. JAGJIVAN RAM

On 31-10-60 in the emerald green lap of the Rajhara hills of Madhya Pradesh the biggest mechanised iron ore mine has come into being. The mine was inaugurated by India's Minister of Railways Mr. Jagjivan Ram.

The mine site wore a festive garb with splashes of golden sunshine. The Minister and his party consisting of the General Manager of the Bhilai Steel Plant Mr. N. C. Shrivastava, the Soviet chief engineer of the Plant Mr. N. V. Goldin and other distinguished personalities arrived at the meeting on the valley in which the mine is situated.

Speaking on the occasion Mr. Shrivastava informed the audience that the original idea to build an iron ore mine at Rajhara, so rich in the most important ore for the economic development of a country, was born in the mind of Pandit Ravi Shankar Shukla, the ex-Chief Minister of Madhya Pradesh. Mr. Shrivastava said that for power feeding of the mine a 60-mile-long transmission line has been laid from the power station at Korba which is one of the coal supplying centres for the Bhilai Plant. Mr. Shrivastava said that the mining designing bureau jointly manned by Indian and Soviet designers designed this mining works costing nine crores of rupees including the township. The Indian and Soviet engineers and personnel manifested an admirable co-operation which has now been crowned with a grand success, Mr. Shrivastava said. The Rajhara mine has so far supplied 14 lakh tons of ore to the Bhilai Plant. With the inauguration of the railway line from Rajhara to Bhilai 7,000 tons of ore are to be transferred to Bhilai every day.

"Bhilai particularly has a special significance for Indian railways", Mr. Shrivastava said, "because here we shall manufacture annually one lakh and ten thousand tons of broad and narrow gauge rails and 90,000 tons of sleeper bars and crossing sleepers. The Bhilai Steel Plant will thus have an important part to play in the expansion programme of the Indian railways".

Mr. Shrivastava said further that the mine has given employment to more than one thousand local persons and it is expected that direct employment would increase by some 2,000 and more would find employment in different ancillary industries.

After a short speech of greetings by Mr. Goldin, Mr. Jagjivan Ram spoke of the great significance of the Rajhara mechanised mine for the development of India's national economy. He declared that mechanisation would have to be introduced in India gradually for its industrial development. "We have to depend more and more on machines", he said.

Mr. Jagjivan Ram said, "This is the age of steel. How far it will remain so cannot be said. Science is progressing and steel may one day become obsolete. But today it is steel age and iron and steel are the barometer of a country's progress. India

is behind in this respect. Therefore we have to build more and more steel plants."

Mr. Jagjivan Ram was happy to note that Bhilai would be producing rails, rail-sleepers and crossing bars which were in short supply in this country and were being imported.

He said, "The association between railway and Bhilai has become very close. Railways cannot carry on without iron and steel; steel plant cannot function without railways for transport of its raw materials and finished products".

The Union Railway Minister stressed that the country was engaged today in a two-fold task: to provide more employment opportunities to people and to raise their standard of living. Railways and Bhilai project were both making their due contribution in this respect.

At Rajhara where he was inaugurating the mechanised iron ore mine a great wealth lay hidden underground. Bhilai steel works had now been built to exploit this hidden wealth for the benefit of the country, he said.

The Union Minister congratulated Indian and Russian engineers of Bhilai Steel Plant on their rapid progress and their achievements. Here workers were not working merely to earn their living but they were also making a contribution to the development of the country. "Success of your efforts is its own reward for you", he said.

Mr. Jagjivan Ram then inaugurated the new hospital and the railway.

SOVIET AID TO CEYLON IN CONSTRUCTION OF IRON & STEEL PLANT

A group of Soviet specialists, staff members of the State Institute for Designing Iron and Steel Mills, is preparing to leave for Ceylon. The engineers will take with them blueprints of the first Ceylonese iron and steel plant, which will go up near Colombo.

This undertaking will consist of three principal departments: the blast furnace, open-hearth and rolling mill. The latter is to be built first. Its capacity will amount to 35,000 tons of rolled stock a year. Units are being produced for the rolling mill, intended to manufacture various grades of iron.

The rolling mill department is designed in combination with cold drawing of wire.

Orders for equipment for the first section of the Ceylonese plant are being filled by many Soviet undertakings. Soviet ships will shortly begin delivering to the port of Colombo, machine-tools and machinery for the firstling of the Ceylonese iron and steel industry.

* * *

GEOLOGISTS DISCOVER A SECOND URALS

New deposits of iron ore have been discovered in the Eastern Transurals area which is called by Soviet geologists "the second Urals". During the prospecting of the magnetic anomaly in the Kurgan district the exploration bore hole struck a stratum of rich martite (oxidized) ores at the depth of 330 metres. The bore hole penetrated the layer for more than 50 metres but as yet has not reached the end of it.

The new deposits form the continuation of the main ore-bearing region where exceedingly rich Socolovsko-Sarbai iron ore deposits and Gai copper deposits have been previously discovered. A brilliant future was foretold to this very region by the noted Russian explorer Academician Alexander Karpinsky (1847-1936). Karpinsky was convinced that east of the mining Urals region the "second Urals lies buried under a loose earth cover", whose mineral resources are as rich as those of the mountain ridge which divides Europe from Asia.

Three hundred teams of geologists worked last summer in the Urals and in the Eastern Transurals.

* * *

A THIRD IRON AND STEEL AREA IN THE SOVIET UNION

Soviet engineers have designed what will be among the world's largest iron and steel mills. It will be built near the town of Taishet, Eastern Siberia, in a locality extremely rich in iron ore and coal. The project will include several high-capacity blast furnaces, coke batteries, a rolling shop and a steel foundry. An idea of the project's scope can be obtained from the fact that the metal making shops alone will take up an area of 850 hectares.

GASEOUS ANNEALING OF MALLEABLE CASTINGS

By *C. G. W. OVERTON, B. Sc. (Eng.), A. M. I. Mech. E., A. M. I. E. E.

TYPES OF MALLEABLE IRON CASTINGS

THERE are in the main three types of malleable castings in common use :—

1. Standard or Ferritic Blackheart.
2. Pearlitic Blackheart.
3. Whiteheart.

All the three are cast as hard white iron, the as-cast structure consisting of iron carbide and ferrite with no free graphite. The annealing treatment in every case is aimed at eliminating the excess carbide, so making the material ductile, shock resistant and machineable. The annealing method by which this is achieved, however, and the final metallography are different in the three cases.

GASEOUS ANNEALING PROCESS OF MALLEABLE CASTINGS

The 'Gaseous Annealing Process' patented and introduced by A. E. I. Birlec Ltd., is perhaps the most modern and quick method of annealing Blackheart and Whiteheart castings. It dispenses with the cans and packing material invariably associated with the older methods, thereby greatly reducing the dead weight within the furnace. The castings are instead placed on suitable supports, and annealed in contact with atmosphere capable of promoting or effecting the desired change, namely graphitisation in the case of blackheart and decarburisation in the case of white-heart. As a result, an extremely rapid rate of heating and cooling is achieved, which directly reduces the annealing cycle to a fraction of that possible by older methods. The speed and efficiency of heating or cooling are further increased by the special fans which keep the atmosphere within the furnace in vigorous circulation. The atmosphere circulation also ensures uniform heating of the entire charge and in consequence results in outputs free from distortion due to uneven heating.

*Mr. Overton is Manager, Electric Furnace Division, Associated Electrical Industries (India) Private Ltd., Calcutta-1

GASEOUS ANNEALING OF BLACKHEART CASTINGS(¹)

The object here is to decompose the combined carbon in the castings to ferrite and graphite without decarburisation. Accordingly an inert and static atmosphere to ensure non-decarburisation is required. This is very simply obtained by allowing the small amount of air within the gas tight furnace to react with the carbon of the castings. The resulting atmosphere containing a mixture of Nitrogen, Carbon monoxide and Carbon dioxide has the required characteristics, and is left within the furnace undisturbed throughout the anneal. In continuous furnaces which cannot be completely sealed a small amount of externally generated atmosphere may be necessary to combat inward air leakage.

The complete annealing cycle comprises of three definite stages, (See Fig. 1 below) starting with (A) controlled preheating followed by (B) final heating to top temperature and soaking for the required time, and finally (C) controlled cooling to the discharge temperature. The duration of the full cycle largely depends on the composition of the castings. For normal grades of blackheart the annealing cycle is of the order of 48 hours.

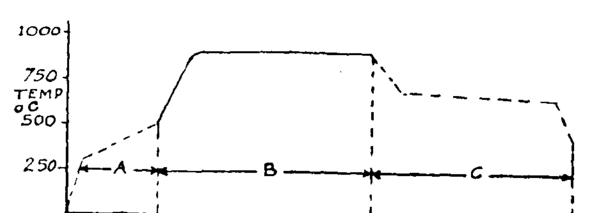


FIG. 1.

The entire cycle may be carried out in either a single furnace or in two separate furnaces. The twin-furnace scheme, incorporating separate high temperature and low temperature furnaces and three hearths, forms a very economical installation for the production of blackheart castings. It must be noted that the total time for preheating and final controlled cooling both carried out in the low temperature furnace, is approximately equal to the soaking time within the high temperature furnace. In the twin

Editorial Notice

Articles in original are invited for publication in this Journal from Works Managers, Production Engineers, Foundrymen, Metallurgists, Plant Engineers, and Chemical Engineers on all subjects relating to Iron and Steel Industry

Articles should be of a high quality, exhaustive and accompanied by illustrations, wherever possible. Only glossy photographs will be accepted. All contributions intended for publication in any particular issue should reach the Editor 30 days in advance. This Journal is issued twice in a year i. e. *May* and *November*.

All copy should be brief and typed as far as possible. Twenty reprints only are supplied to authors free of cost. Used manuscripts and photographs will not be returned

The Editor is not responsible for the views expressed in the articles. Contributions for publication should be addressed to the "Editor, Journal of Iron & Steel Engineering, 2258, Manojiappa Street, Post Box No. 57, Tanjore (South India)".

furnace scheme therefore, by correctly manipulating movements over the cycle, to bring the appropriate hearth and furnace together, an output could be obtained every 24 hours. Both the furnaces would be more or less kept in continuous operation, except for the change-over time, and consequently furnace utility would be high.

Where financial considerations prohibit the installation of a twin furnace scheme all at once, it is quite possible to achieve it progressively in two stages. The first stage would consist of a single dual temperature furnace in which the entire annealing cycle could be carried out. This could later be supplimented by a high temperature furnace, the first one being converted for low temperature work. The second stage equipment would approximately cost 60-70% of the first stage equipment and would double the output.

The first gaseous annealing equipment to be installed in India was supplied on the above basis, and is of the bell type. This furnace was commissioned and put into operation at a well-known foundry in Bombay.

Due to the necessity of closer compositional limits and lower carbon content, the as-cast condition for Blackheart malleables cannot be conveniently made from the cupola. A holding furnace either of the rotary oil fired or electric mains frequency coreless induction type is therefore essential. If, however, the scrap involved contains phosphorous in excess of the permissible limit, obviously a direct arc furnace would have to be used.

GASEOUS ANNEALING OF PEARLITIC BLACKHEART CASTINGS

The material has an as-cast structure similar to standard blackheart, but is annealed in such a way as to retain some combined carbon in the final structure, usually in the form of spheroidised carbide.

Continuous furnaces are best suited for the production of Pearlitic Blackheart castings, but the initial cost of such a layout is comparatively high. Batch furnaces could also be employed for this purpose, and have been successfully used. In this case, however, it is very important that provision should exist for rapid initial cooling immediately after the soak, since the final properties largely depend upon it.

Among the few methods available for Pearlitic Blackheart production the following one is perhaps the most economical and suitable for large scale production of standard grades.

Metal of standard blackheart composition may be submitted to an anneal, in which the second stage has been modified and cut short, so as to retain some combined carbon. The required cycle is as shown in the diagram (Fig. 2).

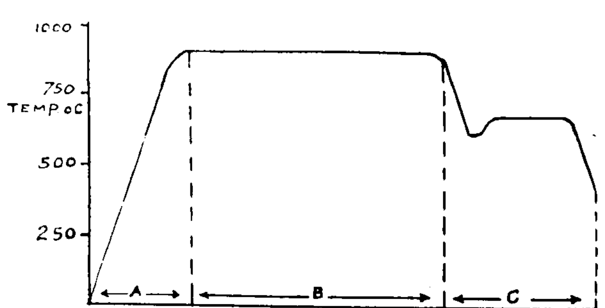


FIG 2.

As before, stage (A) is that of heating to top temperature. Since second stage graphitisation is to be suppressed, there is no need for retarded heating in the 300°—500° C temperature range which is desireable for standard Blackheart, and heating may be as rapid as is consistent with avoidance of cracking.

Stage (B) is the high temperature soak, as for standard blackheart. On conclusion of this, the castings must be cooled rapidly to well below the critical range (say to 650° C), and finally reheated to about 700° C for four to six hours to allow spheroidisation of the free carbide (stage (C)). As explained earlier, the initial rapid cooling is all-important, since final properties are largely dependent on it.

The atmosphere requirements are precisely as for standard blackheart.

GASEOUS ANNEALING OF WHITEHEART CASTINGS(2)

In the case of whiteheart castings, since annealing is effected primarily by decarburisation, the atmosphere for gaseous annealing of whiteheart must be strongly decarburising, and considerable quantities are necessary to remove the required 50—70 lbs. of carbon per ton of castings. Further, scaling must be avoided, i. e. the atmosphere must not contain free oxygen, and the ratios of $H_2 : H_2O$ and of $CO : CO_2$ must at no time be less than the equilibrium valves for the

oxidation/reduction reactions involved. For the temperature range employed, and allowing a margin of safety, both ratios should be not less than $2\frac{1}{2} : 1$.

There is a wide range of atmosphere compositions satisfying these requirements, which may be generated in many different ways. However, the only practical solution, from the economic aspect, is that in which the atmosphere is derived entirely from reaction of air and/or steam with the carbon content of the castings themselves.

In batch furnaces, the method operates in the following manner. When a new charge of castings is inserted into the gas-tight furnace, the residual air in the chamber reacts with the iron castings to form a thin layer of oxide, which in turn, as the charge is further heated, reacts with a small part of the carbon in the castings to form CO and CO_2. Thus, by the time full temperature is reached, a reducing atmosphere, containing N_2, CO and CO_2 is established. This is then circulated throughout the furnace, usually by high temperature fans in the furnace roof, and continuously "regenerated" by a controlled addition of air and/or steam.

By regulation of the amount of steam or air added in relation to the amount of carbon available for removal from the castings at any stage of the cycle an atmosphere which is strongly decarburising but non-oxidising may be maintained throughout the soaking period.

A typical whiteheart annealing cycle would be as given below. (Fig. 3)

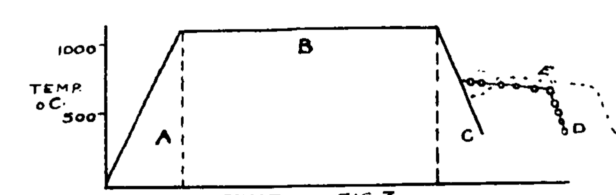


FIG 3.

The basic cycle is as indicated in the diagram. The heating up to top temperature ((A) in diagram) may be as rapid as is practicable having regard to the size of furnace employed, the only metallurgical limitation being the avoidance of cracking in individual castings, if of complex shape. On batch furnaces, of between 2 and 8 ton wet charge capacity, the time may be between 5 and 12 hours according to the size and density of charge and the furnace rating. On continuous furnaces it may be as little as 2 hrs. The top temperature soak [(B) in diagram] is limited in the conventional ore-annealing process to a maximum level of 980°—1000° C., since at higher temperatures the ore sticks to the castings. With gaseous annealing processes, however, higher temperature can be used, up to the incipient melting point of 1100° C., being limited only by the necessity of avoiding excessive distortion of the castings. Temperatures in the range 1020°—1060° C., are commonly used.

At a temperature of 1050° C., the required soaking time varies according to the section of the casting, thicker sections requiring more time for an adequate degree of decarburisation and/or graphitisation. Typical soaking times would be:—

Section	*Time*
Thin—less than 3/16"	30 hrs.
Medium—3/16"—3/8"	45 ,,
Heavy—over 3/8"	60—80 hrs.

With regard to cooling, thin section castings which have been thoroughly decarburised (residual carbon content .5% or less) may be cooled fairly rapidly at 100° C./hr. or faster, down to a convenient temperature for discharge into air, of 300°—500° C. as indicated by the solid line (C) in the diagram.

On medium or heavy section castings, however, which retain a higher residual carbon content, this treatment would leave the castings too, hard, and the cooling rate must be retarded, to about 5° C./hr., through the critical range of 760°—700° C., as indicated by the dotted line (D) in diagram.

If the best possible combination of tensile strength, ductility and elongation is sought, e. g. to meet the test bar values specified for Grade II of B. S. 309, or if optimum machineability of heavy sections is required, a modified cooling cycle of the "spheroidising" type is necessary. In this case, the castings are cooled as rapidly as possible from the top temperature to below the critical range, i. e. to 650°—700° C., then reheated to above i. e. to 760°—780° C., and finally cooled again at about 5°/hr. through the critical range (line E in diagram). The structure so produced has the combined carbon present as spheroidised carbide, instead of pearlite as in the case of straight cooling.

Practical overall annealing cycles thus vary from about 40 hrs. for thin section castings rapidly cooled, to 120 hrs. for the heaviest castings requiring an 80 hr. soak followed by a spheroidising slow cool. The average run of castings can be satisfactorily annealed in a total cycle of about 70 hrs.

EQUIPMENTS FOR GASEOUS ANNEALING[3]

Batch Furnaces

In the main there are four types of batch furnaces in normal use, all of which are essentially gas tight chambers with refractory lining to suit the particular application. In every case provision is made for the fitting of a boiler, CO_2 recorder etc., to adapt the furnace for whiteheart annealing. The differences between the various types of gaseous annealing plant otherwise lies only in the manner of bringing the hearth and furnace together, and hence in constructional details, from which the different type names are derived.

(1) *The Elevator Type*

A rectangular box shaped furnace with the bottom side open is mounted in a raised position on columns. The hearth moves transversely on rails from the loading station to a position directly below the furnace. It is then elevated into place to close the open side and thus form a gastight furnace chamber.

(2) *Bell Type*

The charge is loaded on a fixed hearth on to which a refractory lined rectangular belt furnace is lowered by means of a crane.

(3) *Pit Type*

A cylindrical or rectangular pit sunk into the ground is lined with refractories and carries the heating elements to form the furnace. The castings are placed in charge baskets and lowered into the pit by a hoist or crane. The floor-level lid is then closed.

(4) *Bogie Hearth*

This is the common type of single ended furnace with bogie moving in and out on rails as required. The door is lifted up vertically to allow the bogie in.

It is also possible to do away with the bogie and just stack the castings in drum containers and place them in the furnace by a charging machine. This has the advantage of reducing the bogie dead weight within the furnace and consequent reduction in the furnace rating is possible.

CONTINUOUS FURNACES

These generally are of the straight-through tray-pusher type, in which trays carrying light open containers holding the castings are pushed along one or more paralleled tracks through the furnace by means of a pusher mechanism located at the entry end. It is also possible to have other types of conveyors e. g. driven roller hearth, but these are likely to be much greater in first cost as compared to the track and pusher type mentioned above. Continuous furnaces are mostly used for the production of Pearlitic blackheart castings.

POSSIBLE USE OF SINGLE INSTALLATION FOR BLACKHEART—WHITEHEART

A question is often raised on the possibility of using a single furnace for both whiteheart and blackheart. This is theoretically possible but usually inconvenient in practice. The atmosphere used for whiteheart with water vapour results in a 'wet' furnace and needs extensive drying out before the furnace can be used for Blackheart, even traces of water vapour being harmful for this latter type. The considerable drying time involved in the drying out of course causes much loss of production time.

RELATIVE PROPERTIES AND USES

Physical properties of standard blackheart and whiteheart are laid down in British Standards 310 : 1958 and 309 : 1958 respectively, and are as given below.

No British Standards have yet been issued for pearlite blackheart, but American (A. S. T. M.) specifications list seven grades, ranging in properties from 29 tons/in² U. T. S. with 10% elongation to 45 tons/in² U. T. S. with 2% elongation, as determined on the standard 9/16" tensile test bar.

B.S.S. No.	Grade, Type, Designation, etc.	Dia. of test bar ins.	Min. Tensile strength tons/sq. in.	Yield point tons/sq. in.	Elongation %
	Grade 1 W'ht. secns. over 5/16 ..	0.564	22	12	4 on 2"
	,, secns. 3/15 to 5/16 ..	0.357	20	11	6 on 1.25"
309 (1947)	,, secns. under 3/16 ..	0.252	20	11	6 on 1.0"
	Grade 2 secns. over 5/16 ..	0.564	24	13	8 on 2.0"
	,, secns. 3/16 to 5/16 ..	0.357	22	12	10 on 1.25"
	,, secns. under 3/16 ..	0.252	22	12	12 on 1.0"
	Grade 1 B'ht all sections ..	0.564	18	10	6 on 2.0"
310 (1947)	Grade 2 ..	0.564	20	11	10 on 2.0"
	Grade 3 ..	0.564	22	12	14 on 2.0"

With regard to uses, whiteheart is generally chosen for light thin section castings such as pipe and conduit fittings, cycle frame parts, window fittings etc. Standard blackheart, having more uniform properties and excellent machineability, is preferred for engineering castings, particularly where large scale production is involved as in the motor trade. Many other types of casting can be made satisfactorily in either materials. Pearlitic is useful where high tensile strength with lower, but still acceptable, ductility is indicated. The latter material also has the advantage of a structure suitable for surface hardening by flame or induction methods. The relative usage of pearlitic is rapidly increasing.

MALLEABLE CASTINGS FROM INDIAN RAW MATERIALS

The normal pig iron and scrap obtained in India has a phosphorous content beyond the permissible limits for malleable castings. It therefore becomes very essential to resort either to a melting equipment in which phosphorous can be eliminated or to careful grading and selection of scrap low in phosphorous level.

In a normal malleablising foundry it is estimated that approximately 50% of the production comes back to the melting unit as foundry returns. Therefore once production is got under way, foundry is then automatically provided with about 50% of its melting requirements in right specifications from the foundry returns. The remaining 50% will still have to be

(1) From selected scrap, or
(2) From a suitable refining unit.

In case (1), a duplex process involving a cupola as a primary melter and a rotary oil fired or an electric Mains Frequency coreless induction furnace for holding would be quite suitable. But where phosphorous has to be eliminated (case 2), and low grade scrap is concerned, a Direct Arc Furnace appears to be the only practical solution for Indian conditions.

Associated Electrical Industries (India) Private Ltd., Head Office, Calcutta are in a position to supply all types of electric melting furnaces. There is a special point about the direct arc furnaces though, in that, the Government of India have granted A. E. I. (India) Private Ltd., a licence to manufacture 3 and 4 ton Direct Arc Furnaces to their associates' designs. A major portion of these furnaces would be manufactured in India, the remaining few essential parts being imported on a own quota licence. This enables A. E. I. (India) Private Ltd., to offer the above two sizes on a complete rupee basis.

Sizes other than these would still have to be imported, but A. E. I. could arrange for part local manufacture of any size of Direct Arc Furnaces, whereby the customer would have to procure an actual users import licence for the imported parts only.

A. E. I. (India) Private Ltd., will be glad to be favoured with enquiries and to supply any information or assistance which may be required. A specialised and experienced team of engineers hold themselves ready, should any discussions or visits be desired.

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New Fully Automatic Gas and Air Dryers

A.E.I. BIRLEC LTD.* INTRODUCE NEW DRYERS

As the result of nearly two years of intensive research and development the Dryer Department of A.E.I. Birlec now introduce a new series of absorbers—the BZ series Autosorbers.

The new designs are fully automatic, dual tower plants, eminently suitable for the continuous drying of compressed air and other gases. They have been arranged to be capable of using any of the commercially available absorbents—activated alumina, molecular sieves, silica gel, Sorbead—and to employ them effectively to their best capacity according to the required circumstances.

A further feature of the new plants, which derives from their ability to operate with molecular sieves, is their utility for the absorption of carbon dioxide.

The absorbers have been sized to provide compact designs for the capacities most frequently demanded by customers, Typical figures are in the range of 25—500 s.c.f.m. at 100 p.s.i.g. or 5—100 s.c.f.m. at atmospheric pressure. Extensive experimental work on process capacity and pressure drop under a range of flow conditions underlies the final designs now in production.

Arising from the fundamental approach to dryer design and the exploitation of a laboratory budget of Rs. 1,33,000/- devoted to research and development, 8 applications have been made for patent cover. These applications include new methods of heating and cooling the absorbers during the reactivation period and new methods of economising in the flow of purge gas.

The overall directive in the introduction of these new designs has been to provide the customer with a dryer of lower price, more compact and better looking and with a soundly based rating and performance. Apart from radical design changes the establishment of new manufacturing techniques has contributed to making a cheaper and more attractive proposition for customers. Typical savings in floor area compared with previous designs of comparable capacity are: for a former floor area of 15 square feet a reduction to 10: for a former floor area of 33 square feet a reduction to 23:

The more popular sizes in the range are now available from stock as standard units fitted for electrical reactivation. By simple modification these units may be converted to steam reactivation of flameproof electric working. Optional extras are available for purge re-use. (Further information may be obtained from :- Electric Furnace Division, A.E.I. (India) Private Ltd., Calcutta-1)

* * *

EUROPE'S BIGGEST ROLLING MILL COMMISSIONED IN THE UKRAINE

A continuous thin sheet rolling mill " 1,700 " went into operation at the Ilyich Iron and Steel Plant in Zhdanov, the Ukraine.

This is the biggest rolling mill of its kind in Europe with a record rolling rate.

The new mill is completely automated and mechanised all along its almost one kilometre-long through-flow line. The hundreds of units and machines comprising the mill are driven by 2,500 motors. For the first time in the world the adjustment of the mill is done by means of a self-adjusting system controlled by electronic computers. The mill has been built in the record time of one year, as compared with the two or three years it usually takes to build such a giant unit.

*A. E. I. Birlec Ltd., are represented in India by Associated Electrical Industries (India) Private Ltd., Calcutta-1.

ALUMINIUM IN STEEL

By A Special Correspondent

ALUMINIUM in used in steel for two quite different reasons. On the one hand because of its high affinity for oxygen it is used as a "deoxidizer" for the molten steel during the deoxidation period following the oxidation refining period. On the other hand it is used as an alloying element which affects the properties of the steel to which it is added.

ALUMINIUM IN STEELMAKING

We know that steelmaking commences with a period of so-called refining treatment, the object of which is to rid the bath of oxidizable impurities introduced via the raw materials. At the end of this period, oxygen is left in the metal partly in solution and partly in the form of refractory inclusions.

If the molten steel were allowed to cool in this oxidized state, the shift of equilibrium occasioned by the drop in temperature would give rise to the evolution of copious volumes of carbon monoxide, sufficient to expel the liquid from the mould. Moreover, the density of the ingot would be low, with numerous blow-holes arising from gas bubbles which had been unable to reach the free surface of the liquid before being locked in by solidification. Again, the presence of numerous oxide inclusions would render the steel impossible to forge without cracking. It is thus essential to deoxidize to molten steel in a second operation, following removal of the slag formed during the oxidation period.

This " deoxidation " is not actually a direct removal of oxygen atoms from the steel bath; this could only be achieved by adding an element which forms a gaseous compound with oxygen, such as carbon, or by using vacuum, a process which is rapidly expanding in the manufacture of fine steels. This " deoxidation ", in current processes, consists on the one hand in combining the dissolved oxygen with elements capable of forming with it compounds which are less harmful than iron oxide, and on the other in transforming existing iron oxide into other oxide compounds the presence of which is less unfavorable to the properties of the steel. The treatment must be carried out in such a way that the deoxidation products can rise to the bath surface and enter the slag, so as to leave in the steel only a minimum of inclusions.

The elements most used at present are silicon and manganese. Aluminium has a greater deoxidizing power than aluminium, particularly in the presence of manganese, but whereas silicon and manganese both combine with oxygen to form molten compounds capable of rising to the surface, aluminium forms extremely fine particles of solid alumina, which remain practically stationary and form inclusions. Thus, aluminium is only employed as ladle or ingot-mould additions, after additions of manganese and silicon have already effected the bulk of the deoxidation. Such additions of aluminium, which are made gradually, make it possible to obtain a denser steel with fewer gas cavities or completely devoid of all gas evolution. Aluminium is often called a " sedative ".

The well-known phenomenon of the ageing of mild steel involving changes in the apparent yield point, has a number of practical drawbacks; in particular, rimming steel sheets used for deep drawing applications are liable to ageing during storage. This is due to the presence of nitrogen in the steel. One remedy consists in adding aluminium in small quantities of the order of 4 to 8 lbs. per ton of steel. The steel is thus killed and rendered immune from ageing.

However, this is not entirely satisfactory, since when aluminium-killed sheet are deep-drawn they do not give such a good surface finish as rimming steel sheets. This observation has led to aluminium being replaced by vanadium, which since it also has a high affinity for nitrogen, also suppresses ageing but since it has a much less pronounced killing effect than aluminium makes it possible to produce a non-ageing rimming steel.

ALUMINIUM AS AN IMPURITY

Scrap can introduce aluminium into steel; it may be part of the scrap composition or it may originate from aluminium oxidized when the steel was made. We have just seen, moreover, that when steel is killed by means of aluminium extremely fine alumina particles are formed in the metal bath.

These inclusions affect the properties of the metal. They reduce the transverse properties of the forged or rolled steel. Since the presence of aluminium in a steel reduces its grain size, this element has a harmful effect on the creep of ordinary steels under load at elevated temperatures. Creep is also adversely affected by the effects of spheroidizing the cementite and of graphitization, the latter considerably reducing hot strength. Accidents have occurred with superheater tubes made from aluminium-killed steel. This harmful effect on hot mechanical properties is much less pronounced in the presence of silicon, manganese and molybdenum. These drawbacks must be borne in mind in discussing the useful aspects of aluminium additions, some of which have already been described, and to which we now return.

ALUMINIUM AS A GRAIN-REFINER

We know that when steel is heated above the Ac_3 transformation point, the austenite grain size increases with increasing temperature and heating time. This grain growth, although useful in moderation since it increases hardenability, also has the disadvantage that it causes embrittlement. Depending on the service conditions to be encountered, it may be required to produce moderately course grain in order to increase the depth of quenching or to maintain the minimum grain size to minimize embrittlement. There is therefore an advantage in being able at will to make casts which give a fairly coarse grain without excessive heating or casts which are highly resistant to grain growth.

Now the addition of aluminium makes it possible to regulate the grain size of a steel, or in English parlance to "control" the grain size.

In this way "grain-size-controlled" steel can be made.

Aluminium is capable of combining in steel, with oxygen to form alumina inclusions ($Al_2 O_3$) and with nitrogen to form aluminium nitride inclusions (AIN). Depending on the oxygen and nitrogen contents of the steel, it will contain these two types of inclusions, and if there is excess aluminium this will remain in solid solution. Recent investigations by Jacques *Pomey* and Gilbert *Vigneron* have confirmed earlier hypotheses to the effect that it is only the aluminium nitride AIN which affects grain growth; neither dissolved aluminium nor alumina have the same effect. The hindrance to grain growth is a maximum when the nitride is fine and uniformly distributed.

The addition of small quantities of aluminium to steel, by producing a fine grain size, promotes resistance to welding cracking.

ALUMINIUM AS AN ALLOYING ELEMENT

We have seen that aluminium readily combines with oxygen to form alumina and with nitrogen to form nitrides. These properties are utilized in various types of steel, in the formation of nitrides for the surface hardening of the steel by nitriding, for the through precipitation-hardening of the steel, or for improving its scaling resistance by the formation of a protective film of alumina.

ALUMINIUM-BEARING NITRIDING STEELS

A recent article on the role of nitrogen in steel showed that it is possible to produce a very high surface hardness in certain types of steel by the action of a stream of ammonia at around 525°C. The steel composition must be such that it forms a surface layer of nitrides, of very high hardness and highly adherent.

Iron can form nitrides, but the action of nitrogen on carbon, steel extends inwards and the surface layer is very brittle. To produce usable steels it is essential to introduce alloying elements which limit the penetration of the nitrogen and reduce the brittleness of the nitrided layer; the most successful of these are chromium and aluminium. Aluminium nitride is stable to about 1 100°C, whereas the chromium nitride is only stable to about 900°C. Apart from this, molybdenum additions make it possible to supress temper brittleness which, without molybdenum, would be unpleasantly in evidence since the nitriding process involves very prolonged holding at around 525°C in an ammonia atmosphere; this temperature is in fact within the sensitivity range for temper embrittlement.

Nitriding steels are alloyed with chromium (about 1.5%), aluminium (from 0.45 to 1.3% depending on the grade) the molybdenum (around 0.35%).

PRECIPITATION HARDENING BY ADDITIONS OF ALUMINIUM

When an element which is in solid solution in a matrix phase at elevated temperatures precipitates on lowering the temperature, either as the element or as a compound with some other dissolved element or the base metal itself, it is possible to heat treat the alloy so as to obtain a hardening effect due to the distribution of fine precipitate particles in the matrix. This treatment comprises first a solution treatment, involving heating to a sufficiently high temperature, followed by rapid cooling to prevent precipitation from occurring. The result is a solid solution unstable at room temperature, the breakdown of which is only prevented by the extreme slowness of the diffusion processes in the matrix which are required to form the precipitate particles. The alloy is then heated to a temperature sufficient to speed up this breakdown, thus bringing about the required hardening effect.

Two examples can be given of well-known materials which utilize this mechanism. Duralumin is a precipitation-hardened light alloy. The secondary hardening produced in high-speed steel on tempering after quenching is largely due to carbide precipitation at the tempering temperature.

Aluminium is one of the elements which can give rise to precipitation hardening effects.

PRECIPITATION-HARDENING NITRIDING STEEL

The addition of nickel to an aluminium-bearing nitriding steel of the type discussed above gives components of higher core strength than in the steel without nickel, by reason of hardening produced by precipitation of an aluminium-nickel compound.

There is an American steel, containing 0.2%C, 1.1%Cr, 1%Al, 0.25% Mo and 3.5% Ni, which after nitriding for 48 hours at 525°C has a tensile strength in the core of 80kg/mm². whereas in the absence of nickel the value is only 60 kg/mm² In accordance with what has been said above, quenching takes all the elements into solution and prolonged holding at 525°C causes precipitation hardening.

It should be pointed out that the nitrided case on this steel is somewhat less hard but also less brittle than in the absence of nickel.

PRECIPITATION-HARDENING HEAT-RESISTING STEELS

The addition of aluminium to nickel-base alloys produces hardening by precipitation of a fine and uniformly distributed intermetallic compound.

It was in France, in 1935, at the *Imphy* steel works, that Pierre *Chevenard* showed that simultaneous additions of aluminium and titanium increased the hot strength of austenitic heat-resisting steel of the 35% Ni—11%Cr type (A. T. V. steel, thus forming A. T. V. S. steel). This hot hardening process has become practically universal for nickel-base alloys, which are used in particular for gas-turbine blades and other components subjected to mechanical loads at high temperatures. The aluminium content varies between 0.5 and 3%, together with titanium in the same range. To produce the required precipitate distribution, one must start by taking the various alloys into solution in the austenite matrix, by heating to high temperatures in the range 1 050—1 150°C, followed by air-cooling, which is sufficient for all but the largest components to prevent any precipitation. The hardening precipitation is then produced by ageing for several hours at 700°C.

The hardening precipitates formed by aluminium comprise the intermetallic compound Ni_3 Al. Optimum strength coincides with the formation of this compound, as can be demonstrated by examination under the electron microscope.

ALUMINIUM VERSUS CERTAIN TYPES OF CORROSION

Some additions of oxidizable elements have the paradoxical effect of preventing oxidation in steel. If the oxide of the element has a higher density than that of the steel itself, there will be formed on the steel surface under the action of an external oxidizing medium a layer of oxide which will be put in tension by contact with the metal and will either crack or become detached, leaving the metal surface exposed to the medium. If on the other hand, the volume of the oxide formed is greater than that of the metal producing it, i. e., if the density of the oxide is less than that of the steel, and if in addition the compressive strength of the oxide is adequate, there will be formed on the steel surface a sound layer of oxide which is impervious to the oxidizing gas and thus protective. Oxidation of the metal will be arrested.

Aluminium fulfils these conditions for protection against continued oxidation. It has thus been used to increase the scaling resistance of steel.

Simultaneous additions of chromium and aluminium to steel give rise to alloys with very high resistance at extremely high temperatures. Particular reference can be made of ferrous alloys containing 20% Cr. and 5% Al. or 30% Cr. and 5% Al, which are used to manufacture resistance elements for electric heaters used up to 1 250 and 1 300°C respectively.

These alloys have a high electrical resistivity, of the order of 130 to 140 microhm/cm²/cm, practically constant up to about 1 300°C, which is an excellent property in heater resistance wires.

The improved scaling resistance of this type of alloy at elevated temperatures, compared with Fe-Ni-Cr or Ni-Cr alloys, is unfortunately offset by extreme brittleness after prolonged service above 900°C. The reason for this is that the high chromium and aluminium contents suppress the allotropic transformations of steel; the alloys remain ferritic to melting point, so that it is impossible to prevent grain growth, culminating in the extreme embrittlement of the material. The handling of these wires after they have been in service for some time requires every precaution being taken.

A further drawback in this type of alloy is its low mechanical strength at elevated temperatures, which is such that the wires must be supported to prevent stretching under their own weight.

Moreover, contact between the protective oxide film and any siliceous refractories is harmful to the elements; if they are to be used in contact with furnace refractories, the latter must be of the alumina-base type. This type of alloy has a very good resistance to hydrogen sulphide.

Certain fuels and petrols contain vanadium pentoxide, which is extremely aggressive at combustion temperatures; the addition of aluminium to a stainless steel renders it resistant to this type of corrosion. A 23% Cr.—10% Al steel has twice the resistance of an austenitic 25 Cr—20 Ni steel.

To economize in the "strategic elements" nickel and cobalt, use has been made in the U.S.A. of an Fe-Al-Mo alloy containing 16% Al and 3% Mo; this alloy has a good high-temperature oxidation resistance and quite good hot strength properties.

These high-aluminium alloys are difficult to make by ordinary methods. Vacuum steel-making, which is expanding rapidly, greatly facilitates their manufacture.

The addition of aluminium to low-alloy steels confers resistance to certain types of chemical corrosion, as demonstrated by *E. Herzog* in his thesis.

Addition in small quantities to a 4% Cr. steel improves its resistance to marine atmospheres, as regards general corrosion and pinpoint corrosion.

The addition of small amounts of aluminium to low-alloy Cr-Mo steels improves their resistance to H_2S. This finding led to the discovery of *Pompey* steel, used for the tubework at *Lacq*, where the hot gases contain large amounts of H_2S and are very aggressive.

MAGNET STEELS OF THE Fe-Ni-Al TYPE

In 1932 it was discovered by the Japanese worker *Mishima* that additions to iron of between 15 and 35% nickel and between 8 and 15% aluminium greatly increased the coercivity (to 600 oersted against around 75 for the classical 6% tungsten magnet steels); the remanence remained at useful levels (5,000 to 8,000 gauss).

The high coercivity of this type of alloy was found to be due to the presence in the ferritic matrix of particles of an ordered phase, designated x', and containing Ni and Al. In general, any structural heterogeneity or machanical heterogeneity produced by stresses will cause an increase in coercivity, the minimum value for any alloy being reached when it is in the most homogeneous condition possible. In any case, it had already been observed with the old 6% tungsten magnet steels that an increase in the quenching temperature, by increasing the amount of residual austenite (non-magnetic phase) increased the coercivity.

The extremely high coercivity of the Fe-Ni-Al alloys would thus be due to the stresses set up by the difference in specific volume between the two phases x and x'.

The heat treatment of this type of alloy, like that for precipitation hardening, involves heating to high temperatures (around 1 150°C), followed by quenching to produce a solid solution of low coercivity; subsequent heating for long times at an intermediate temperature (around 500°C) produces the high-coercivity structure.

The modern magnet alloys of this type also contain additions of cobalt, titanium and copper.

ALUMINIUM AS A FERRITE-FORMER

Ferrite-former is the name given to an element which tends to favour the presence of the low-tempera ture body-centred cubic alpha form of iron and to oppose the formation of the high temperature face-centred cubic structure, so that a sufficient content of such an element will entirely suppress any allotropic transformations in the iron up to the melting point. This effect is produced in the low-carbon high-chromium steels in particular, which are known for this reason as "ferritic steels". Aluminium is an alloying element of this type; above 1% of aluminium, the Fe-Al alloys are ferritic up to the melting point. The addition of austenite stabilizers (carbon and nickel in particular) opposes this tendency and thus increases the amount of ferrite-former required to suppress transformation.

This property of aluminium is utilized in certain stainless chromium steels to prevent the hardening which may at times prove troublesome, particularly in welding, where air cooling may give rise to cracking. This effect can be obtained in a steel with 0.15%C and 13.5%Cr, by adding 0.1 to 0.3%Al.

[Courtesy: "Les Aciers Fins & Speciaux Francais"]

India on the threshold of Steel Revolution

India's determination to achieve a production target of 6 million tons of steel ingots by the end of 1961 was described as 'courageous' by some pessimists at home and abroad. But the determination has been crowned with success belying all echoes of alarms. All the three new steel plants were commissioned during 1959 and it can be safely predicted that a capacity of 6 million tons of ingots would have been created by the end of the Second Five-Year Plan in 1961. Considerable expansion programme of the existing steel plants at Jamshedpur, Burnpur and Bhadravati was also completed in 1959.

A large reserve of trained personnel is being created to man the plants. The expansion of the steel processing industry is receiving due attention. India is also adopting recently developed techniques such as high top pressure operation in blast furnaces and sintering for increasing production.

A new plant to manufacture tool and alloy steels will also be set up at an early date.

The Government of India have taken steps to encourage the development of small iron, steel and re-rolling units in the country simultaneously with the establishment of large integrated steel works. More than 20 scrap-based electric furnaces were working so far. A solid foundation has thus been laid for rapid industrial advancement in the country.

The blast furnaces that started production in 1959 produced 1.5 million tons of pig iron upto October 1960. More than 100,000 tons of pig iron has already been exported.

Eight firms have been licensed for setting up small pig iron plants. Of these, two—one at Coimbatore in Madras State and the other at Barbil in Orissa State—have gone into production.

In view of the necessity to plan for a further capacity of 200,000 tons to 500,000 tons of pig iron to be able to meet the requirements by the end of the Third Five-Year Plan, Government has decided to revise its earlier decision and to license pig iron plants to a capacity of about 100,000 tons a year each.

As a result of increased production, larger supplies of billets were available to the re-rolling industry, which stepped up production from about 680,000 tons in 1959 to 572,000 tons (upto August) in 1960.

A still higher target of 10 million tons of steel ingots has been envisaged in 1965 by the expansion programmes of the existing steel works and by setting up a new steel plant at Bokaro in Bihar.

* * *

HUNGARIAN MINERS BEAT PRODUCTION PLAN

Hungarian coal miners overfulfilled their production plan by 2.4 per cent in the first six months of 1960 Mr. Bela Biaha, General Secretary of the Mineworkers Union told the union's annual conference in Budapest. Other sections of mining also beat the planned figures —mineral mining by 17 per cent and ore mining by 9.5 per cent. Oil production beat the plan by 1.7 per cent. It was aimed to produce 4,100,000 tons more coal and 200,000 tons more oil than 1960.

Trends in the Shape of Oxygen Converters*

By *JOSEF REICHMAYR*
Project Engineer, Pennsylvania Engineering Corporation

AMERICA produced its first million tons of basic oxygen process steel in 1959, just five years after the first oxygen furnace was blown into operation. A contributing factor to such a relatively high tonnage in so short a period has been a significant change in the shapes and sizes of furnaces used.

Developed in Austria in 1952, the oxygen process initially used 30-to 38-ton Bessemer-type converters with a typically slender silhouette and removable bottom. The earliest units blew approximately 3500 cfm of oxygen with an average lance distance of three to four feet. Most of the very early commercial converters in Japan, Germany, Canada and the United States adopted the principle of the Austrian L-D converters.

The earliest exception to the slender silhouette furnace was a 25-ton German spherical furnace. Slightly later in the United States came a spherical furnace, a 4000-scfm unit based on the actual wear line of refractories in oxygen furnaces.

Since then much research has been conducted on such operating characteristics as flow patterns of jet blowing, kinetic energy of primary and secondary oxygen streams, jet impact pressure, lining wear lines and aerodynamic principles of the stream. Research has been conducted in laboratories as well as on experimental furnaces with capacities as large as 8 tons.

INCREASING OXYGEN FLOW RATES

Experiments to increase oxygen flow and refining rates have been made by several producers. Jones & Laughlin Steel Corporation was the first to alter the usual blowing operation significantly by increasing the oxygen flow rates to 8400 scfm, while refining $5\frac{1}{2}$ tons of steel per minute. These changes have led to new concepts in furnace shapes, necessary to accomplish highest capacity under such changed blowing condition.

When the lance distance is raised for optimal blowing results, the impact diameter of the jet on the slag and metal surface increases, requiring larger diameter furnaces. Taking this into consideration, dimensions for new furnaces should be determined by the expected blowing rate. Furnaces of the future should not only be designed to accommodate a certain batch size, but rather to accommodate the volume of oxygen that may eventually be blown.

The oxygen furnace, as designed today, is capable of blowing 10,000 to 15,000 cfm and in some conditions, even more. Blowing 8000 scfm oxygen into an 18-foot diameter furnace produces better results than blowing that amount into a 16-foot diameter furnace. However the increase in flow rates can be justified only as long as refractory life and metallic yield is kept within economical limits.

INCREASE IN HEIGHT-TO-DIAMETER RATIO

More recent furnaces have had a much smaller ratio of height-to-diameter. Although the bath area has increased greatly, the ratio of bath-surface to ton-of-yield has remained about the same—approximately 1.5 square feet per ton of steel. Furnaces with large bath areas have shown that the ratio of surface to ton-of-steel still is four times less than in open hearth practice.

ONE LARGE OR SEVERAL SMALL FURNACES

Compared with multiple small furnaces, large furnaces promise savings in steel-making costs, as well as reduced installation costs. However, optimum furnace size depends on plant layout, existing conditions and production programming in the steel mill. An increase in bath size can be justified only if the refining speed is increased in proportion. If this is not the case, two small furnaces will produce more steel in the same time as a large one.

*Synopsis of paper given at the Engineers' Society of Western Pennsylvania Meeting in Pittsburgh, March 15, 1960.

The Hanover Fair enlarges for 1961

THE 15th Industries Fair will be held in Hanover between April 30 and May 9, 1961. Since the Fair was first held in 1947, its importantce for international trade has constantly increased. To accommodate the growing number of German and foreign exhibitors, it has been necessary to extend the exhibition area every year, but it has not yet been possible to satisfy everyone. From 30,000 sq. m. in 1947, the covered area available grew to 285,000 sq. m. in 1960 with 314,000 sq. m. being provided for 1961 The open air section has increased from 8,000 sq. m. in 1947 to 162,000 sq. m. in 1960, with 192,000 sq. m. being provided for next year. The 5,000 exhibitors expected for 1961 will thus have a total area of 506,000 sq. m. at their disposal.

The exhibitors are solely producer firms, and play an important part in foreign trade. They are represented by top-level executives, which enables vital and decisive negotiations to be held. In view of this, authoritative commercial delegations and many economic experts from abroad attend the Fair.

Such is the scope and diversity of the German and foreign displays in each branch, that the possibilities of comparison cannot be bettered. National pavilions not being permitted, each branch of industry is a self-contained entity. This feature is greatly appreciated by the visitors. German and foreign producers of a given article exhibit in the same section. All this is a great aid to visitors particularly interested in a given branch. Over twenty-industrial European and oversea countries maintain in addition, information offices in Hanover, which advise on questions of foreign trade.

The following industrial groups are represented: mechanical engineering, electrical engineering, chemistry and plastics, precision mechanics and optics, iron and steel, tools, rubber, office supplies, procelain and ceramics, glass, jewellery and silver-ware watches and clocks, cutlery and metal goods.

Foreign exhibits are a very important feature of the Fair. Their number has materially increased over the last few years, having doubled in four years to 836 firms out of about 4,800 exhibitors in 1960. Despite such an increase in participation from abroad, many firms are still on the waiting list. Some of these will be able to exhibit in 1961. In 1960, French firms led with 177 exhibitors, followed by Great Britain and the United States with 96 and 91 respectively. Twenty-four European and oversea countries exhibited this year.

Foreign visitors have also been appearing in increasing numbers. While the 1959 Fair, was visited by buyers from 93 countries, visitors from 103 nations attended in 1960. Visitors from the United States were 45% above the previous year. Among these, particular reference should be made to a group of more than 100 buyers from various branches who remained several days in Hanover to make a detailed survey of the exhibits.

The enlargement of the 1961 Fair, which will enable many foreign and national producers to exhibit for the first time, will probably make the next event even more successful, to the benefit of trade the world over.

MACHINE CONSTRUCTION AT THE 1961 HANOVER FAIR

At the 1961 Hanover Fair (April 30—May 9), machine construction will be divided into 24 sub-groups. Of the approximately 1,500 firms (1,402 in 1960) some 20% are foreign. Their fields of activity range from woodworking machinery through lifts and lifting equipment and mechaninal handling to pipe fittings and refrigerating machinery. In addition to the foregoing there are 200 manufacturers of office machinery. Machine construction alone occupies a stand space of almost 255,000 sq. metres of which 140,000 sq. metres are in the open-air section. It is thus the largest branch of engineering represented at the Hanover Fair, followed by the electrical trades.

Woodworking machinery, contractors' plant, building materials, road-making machinery, cranes, hoists and materials handling, steam hydraulic and nuclear engineering are all well represented internationally. Austria, Belgium, Canada, Czechoslovakia, Denmark, Finland, France, Great Britain, Italy, Luxemburg, the Netherlands, Norway, Poland, Portugal, Sweden, Switzerland and the U.S.A. will all be there in strength.

With about 240 firms occupying a space of 20,000 sq. metres woodworking machinery is the largest sub-group in machine construction. Next in order come contractors' plant building materials, road-making machinery (205 firms and 90,000 sq. m.) cranes, hoists, mechanical handling (200 firms and 57,000 sq. m.) gearing and transmission (98 firms and 6,500 sq. m.) processing machinery for rubber and plastic masses; chemical machinery and ceramics machinery (together 111 firms and 12,000 sq. m.).

Owing to the lively interest shown by international machine construction in the Hanover Fair, the extension of the Fair grounds planned for 1961 will be almost exclusively devoted to this group. In the northern part, three large halls of 20,000 sq. m. are now being erected for mechanical handling, lifting appliances, bearings and journals, balances, fittings pumps, oil-hydraulics, pneumatics, compressors, paint-spraying plant, instrumentation and control engineering seals and packing. The result will be an increase in the range of each and a better concentration of the various branches. These extensions will also free space for other sub-groups of machine construction.

The Official Representatives in India for this Fair, are AJANTA ADVERTISING, Bombay, Calcutta and Madras, who can be contacted for any further detailed particulars.

Conveying Plant and Machinery — An Innovation

The firm of Messrs George Robson & Co. (Conveyors) Ltd., Hodgson St., Sheffield England recently introduced conveying plant with the conveyor BELTS MAGNETISED. Magnets are fixed to the underside of the Belting and this enables steel scrap and small parts to be carried to the perpendicular on moving belting. This method appeals to firms who have light scrap turnings and parts to be removed, also for Hotel work where crown corks can be removed immediately by throwing them on to a small conveyor belt. Since the above method came into operation there has been a further development. Rubber Belting is being magnetised by treatment to impregnate the belting with Iron and then magnetising. In this development experiments are taking place to see how strong the magnetism can be made and to determine the weight which can be carried.

German Steel Arrives at the Port of Los Angeles

By A Correspondent

CLOSE on the heels of a strong warning against curbing the flow of foreign steel into America, a German flag freighter, the M/S. JOHANNA OLDENDORFF, arrived at the Port of Los Angeles recently with 1,231 tons of manufactured steel products—all destined for the booming construction industry of Southern California.

The warning by Albert Perrish, president of the West Coast Metal Importers Association, was inspired by a published suggestion of a small but vocal group of protectionists that restrictions be placed against imported steel.

According to Perrish, restrictions against imported steel would only result in retaliatory measures overseas which, in turn, could lead to unemployment among American steel workers.

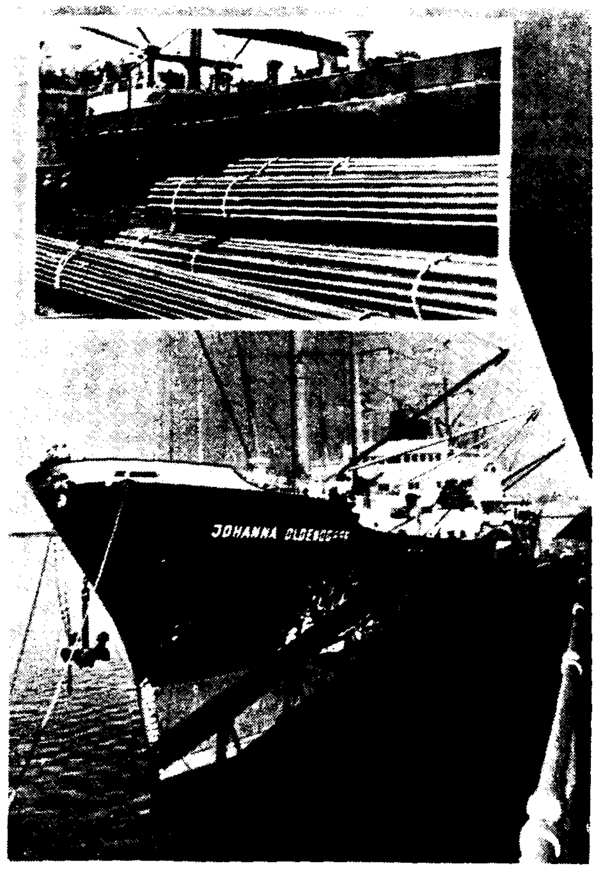
"Without foreign trade," he declared, "layoffs in the steel industry would have been much greater than they now are."

PORT OF LOS ANGELES STEEL IMPORTS

Fiscal 1960 and 1959 (ending June 30) in short tons.

Type of Steel Product	*Exporting Nation*	*Fiscal 1960*	*Fiscal 1959*
Steel Mill Product	Belgium	42,544	31,320
Rolled or Finished	France	96	25
	West Germany	2,516	1,829
	Italy	376	21
	Netherlands	2,157	497
	Spain	1,314	—
	Sweden	1,074	177
	United Kingdom	15,778	4,437
	Mexico	3	—
	Chile	2,649	—
	Peru	221	—
	British Malaya	6	—
	Japan	62,174	30,430
	Taiwan (Formosa)	1,264	—
	Australia	1,061	367
Pipe, Tubes, Tubing	Belgium	29,463	17,773
	France	518	1,276
	West Germany	8,291	5,573
	Italy	1,428	91
	Netherlands	9,142	5,722
	Sweden	26	2
	United Kingdom	21,581	8,867
	Venezuela	4,289	—
	Japan	21,815	8,931
	Australia	33,683	23,198
Steel Wire and Manufactures	Belgium	7,282	15,619
	Denmark	109	—
	France	392	196
	West Germany	4,263	5,219
	Italy	546	260
	Netherlands	2,829	2,777
	Norway	67	42
	Sweden	257	27
	United Kingdom	6,578	7,913
	Hong Kong	14	2
	Japan	39,210	29,171
	Australia	8,674	984
	New Zealand	34	—

Meanwhile, all types of overseas steel continue to move across the wharves of the Port of Los Angeles. In the shipment discharged by the JOHANNA



Steel pipe from West Germany swings over the side of the M/s. Johanna Oldendorff, berthed at her wharf in the Port of Los Angeles. In inset is close-up of small portion of 994 tons of pipe discharged, all destined for the booming construction industry of Southern California.

OLDENDORFF, for example, there were 994 tons of steel pipe, 105 tons of barbed wire and 32 tons of wire webbing.

Statistics on the 10 leading imports (excluding petroleum) in the latest Port of Los Angeles Annual Report (fiscal year ending June 30, 1960) show steel mill products (rolled or finished) and pipe, tubes and tubing in the two top positions on the list. Steel wire and manufactures are in sixth place. Total steel imports in fiscal '60 were 333,725 tons, compared with 203,090 tons in the previous year—a rousing gain of 64 percent.

Admittedly, steel imports through all West Coast ports, including Los Angeles, declined somewhat in the last six months of calendar 1960. But local importers as well as port officials are far from being pessimistic, pointing to the continuing population and industrial growth of the area as powerful stimulants to building of all kinds.

Based on final figures for 11 months of 1960, total building and construction in the southern half of California should total an all-time high expenditure of $3,490,000,000, compared with $3,483,000,000 during 1959, the previous record year.

CAST IRON SPIGOT AND SOCKET SOIL, WASTE AND VENTILATING PIPES, FITTINGS AND ACCESSORIES

The Indian Standards Institution has prepared a draft specification for Cast Iron Spigot and Socket Soil, Waste and Ventilating Pipes. Fittings and Accessories [Doc: SMDC 9(270)P1].

Hitherto in India, the manufacture of cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories has been generally on the basis of British Standards which had found wide acceptance both by the producers and consumers. However, in view of the Government of India's decision to introduce in the country a uniform system of weights and measures based on the metric system all the values specified in this standard are given in metric units. The standard dimensions proposed will give reasonable interchangeability between the fittings at present being manufactured and the new fittings.

* * *

PHYSICAL TESTING OF STEEL

The following four Indian Standards are the latest addition to the series of Indian Standards for mechanical testing steel :

(1) IS: 1599-1960 Method for Bend Test for Steel Products Other than Sheet, Strip, Wire and Tube

(2) IS: 1692-1960 Method for simple Bend Testing of Steel Sheet and Strip Less than 3 mm Thick

(3) IS: 1716-1960 Method for Reverse Rend Testing of Steel wire

(4) IS: 1717-1960 Method for Simple Torsion Testing of Steel Wire

All the standards are based on the relevant international Recommendations prepared by the International Organization for Standardization (ISO).

Cause and Effect of Work Hardening in Austenitic Stainless Steels*

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THE term "work hardening" refers to the deforming of a metal plastically at such a temperature and rate that strain hardening occurs. In the stainless steels it is a notable characteristic of the 18-8 chromium-nickel austenitic types, the AISI 300 Series, and these are the grades I will discuss here. When we speak of work hardening, we usually think of cold working metal at or near room temperature.

The performance of a simple tensile test is a good example of work hardening. When a tensile load is applied, the specimen first goes through a range of elastic deformation. This is a temporary deformation in that, if the load is removed at any point in this range, the specimen will return to its original shape and size. However, as the tensile load passes the elastic limit of the metal, plastic or permanent deformation begins and this continues up to the point of fracture or ultimate tensile strength. In this range of plastic deformation, the metal takes on a permanent set, and it is in this range, between the yield and tensile strengths, that work hardening occurs. The degree of this work hardening effect is a function of the applied stress and temperature dependent upon the time or rate of application.

The theory and mechanics of this phenomenon are not completely understood. Probably the most prevalent theory offered today—a theory which is the outgrowth of previous concepts—is the dislocation theory which relates the work hardening effect to minute flaws occurring within the atomic lattices of the crystalline grains in the metal. When a force sufficient to cause distortion of the metal is applied, these flaws tend to restrict a uniform change in the reorientation of the grain structure, with a resultant hardening and strengthening of the metal.

The degree of work hardening, created by applying a certain given force on the metal, is affected by several interrelated factors. First, the effect of temperature is considerably significant. Work hardening may occur at any temperature up to the recrystallization temperature, which is around 1600 F for the austenitic stainless steels. Elevated temperatures above this point permit the metal to flow, and there will be no significant work hardening effect. Conversely, as the temperature drops below the recrystallisation point, the degree of work hardening gradually increases for the same applied force. Cold working the metal at ambient or room temperature results in a marked increase in tensile strength and hardness. At sub-zero temperatures, the effect of work hardening, still using the same level of applied force, is even more notable. The effect of the working temperature is indicated in Fig. 1, and the contrast in tensile

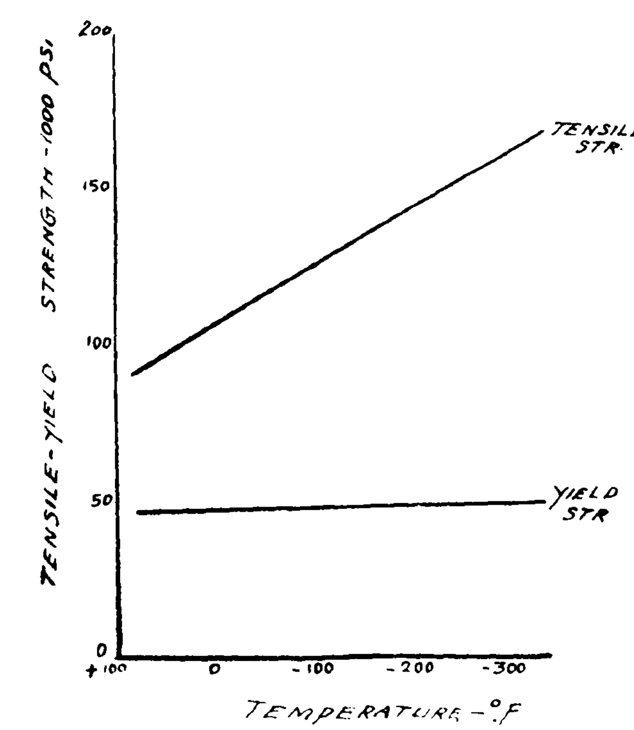


Fig. 1—Type 347 stainless steel. Effect of temperature on work hardening as demonstrated by tensile properties at room temperature and sub-zero temperature.

strength at room temperature versus that at—320 F is a measure of the work hardening effect. These results were obtained from two tensile specimens cut from the same hot rolled and annealed plate and subjected to the same rate of tensile loading. The increase in the rate of work hardening with drop in temperature is a measure of the greatly expanded plastic deformation range occurring between the tensile and yield values.

Work hardening is also dependent on time. The rate of stressing—that is, the rate at which stress is applied to the metal—will determine the extent of work hardening. Low stress rates result in a greater degree of work hardening for a given amount of deformation. High forming speeds in drawing and pressing operations are advantageous in that more severe deformation may be accomplished with fewer intermediate annealing treatments. This is also apparent in the case of machining the austenitic stainless steels. Low machining speeds may cause surface work hardening to the degree that the tool or bit will not penetrate the metal. This can occur especially in the case of milling or turning.

A final influence on work hardening is chemical composition, and nickel is the element which strongly modifies the work hardening effect. As the nickel content in the alloy is increased to approximately 13 per cent, work hardening is retarded. This tendency has been utilized for certain applications and is exemplified in the cases of AISI stainless steel Types 301 and 305. Type 301 with 6 to 8 per cent nickel is the cold rolling grade. It work hardens rapidly with an appreciable increase in strength, and it is often used in structural applications where high strength is desired. Type 305, with its 1 to 13 per cent nickel, on the other hand, is a good spinning or drawing grade, since it work hardens relatively slowly and will, consequently, withstand a greater degree of deformation.

Work hardening can occur at many points in the production and fabrication of austenitic stainless steels. Forming operations at room temperature—for example rolling, drawing, pressing and spinning—normally produce the greatest degree of work hardening. These processes involve severe deformation of the metal either locally, as in the case of the knuckle radius and flange on a tank head, or uniformly, as in a cold rolled sheet. Flattening or straightening operations will create some degree of work hardening, mostly at those points where waves, wrinkles, or kinks occur. The degree of hardening is usually slight and is seldom measurable.

Cutting processes such as shearing, cold sawing, and abrasive cutting and operations like machining, drilling, grinding, and polishing will tend to work harden the metal to some slight extent in that only the metal surface immediately in contact with the tool or belt will be hardened. This is superficial and the metal beneath the surface will not be affected. This characteristic can sometimes create difficulty in machining operations since, if the tool is not in proper condition and proper adjustment to continually remove the metal, it will tend to burnish the surface. The surface metal tends to work harden to an increasing degree with each pass, forming a hard layer which the tool will not penetrate. Sharp tools operating at the prescribed feeds and speeds for these metals will minimize this problem.

The effects of work hardening on the austenitic stainless steels are evident in the changes which occur in the properties of these metals. The most notable change is observed in the mechanical tensile properties wherein the yield and tensile strength show a marked increase while the ductility diminishes. Table I demonstrates these facts. Test A was conducted on a tensile specimen in its soft annealed condition, while Test B was made on a tensile specimen from the same plate after the specimen had been cold worked well beyond its original yield strength. The result of this work hardening are seen in the changes in tensile properties. An interesting point is that while both tensile and yield strength increase, the yield strength value approaches the tensile value. These values would be quite comparable in a specimen that had undergone 100 per cent work hardening.

TABLE I

Type 304 Stainless Steel

Tensile Properties

Test	Condition	Tensile Strength	Yield Strength	Elongation	Reduction of Area
A	Annealed	74,800	31,300	65	72
B	Work Hardened	93,525	74,075	41	58

A notable effect on the physical property characteristics is the change in magnetic permeability, or magnetism, experienced through work hardening. In the soft, ductile annealed state these metals show an extremely low residual magnetism which can be determined only by sensitive instruments. However, cold work and strain hardening increase the magnetic

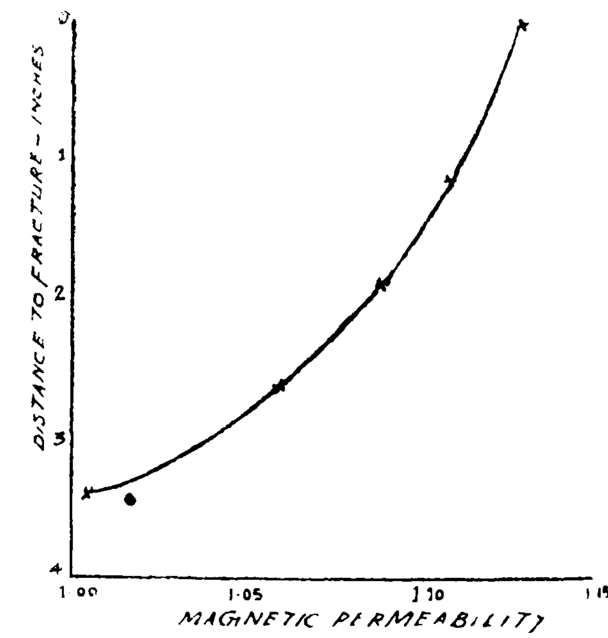


Fig. 2. Type 304 stainless steel. Effect of work hardening on magnetic permeability as measured on fractured tensile specimen.

permeability appreciably. Fig 2 describes this effect produced in a tensile specimen pulled to failure. The lower left corner of the graph indicates the extremely low degree of magnetism in an unaffected area several inches from the point of fracture. Approaching the break, as the work hardening intensifies the magnetic permeability steadily increases. At the point of rupture, where the reduction in area and the work hardening effect reach a maximum, the magnetic permeability is also at a maximum.

The non-magnetic property of these alloys is sometimes questioned when a machined part appears to be magnetic to the touch of a hand magnet. This, of course, is attributable to the surface work hardening effect created in machining. It is only superficial, and the metal just below the surface should normally be free of any magnetic attraction.

The effect of work hardening on corrosion resistance, one of the attributes of these alloys, is dependent on the application or environment in which the metal is used. There are many corrosive conditions in which work hardening has no detrimental effect, but work hardening *per se* does not improve corrosion resistance. The chromium-nickel stainless steels are susceptible to one particular form of corrosion known as stress corrosion or stress corrosion cracking, and work hardening can play a definite part in producing this susceptibility. The process by which this corrosion develops is not fully understood, but the fundamental conditions for its occurrence appear to be a high concentration of chlorides in contact with the metal surface which is itself under tensile stress. It has been generally accepted that work hardened surfaces are preferentially attacked by these chlorides, and the lower the level of work hardening the greater the immunity to stress the corrosion cracking.

Some of these effects of work hardening appear in Fig. 3 which describes a cold formed tank head. These heads are produced by taking a flat disc and pressing to the desired shape on a die, or by first bumping out the dish section and then rolling the flange to shape. The head shown here was produced by the latter method and, as would be expected, the greatest degree of work hardening occurs across the knuckle radius and down the flange where deformation of the metal is most severe. Several properties were determined. Both magnetic permeability and Brinell hardness were measured across the diameter of the head. There was sufficient work hardening on the dished section to cause the hardness to increase about 40 points above the original annealed hardness, but there was little increase in magnetic permeability. In the vicinity of the knuckle radius and on the flange both magnetic permeability and hardness increase appreciably.

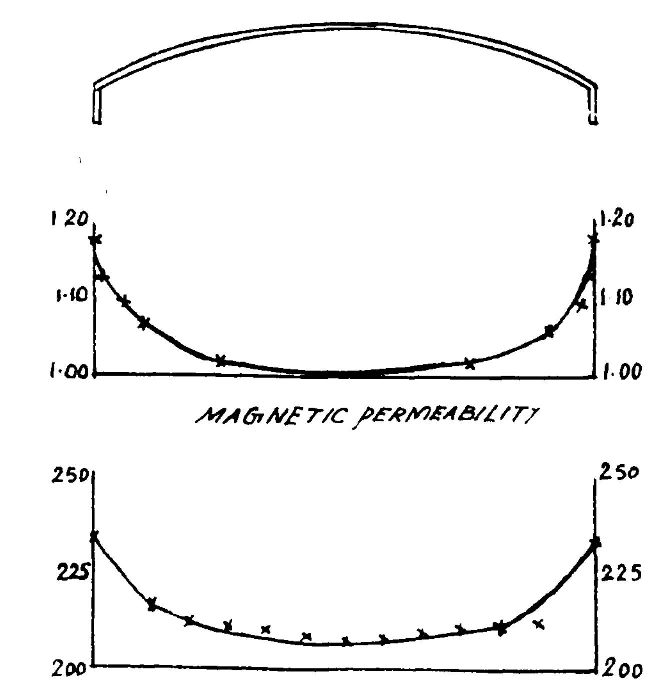


Fig. 3—Type 304 stainless steel ASME flanged and dished head. Effect of work hardening on magnetic permeability and Brinell hardness.
Note: Brinell hardness before forming was 165.

Test specimens were removed from the head at points A and B and the work hardening effect on tensile and impact properties is shown in Table 2 in a comparison with the annealed plate properties. In the area of the dished section (Location A) only the yield strength shows a significant increase over the original tensile values. Along the flange represented by Location B, the effects of work hardening are quite apparent with a substantial increase in tensile-yield strength and a decrease in ductility as measured by elongation and impact strength.

In some cases, stainless steels are worked hardened purposely to increase strength of the material. Cold rolling sheet and strip and cold drawing bars and wire are common techniques of this nature. Tensile strength may be nearly doubled and yield strength increased by a factor of 3 to 4 in the cold rolling of AISI Type 301 stainless steel sheet. While plates are not normally cold rolled, some purposeful work hardening effect may be achieved by what is termed "cold—hot rolling" on the mill, that is, by accomplishing the final reduction to desired gage after the temperature of the plate drops below the recrystallization temperature. In this way the tensile and yield strength of the plate will be improved.

Another potential work hardening technique, still in the developmental stage, is impact hardening by the use of an explosive force. This method is relatively new and is being considered primarily for the hardening of fabricated parts. Flexible sheet explosive is placed on the surface of the metal which, in turn, is backed up by a mold or suitable fixture. Upon detonation of the explosive, plastic deformation occurs with only slight surface depression. Tensile, and especially yield, strengths are increased appreciably. The degree of hardening is controlled by the weight of explosive and the number of applications to a given area. Differential hardening of metal parts may be accomplished in this manner.

TABLE 2

Type 304 Stainless Steel
Flanged and Dished Head
Mechanical Properties

	Original (Plate)	Lacation A (Dish)	Location B (Flange)
Tensile Strength	87,000	85,800	93,600
Yield Strength	39,000	50,000	67,300
Elongation	54	52	30
Impact Strength	—	43	39

To summarize, we can say work hardening is a characteristic of the austenitic stainless steels. We encounter it most often as a side-effect in production and fabrication processes, and it can occasionally create minor shop problems if correct forming and machining procedures are not used. A proper understanding of the effects of work hardening is important in the application of the 18-8 stainless steels. While it may be detrimental in some applications involving non-magnetic or corrosion requirements, the utilisation of the work hardening effect can be beneficial and may hold some interesting future possibilities in enhancing the strength levels of these alloys.

*[Presented at Philadelphia Regional Technical Meeting of American Iron and Steel Institute, October 13, 1960.]

U. K.'S STAINLESS STEEL OUTPUT EXPANDS

Stainless steel is being used increasingly in a number of trades and industries. It is exported to India, Canada, South Africa, New Zealand and Australia, although Australia is now producing from home-based plant. Other exports go to Belgium, Switzerland, the Netherlands, and the Scandinavian countries. In the United Kingdom, bulk users are manufacturers of domestic appliances and the motor-car industry.

The chairman of the Stainless Steel Manufacturers' Association gave the figures at a London exhibition of stainless steels covering industries ranging from cutlery and medical supplies to sport and aircraft.

The United Kingdom produced 220,000 tons of stainless steel last year—nearly five times the 44,300-ton output in 1945.

Announcing this in London, the Stainless Steel Manufacturers' Association says that with the expansion schemes in hand, the industry will produce 280,000 tons a year by 1963.

* * *

IRON ORE EXTRACTION STARTS AT BIGGEST SOVIET MINE

A powerful blast which blew up thousands of tons of iron ore marked the beginning of the operation of the first section of the Soviet Union's largest Sarbaisk mine at the Sokolovsko-Sarbaisk ore dressing combine, Kazakhstan. The annual capacity of the first section of the new gigantic quarry is 15,00,000 tons of raw ore. The annual capacity of another—Sokolovsky—quarry of the same combine which is already in operation is 50,00,000 tons of raw ore.

The Tagus River Bridge—Europe's Longest Clear Span Bridge

UNITED States Steel Export Company and the Portuguese Government have signed a contract for the construction of Europe's longest suspension bridge, it was announced in New York by William S. Morrison, President of the Export Company.

The bridge will cross the Tagus River at Lisbon, Portugal, and will take four years to build. It will be a four-lane highway bridge with provisions for future installation of a double-track railroad.

Provisional award of the contract was made on May 28, 1960, after approval by the Council of Ministers of the Portuguese Government, presided over by Dr. Oliveira Salazar. Various groups of international bridge builders and contractors had submitted competitive designs and proposals last year.

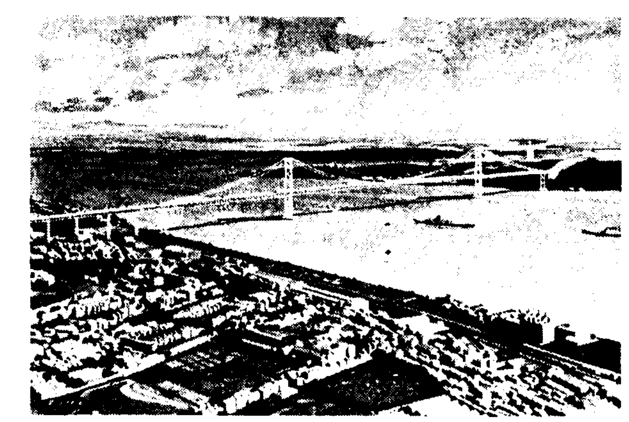
The Tagus River Bridge will be Europe's longest clear span bridge and the fifth longest in the world. With the main structure stretching nearly two miles, the bridge will have a central span of 3,318 feet (1,011 meters) and two side spans of 1,540 feet (469 meters) each. The entire project, including access roads, will encompass more than eight miles (12.87 kilometers) of roadway, including many grade-separation structures.

The length of the bridge from anchorage to anchorage will be 7,428 feet (2,264 meters) and its deepest pier will extend 270 feet (82 meters) from the surface of the water to bedrock, and will require excavation and foundation construction to record depth. The depth of the water is approximately 90 feet (27 meters).

The main steel towers, which will support the central span 230 feet (70 meters) above mean-tide level to permit passage of the largest ships, will rise 625 feet (191 meters) above the water or 895 feet (273 meters) above solid rock.

U. S. Steel Export is the prime contractor for the project, which was designed by the firm of Steinman, Boynton, Gronquist and London of New York City, and the Tudor Engineering Company of San Francisco.

The American Bridge Division of United States Steel will fabricate structural steel for the main bridge structure, and also participating will be the Portuguese steel fabricating firm, Sociedade Reunidas de Fabricacoes Metalicas, Lda. (SOREFAME).



Architect's drawing of the Tagus River Bridge, Lisbon, Portugal.

Construction of the main piers and approach roadways will be undertaken by International Morrison-Knudson Company, Inc., and its French associates, Compagnie pour l'Etude et le Developpement des Echanges Commerciaux (COMPADEC), specialists in deepwater work.

Since last May, the Portuguese Government and U. S. Steel Export have been conducting underwater investigations, including a comprehensive boring pattern, to confirm and fix the final measurements of the bridge, as well as studies of various alternative designs proposed for adoption of the one best suited to long-range requirements.

As a result of these studies, the Portuguese Government decided on the construction of a four-lane highway bridge, with provisions for future installation of a double-track railroad.

1960—A Record Year for U.K. Steel Industry

FEDERATION'S ANNUAL REPORT PUBLISHED

NINETEEN-SIXTY was a year of records for the British steel industry. This is a keynote of the annual report of the British Iron & Steel Federation, just published in London.

Steel output reached the record level of 24,300,000 tons in the United Kingdom in 1960, and the year confirmed the recovery from the 1958 recession which was under way in the fourth quarter of 1959.

Crude-steel production in the United Kingdom in 1960 was, in fact, nearly 20 per cent. higher than in the previous year, and some 12 per cent. above the previous record set in 1957. Steel exports in 1960, at 4,100,000 tons, were also a record.

The British steel industry, according to the federation's annual report, maintains an optimistic attitude towards probable developments in 1961. The report cites the federation's view that crude-steel output this year may reach 24,500,000 tons, just above the 1960 peak.

CAPACITY STILL EXPANSIBLE

The industry is also well placed, says the annual report, to push output still higher if demand warrants it. The capacity available will reach 27,000,000 tons this year, and raw materials could be made available to sustain steel production at any likely level.

Looking still further ahead, the federation has been assessing the supply and demand position up to 1965. This indicates that demand for steel in the United Kingdom may reach 25,000,000 tons by the mid-'sixties, which, with export requirements of about 5,000,000 tons, would add up to a total demand of some 30,000,000 tons; on the supply side, the companies' plans will raise steel capacity to about 34,000,000 tons by that time. In general, the steel industry expects to be in a position in the mid-'sixties to meet all demands on it.

As to external relations, the British Iron & Steel Federation welcomes the progress being made with the development of the European Free Trade Association. The report also stresses the "essential need to promote a wider unity in Europe".

INDIA ORDERS MACHINE TOOLS FROM U. K. FIRM

Craven Bros. (Manchester) Ltd., the Stockport (England) firm of machine-tool makers, have been awarded orders from India valued at more than £600,000.

The firm were told by cable of the order, the precise value of which will not be known until they receive details of the additional equipment required with the machines.

Craven Bros. specialize in large, heavy machine tools for general purposes.

This latest order brings the intake of new work since the beginning of this year to well above £1,000,000, and further substantial contracts are at present being negotiated.

Craven Bros. have already fulfilled a number of orders in India.

⁂ ⁂ ⁂

BOOK-REVIEW

DU PONT JET TAPPERS
for Open Hearth Furnaces

Messrs. E. I. Du Pont De Nemours & Company (Inc.), Explosives Department, Wilmington 98, Delaware, U.S.A. deserves to be congratulated on their perfecting a new tool for tapping open hearth furnaces. A beautifully-illustrated brochure issued by them explains vividly and in a lucid manner the advantages of these *Du Pont Jet Tappers* even the earlier device of oxygen lancing both from the point of view of operational efficiency, ease and also safety. The brochure further gives a fund of information regarding the principle underlying the composition and working of these jet tappers which must prove of absorbing interest to any student of the progress of Iron and Steel Industry.

HINDUSTAN STEEL SUPPLEMENT

BHILAI STEEL WORKS—A REVIEW FOR 1960

THE year 1960 was one of significant progress for Bhilai. The year was rounded up on a happy note of commissioning of several important units of the Steel Works for the production of coke, iron and steel.

The one-million ton steel plant now stands virtually completed.

" This fine plant ", to quote Prime Minister Nehru, " stands there in all its strength and majesty a symbol of the new India".

The picture at Bhilai at the end of the year was as below:

Main Plant Structures	*Designed*	*Position*
Coke Oven Batteries	3	All commissioned
Blast Furnaces	3	All commissioned
Open Hearth Furnaces for steel-making	6	Five commissioned
Rolling Mills	4	Three commissioned Hot trials in the fourth started.

Many notable events were witnessed at Bhilai during 1960. Among these were the visits of the Soviet Prime Minister Mr. N. S. Khrushchev on the 14th February 1960, and Prime Minister Nehru on the 27th October 1960. A number of foreign delegation including some steel delegation from Japan, United Kingdom and the United States of America and delegation of the World Bank Mission also visited the Bhilai Steel Works during the year.

Production of pig iron and crude steel (ingots) and semi-finished steel in the form of billets was started at Bhilai during 1959. The year 1960 saw the commencement of rolling of finished steel in the form of heavy structurals like beams and rails. Hot trials were also started in the Merchant mill.

THE RAIL AND STRUCTURAL MILL

The inauguration of the half mile long Rail & Structural Mill of the Bhilai Steel Works, the third of the four Rolling Mills and the largest and heaviest unit of the Bhilai Works, by Prime Minister Nehru on the 27th October 1960, was an outstanding event of the year. The two other Mills – the Blooming Mill and the Billet Mill were commissioned towards the end of the year 1959.

The Rail and Structural Mill has an annual production capacity of 3,65,000 tons, and its main products will be rails, both broad and narrow gauges, components of railway sleepers and heavy structurals like beams, girders, channels, angles, etc. The rate of out-put of this mill varies from 30 to 150 tons per hour for different range of products.

The erection of the steel framework of the mill weighing 16,000 tons was started about a year back and erection of the mechanical and electrical equipment weighing 19,000 tons was started in January, 1960. The mill has been designed on uptodate technical standards, and incorporates most advanced Soviet technological processes and methods of production based on the operations of the best steel plants of Russia. It has a large number of automatic devices, controls and measuring instruments etc. There are 1,151 motors in the mill. The capacity of all the electrical machines of this mill combined together is 95,000 H.P.

UNIQUE EVENT

A unique event took place at Bhilai on December 30, 1960, when a number of the remaining units of the Steel Works were simultaneously inaugurated by Dr. Kailash Nath Katju, Chief Minister of Madhya Pradesh.

The units inaugurated on December 30, 1960, were the third and last Coke Oven Battery, the third and last Blast Furnace, the fifth Open Hearth Furnace for making steel and two bye-product plants, namely, the Benzol Rectification Plant and the Coal Tar Distillation Plant.

PRESENT TARGETS

The Bhilai Steel Works are at present planned to produce annually one million tons of steel, which will be rolled into 770,000 tons of various commercial products like rails and railway sleepers, beams and other heavy structural sections, rounds and flats and billets for rerolling mills etc.

In addition, the Steel Works will also produce 300,000 tons of pig iron for sale to foundries in India and for export.

COKE PLANT

The Bhilai Steel Works have three Coke Oven batteries, each having 65 ovens for preparation of coke from coal. Two of the batteries were commissioned during 1959. The third and last battery was commissioned on the 27th December 1960. Each battery produces about 1,000 tons of coke daily and the three batteries together will produce 1,145,000 tons of coke annually. The annual coke requirements of the Bhilai Steel Works have been estimated at 1,100,000 tons and the balance of 45,000 tons will be available for sale to the market.

About two million tons of coal will be required annually by the Bhilai Steel Works for production of coke.

For the Bhilai Steel Works, coking coal is received from Jharia and Kargali.

Coke Oven Battery No. 3 of the Bhilai Steel Works commissioned during the last week of December 1960.

BYE-PRODUCTS

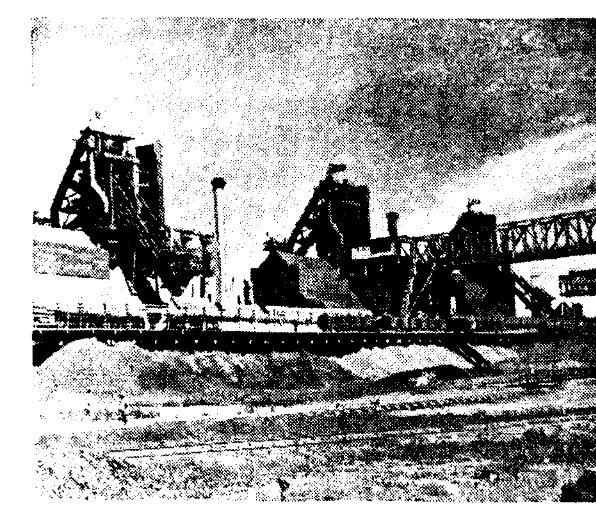
The three batteries together will give annually 60,000 tons of bye-products from the coke oven gases including 44,500 tons of tar, 16,300 tons of ammonium sulphate, 100 tons of phenoletes, 9,000 tons of light oil and 1,600 tons of crude benzol.

All the bye-product plants of the Steel Works were completed and commissioned during 1960. The bye-product plants are the Ammonium Sulphate Fertilizer Plant, the Benzol Rectification Plant and the Coal Tar Distillation Plant. There is also a Sulphuric acid plant for preparation of sulphuric acid which is required for making ammonium sulphate fertilizer for coal gases. This plant was commissioned a year back.

BLAST FURNACES

Three blast furnaces for production of pig iron from the iron ore at Bhilai were provided for. Two of these furnaces were commissioned in 1959. Third and last furnace went into operation on the 30th December, 1960. Each blast furnace produces about 1,000 tons of pig iron daily. The three blast furnaces together will produce 1,110,000 tons of pig iron per year.

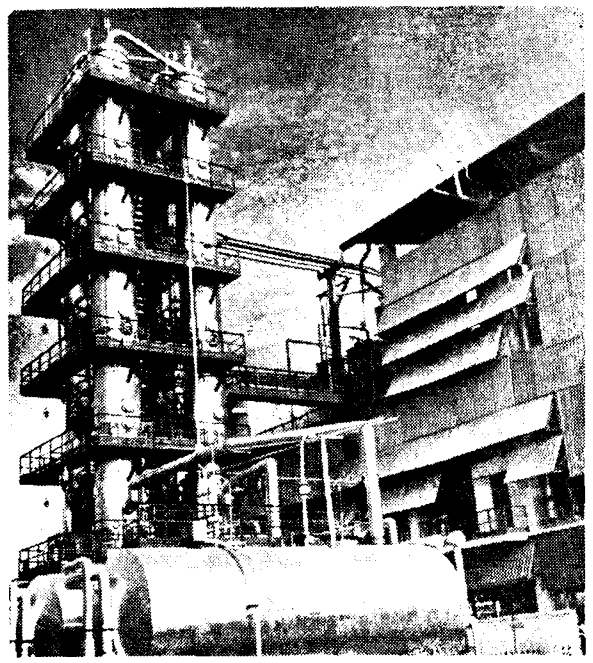
The Bhilai Steel Works receive their iron ore requirements from Rajhara, about 55 miles south. Two and a half million tons of iron ore will be required annually. The Rajhara iron ore is one of the best ores in the world with iron content of 62 to 67 percent and lower contents of silica and alumina. It is Hematite with small quantities of Magnetite.



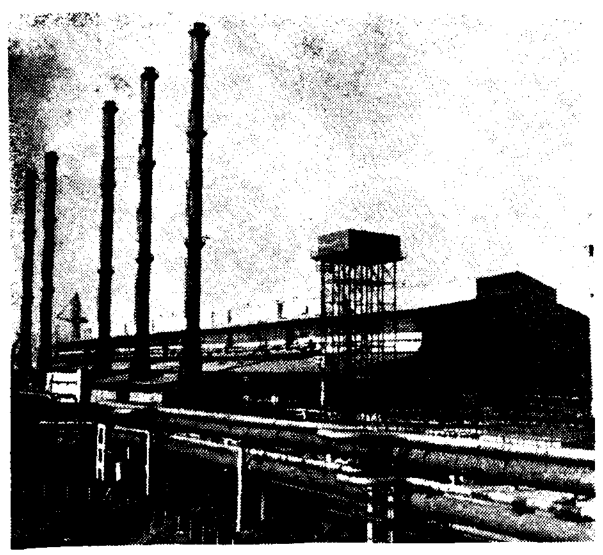
The Blast Furnace Plant of the Bhilai Steel Works. Picture shows all the three furnaces in operation.

OPEN HEARTH FURNACES

The conversion of pig iron into steel at Bhilai is done in the open hearth furnaces.



Benzol Plant of the Bhilai Steel Works commissioned during December, 1960.



Steel Melting Department of the Bhilai Steel Works. Six Chimneys stand for the six open hearth furnaces of the Steel Works.

The Bhilai Steel Works will have six open hearth furnaces of 250 ton capacity each. Two of these furnaces were commissioned during 1959 and three more during 1960. The 5th furnace was commissioned on the 27th December 1960. It is different from the others because it has a roof of basic chrome-magnesite refractory bricks, which lasts longer than silica roof. The 6th and the last furnace is nearing completion. The six furnaces together will produce one million tons of steel.

ROLLING MILLS

The one million tons of crude steel production in the steel-melting department, will be rolled into 770,000 tons of marketable products like billets, rails and railway sleepers, beams and other heavy structurals, bars, rods, etc. For the manufacture of various steel products, the Bhilai Steel Works will have four Rolling Mills. The four mills with annual production targets are as follows :—

		Annual targets in tons
Rolling .. 4 mills.		
Blooming Mill (1,150 mm.)	..	859,000
Billet MIll (700/500 mm.)	..	427,000
Rail & Structural Mill (950/800 mm.)	..	365,000
Merchant Mill (350 mm)	..	255,000

The Blooming Mill, the Billet Mill and the Rail & Structural Mill have now been commissioned. The Merchant Mill, last of the four Rolling Mills will be commissioned in the first month of the New Year. Hot trials have already been started.

MINES

The iron ore mine at Rajhara and the limestone quarry at Nandini have been fully mechanised. The mechanised iron ore mine was inaugurated on October 31, 1960, by shri Jagjivan Ram, Union Minister for Railways and it will supply 7,000 tons of iron ore daily to the Steel Works at Bhilai.

RAJHARA MINE MECHANISED

Iron ore is the principal raw material required for the manufacture of steel. The prospected deposits of iron ore in the Rajhara hills have been estimated to be of the order of 114 million tons. The hills are spread over a length of about four miles and go up to a height of about 1,920 feet above mean sea level. Huge power shovels and drills have been erected on the top and a crushing and screening plant installed on the slopes of the hill.

Rajhara is linked with Bhilai by a broad gauge railway line.

NANDINI LIMESTONE MINE

The mechanised limestone mine of the Bhilai Steel Project at Nandini 14 miles north of the steel works also went into operation a few months earlier.

Limestone is another important raw material required for the production of pig iron and steel.

The limestone deposits in the Nandini mine have been estimated at 27 million tons upto the depth of 175 feet. The equipment installed at the mine includes boring machines in the quarry for blasting, and elaborate crushing and screening plant, and stock pile, and shovels for loading. A nine kilometre long rail line has been laid through the quarry upto the crushing plant. Power shovels are being employed for loading the limestone into wagons, both at the quarry and at the stock pile near crushing plant, for finally loading wagons with limestone for despatch to Bhilai.

The sintering plant, which was the last of the units taken up for construction would be commissioned before the end of this financial year.

Erection of heavy structurals and equipment has completely changed the landscapes at Bhilai, Rajhara and Nandini.

PRODUCTION

The first iron was made at Bhilai on the 4th February, 1959, when the Works' first Blast Furnace was inaugurated by President Rajendra Prasad. The production of steel was inaugurated on the 12th October 1959, at the hands of the Soviet Ambassador in India, Mr. I. A. Benediktov.

Production upto 31-12-1960 :

			production (tons)
1.	Pig iron	..	9,82,001
2.	Steel ingots	..	3,47,227

Despatches upto 31-12-60

1.	Pig iron	6,64,620
2.	Steel billets, beams, etc.	2,68,525

Bhilai had exported about 96,000 tons of pig iron and 15,000 tons of billets to Pakistan, Japan and United Kingdom upto the end of December, 1960.

SALES

The total sales from Bhilai upto the end of December, 1960 amounted to Rs. 27.60 crores, of which nearly two crores were in the form of foreign exchange. A sizeable amount of about two crores of rupees had been contributed to the public revenues as excise duty on iron and steel, royalties on minerals, sales tax duty on electricity and the like. The railway freight on incoming raw materials and despatch of iron and steel amounted to over six crores of rupees.

END OF A PHASE

Thus, the Project which existed on paper only four years ago, has taken concrete shape. Nearly five lakh tons of machines and equipments brought across the seas from Russia in 168 ships, have been erected and have started to contribute towards national prosperity.

RESEARCH AND CONTROL

A Research and Control Laboratory has been established in the Bhilai Steel Works to control the performance of each unit of the Steel Plant, and to give guidance in the preparation and standardization of raw materials in order to achieve the maximum output of quality goods at the minimum cost. The Research and Control Laboratory Building occupies a significant position in the sky-line of the Steel Works, symbolic of its vital functions. The Laboratory has been built and equipped at a cost of roughly Rs. 85 lakhs, and has a total floor area of 7,000 sq. meters. The Laboratory which was inaugurated by Sardar Swaran Singh, Union Minister for Steel, Mines and Fuel on the 1st December 1960, has been conceived, planned and equipped by the Technical Organisation of the Government of USSR on the most modern lines incorporating the latest technological methods in the field of research and control.

Besides this Central Institute, smaller Laboratories have also been set up at various Units of the Steel Works wherever it is necessary. These self-contained stage Laboratories called "Express" Laboratories, serve the essential operational requirements of the respective Shops where they are located. These Laboratories analyse the samples of various materials and gases for the guidance of production staff.

The Research and Control Laboratory will not only facilitate the production of metal of the highest quality, but will also help the new and growing Steel Plant at Bhilai to keep pace with the latest developments in the technology of iron and steel making, and stimulate research of benefit to the metallurgical industries. The elaborate equipment and instruments provided in the various sections of the laboratory would be available for research and applied investigations, besides routine work. Development of instruments for automation of different processes in the Steel Works could also be carried out. Facilities are planned for a Research Bureau with a Statistical Group, Reference Library, Archives, etc.

EXPANSION

As the erection of the huge Steel Plant comes to an end, it has been decided to expand the Steel Works' capacity to 2.5 million tons per annum. This task will be undertaken in the Third Five Year Plan. This will necessitate the erection of some more batteries of coke ovens, Blast Furnaces, Open Hearth Furnaces and an additional Wire and Rod Rolling Mill. The preparation of a detailed Project Report for the expansion scheme is already in hand. Arrangements are being made to enable the Indian engineers who have worked at Bhilai and gained familiarity with the intricacies of the Steel Works, to associate themselves in planning and designing the expansion scheme. They will form the nucleus of the designing organisation for the future Steel Works.

SOVIET CO-OPERATION

As is well-known, the Bhilai Steel Works have been set up in collaboration with the Government of USSR. Besides the preparation of the Project Report, designs and drawings, and supplying equipment and materials for the main plant and the mechanised mines, the Soviet Government sent to Bhilai qualified and experienced engineers and specialists. In Bhilai, the Indian Engineers had the largest participation in actual construction and erection of the Steel Works, which provided them opportunities to learn the latest steel technology and to train themselves in the modern methods of construction, erection and operation of the Steel Works. The relations between the Soviet and Indian personnel have always been extremely cordial.

Bhilai has thus built up a powerful construction force of several thousand engineers, supervisors and workmen who will be capable of executing any other similar project here or elsewhere, with minimum foreign assistance.

At the end of December 1960, there were 446 Soviet Specialists and experts working in Bhilai on construction (310) and operation (136). The number today is less than half of what it was twenty months ago. Many more of them who was engaged on erection will return to their homes in the next month or two. Some of the departments of the Steel Works are already being run entirely by Indians, the Soviet experts giving help and guidance when required.

TECHNICAL PERSONNEL

About 700 Indian engineers and workers have returned here after training in USSR.

The Bhilai Technical Institute has been designed to train 1,420 persons annually for operation and maintenance jobs.

EMPLOYEES' WELFARE AND SAFETY

Considerable attention has been paid to labour welfare and workers' safety at Bhilai as would appear from a review of the facilities provided for the employees of the Steel Project.

The Safety Department is responsible for training workers and exercising proper vigilance at work, make them safety conscious, deliver lectures on safety measures and use of safety appliances for workers. For workers who have to work with hot equipments or in front of hot furnaces, gloves, shoes, goggles and aprons have been adequately provided. Salt tablets are distributed to the workers in the summer season.

Safety Committees have been constituted for the various departments where the representatives of workers are also associated. All accidents are investigated into and suggestions made and steps taken to check their recurrence at the works. In the Steel Works, there are a number of first aid posts and two full time dispensaries under the charge of qualified doctors for immediate medical aid.

CANTEENS

For the welfare of workers working in the Plant site, employees' canteens are being organised. Eleven decent spacious welfare buildings have been built all over the Steel Works, which will have canteens, workers' rest rooms, lunch room etc. A few canteens have already been started and are being equipped with proper steel furniture etc.

LABOUR WELFARE

An important step towards increased employee-management association was taken at Bhilai on the 9th December 1960, when the General Manager of the Bhilai Steel Project, inaugurated the Welfare Committee of the Project, comprising of representatives of both the management and the workers. The representatives of the workers on the committee have been nominated by the Bhilai Steel Workers' Union, which is the recognised Union of steel workers in Bhilai. The Union, which is affiliated to the INTUC, has been given recognition by the Madhya Pradesh State Government. The General Secretary of the recognised union has also been nominated on the Housing Accommodation Allotment Committee of the Project so that the workmen's point of view is available to that Committee.

PROVIDENT FUND

According to Contributory Provident Fund Scheme, the Project contributes $8\frac{1}{3}\%$. This scheme is compulsory for all employees in regular establishment after completion of one year's service.

TRANSPORT

About forty buses are being run by the Project for transporting the workers from their residences to the worksite and vice-versa. For the time being, these buses are being subsidised to the extent of 50 percent by the Project in order to make the bus service as cheap as possible to each and every worker.

About 10,000 persons would be required to run these Steel Works after completion of the construction phases. In order to accommodate these workers, construction of 10,700 permanent quarters has been sanctioned for Bhilainagar. More than 6,000 quarters have already been completed. But over 2,000 of these quarters are at present in the possession of construction personnel. As construction draws to a close, more of these quarters will become available for those working in the Plant. Amenities like shopping centres, cinema and club etc. are being provided. In addition about 6,000 temporary tenements and hutments have been built for construction workers in four camps.

MEDICAL

Medical aid to the Project employees and their families is free. Two hospitals, six dispensaries, two maternity centres and two health centres are at present functioning. A mobile dispensary goes round the construction camps and other distant areas regularly. The construction of a 270-bedded hospital is expected to begin very soon. A Nurses' Hostel near the main hospital site together with doctors' quarters are already under construction. The hospitals provide for all types of specialised treatment.

PUBLIC HEALTH

There is a separate Public Health Department for looking after sanitation of the Township and the Labour Camps, anti-malaria and anti-epidemic campaigns and disposal of unclaimed dead bodies.

EDUCATION

Education for the children of the Project employees is well provided and is free upto the age of fourteen years. Four sets of uniforms and one pair of shoes are given to each student of Primary school free of cost. There are at present one Higher Secondary School, two Middle Schools, and 10 Primary Schools with a total enrolment of over 4,600 students. Besides this, in all the labour camps, Bal Mandirs are functioning where children of pre-primary standard are admitted and elementary education is imparted to them through whole time paid teachers.

OTHER WELFARE ACTIVITIES

There are a number of clubs and playgrounds, children's parks in different sectors. The Mahila Samaj, an organisation of women is working for the welfare of women and children. The Mahila Samaj runs an Udyog Kendra for the purpose of training in stitching and knitting and undertakes orders for making uniforms for schools, security guards, peons etc. which enable the wives of the Project employees to supplement their family income.

AMENITIES FUND

The General Manager has an Amenities Fund of about Rs. 25,000/- for the year at his disposal. The amount is distributed through the Amenities Committees and Sports Committees, etc. for various activities arranged from time to time.

Inauguration of the Bhilai Rail and Structural Mill*

By *N. C. SHRIVASTAVA*
General Manager, Bhilai Steel Project

IN December 1957, Bhilai had the honour of welcoming Prime Minister Nehru and showing him how the construction work had been started. At that time, most of the buildings were only in the foundation stage. Just a few structures had come up above the ground level and production was a distant target.

The Steel Works have since then grown up fast and taken practically full shape. Many of the major units have gone into production. In the two years and ten months since the Prime Minister's last visit, all Bhilai workers—both Russians and Indians—have toiled hard in a cordial and friendly atmosphere and built up this giant factory.

As a result, we have reached the closing phase of construction. The last of the three coke oven batteries was lighted up in the second week of October last. When it begins to make coke in December 1960, the last of the three blast furnaces will be started. More pig iron will then become available, and the remaining two of the six open hearth furnaces will be commissioned with increase of steel production. The fourth and the last of the rolling mills—the merchant mill—will start in January 1961. Thus, before the end of the Second Five-Year Plan period, the one million ton steel plant will be completed, and be in production.

The Steel Plant has already begun to convert the natural wealth lying dormant in the ground into the much needed iron and steel for the country's industrial prosperity.

Though the first iron was made at Bhilai just one year and eight months ago in February 1959, we have already fed into the Indian industry over 5 lakh tons of iron and about two lakh tons of steel made out of the local mineral wealth. The total sales from Bhilai amount to Rs. 22 crores, of which Rs. 1.86 crores were in the form of foreign exchange. Besides, a sizeable sum amounting to nearly rupees two crores has been contributed already to the public revenues as excise duty on iron and steel, royalty on minerals, sales tax, duty on electricity and the like. In addition, the railway freight on incoming raw materials and despatch of iron and steel amounts to over rupees six crores todate.

These are the direct tangible results of the operation of the Bhilai Steel Works during the last year and a half. Besides, the many indirect benefits in the shape of new avenues of employment, and the increased tempo of trade and business in the area and in the national economy, need hardly be mentioned.

In the coming months, the plant efficiency is expected to increase rapidly, as there will be distinct improvement on all sides. For instance, our young technicians, operatives and skilled workers will gain more experience and the organisation will also be built up more fully. Secondly, the raw materials supply will improve because of the mechanisation of iron ore and limestone mines. Thirdly, the piecemeal starting of the various units of the plant as each got ready was attended with many difficulties, but the plant is now fast approaching the ideal of a fully integrated unit which would function with maximum efficiency.

The rail and structural mill will make 365,000 tons of finished products per year consisting of rails, beams, girders, channels and other structurals. It is half a mile in length from end to end. Erection of the 16,000 tons of structures of this mill was started just over a year ago. Erection of the mechanical and electrical equipment totalling about 19,000 tons commenced in January 1960. This erection work has been done departmentally under the supervision of the young engineers of the Project helped by the Russians.

Our Russian friends and workmen both at Bhilai and in Russia have extended most valuable help in constructing the plant and manufacturing, supplying and installing all the complicated equipment. They have given their advice and guidance very freely and our technicians have greatly benefited by this friendly association.

Bhilai has built up a powerful construction force of several thousand persons which is capable of executing any large project here or elsewhere with minimum of foreign assistance. Bhilai will undertake the new task of expansion to 2.5 million ton capacity (contemplated under the Third Five-Year Plan) with the same ardour, perseverance and diligence which have characterised the execution of the present one million ton programme.

* Extract from speech delivered at the Inauguration of the Bhilai Rail and Structural Mill.

How Rourkela Grew up

TODAY, in the State of Orissa there is a hum of industrial life, where, only a few years ago, there was only a small jungle village of 140 inhabitants hidden away from all hustle and bustle. From New Rourkela a wide road winds its way through a chain of mountains to the iron and steel works built by Indians and Germans.

ROURKELA—AN IDEAL LOCATION

Rourkela is located on the Calcutta-Bombay main line. Hence it has excellent communications. The area around Rourkela is rich in mineral resources, and the Barsua ore deposit--the main ore supply source for the iron and steel works—is only 50 miles away and situated in the so-called Iron Belt. Having an Fe-content of 58 to 64% the iron ore found there is one of the richest in the whole world.

Furthermore, the coking coal required for the metallurgical processes in the plant is mined in the Kargali-Jharia district, located about 186 miles from Rourkela, limestone is won in Purnapani, and dolomite found in abundance about 20 miles from Rourkela. Supplies of manganese ore can be obtained from the Orissa mines which are quite near. Finally, the iron and steel works' water requirement is covered by the Brahmani, formed by the Koel and Sankh rivers near the town.

All these factors help to make Rourkela an ideal location. But the choice of Rourkela as a new industrial centre was due to one further important reason. As is well known, the creation of a new industrial centre brings industrial development to large areas of the hinterland, as has so strikingly been demonstrated by the Tata Iron and Steel Company.

BEGINNINGS REACH BACK TO 1948

The intentions to construct an iron and steel works reach back to 1948. Originally the Indian Government envisaged an iron and steel works with a capacity of only 500,000 tons of ingot steel per annum. So as to materialize the project, a consulting agreement was concluded between the Indian Government and the German companies of DEMAG Aktiengesellschaft and Fried Krupp at the end of 1953. These two companies founded the Indiengemeinschaft Krupp-Demag to realize this large project. In January 1955 the consortium submitted to the Indian Government a project report based on a planned production of 500,000 tons of ingot steel per year. Very soon it became clear, however, that the estimates of India's future requirement of steel were on the low side. As a result, the planned capacity of the Rourkela iron and steel works was increased to 1 million tons of ingot steel in 1955. This increase to twice the previous figure made it necessary, in July 1955, to conclude a supplementary agreement with the consortium to expand the capacity from 500,000 to 1 million tons of ingot steel which, of course, required new planning.

The revised project report was then submitted as early as December of the same year and approved by the Indian Government in January 1956.

The majority of the supply contracts with 36 German main contractors was signed between April and October 1956. Further contracts were signed in the following years. The number of German sub-suppliers was estimated at 3,000. About 60 Indian civil engineering, fabrication and labour contractors participated in the construction of the Rourkela iron and steel works. They, too, relied on a very great number of Indian sub-suppliers. Construction work could commence.

AN IRON AND STEEL WORKS ON A "GREEN FIELD SITE"

215,330,000 cubic feet of earth had to be moved to prepare an area of about 64,200,000 square feet for the foundations of bays and plants. 30,711,000 cubic feet of reinforced concrete went into the foundations and 355,000 tons of structural steelwork, machinery and equipment had to be unloaded from ships at Calcutta. Construction work in Rourkela progressed speedily. Some of the more important milestones in its construction are set out below.

The first coke was produced at Rourkela as early as December 1958. The first of the three blast furnaces was blown-in on February 3rd, 1959, in a ceremony attended by the President of India, Dr. Rajendra Prasad.

In December 1959 the first LD converter and the tonnage oxygen plant, incidentally India's largest, were commissioned. The rolling mill bay went up in the record time of 17 months. Extending over a length of 3,069.6 feet and a width of 1,075.2 feet at its widest point, this bay is the largest covered rolling mill bay in the whole of Asia. To mention only one item, 45,000 tons of structural steelwork were used in its construction.

For the design and supply a number of important German firms formed a Consortium with DEMAG as the leading partner. 42 cranes with capacities ranging from 10 to 150 tons were installed in the bay. The wide strip mill supplied by DEMAG is the hub of the entire rolling mill. It will roll 600,000 tons of steel per year.

THE IMPORTANCE OF STEEL

Steel is in urgent demand wherever men are seeking to achieve rapid economic expansion, wherever they are forging ahead with technical progress.

Without steel, the world would not be the world we know. What would the world look like today and what would its history have been, if there were no iron or steel? We do not even know who discovered iron. We *do* know, however, that without iron and steel, man would still be where he was thousands of years ago. Civilization would have reached only a primitive stage of development; men would have no machines and no means of carrying on international trade; his capacities to resist the forces of nature would be greatly diminished.

STEEL MEANS PROGRESS

The history of steel is in fact therefore the history of the development of civilization, and leads us direct to our modern technical age. The very fact that the historians have designated a whole age with the epithet iron age shows how significant iron is from the historical stand-point.

The raw materials, coal and iron ore, have evolved naturally over the centuries. They are mined in the gloom of the pit-face, in the dust of the ore mines, and are processed into steel, to serve mankind in a thousand different forms.

Primeval forces seem to be at work when, at the steelworks, amidst fire and smoke, pig iron is transformed into steel, and when in the rolling mills the glowing steel ingots are shaped under mighty pressure into sheets and sections, to be manufactured into thousands of different types of goods.

ROURKELA'S OUTPUT: 1 M. TONS

Now that Indian steelworks have reached their full capacity, they produce 6 million tons of steel per year. In 1954 the figure was a mere 1.6 million tons. Such an increase is a remarkable achievement over such a short period of time. India's most modern steelworks at Rourkela, the product of Indo-German co-operation, has alone an output of 1 million tons. DEMAG's engineers designed and built the wide strip mill at Rourkela, which forms the heart of the entire works. It will be capable of rolling 1 million tons of steel per year into strip. This is the first wide strip mill in India and the most modern rolling mill in the whole of Asia.

* * *

EUROPE'S LARGEST OPEN-HEARTH FURNACE READY FOR OPERATION

Europe's largest open-hearth furnace built at the iron and steel works in Krivoi Rog, the Ukraine, will start operating within a few days.

The new furnace will produce much more metal than most efficient open-hearth furnaces already in operation in the USSR. Natural gas and oxygen will be used in steel smelting.

The entire process of steel smelting is mechanized and automated. Approximately 200 electronic devices installed there will control, without man's interference, different production processes including those which were uncontrollable until recently.

The computing devices will determine exactly the quantity of fuel needed for smelting, will automatically maintain the needed heat regime—all this will help to intensify steel production considerably.

The giant open-hearth furnace will be serviced by Soviet-made automatic charging units, powerful laddling cranes and laddles, the biggest in the world steel industry. Yet another open-hearth furnace of this type will be commissioned at the Krivoi Rog Iron and Steel Plant. Several more huge furnaces are to be built there in 1961.

Indo-British Cooperation at Durgapur Praised

STEEL MINISTER INAUGURATES
SECOND BLAST FURNACE

THE second blast furnace of the Durgapur Steelworks was Commissioned on 2-2-61 by Sardar Swaran Singh, Union Minister for Steel, Mines and Fuel.

The Minister operated a lever and hot blast blew into the furnace starting operation. The furnace will produce 1270 metric tons of iron daily.

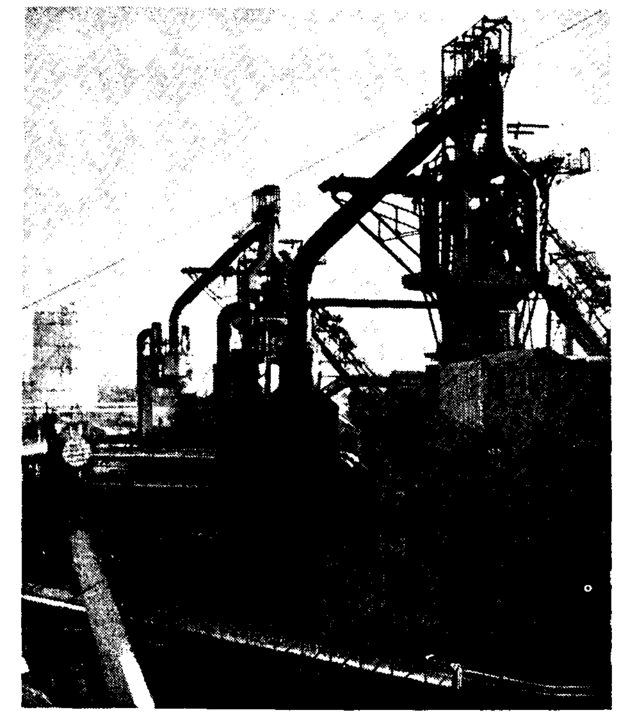
Performing the ceremony, the Minister said that the Durgapur Steel Project would be completed almost according to schedule, which was not an easy matter considering the number of difficulties the Project had to face. It was an achievement, he said, of which any Indian could be proud of and about which any Britisher who had in any capacity helped the construction or operation of the Steelworks could be happy.

He said that commissioning of other parts of the Steelworks also would be done this year and the expansion programme would be taken up.

Sardar Swaran Singh said that it took more time to produce a trained worker than to construct an integrated steelworks. The successful operation of Durgapur Steelworks which was inaugurated one year ago, indicated the progress towards that end.

The Minister appreciated the willingness of the educated engineer to learn more and the keenness of the worker to learn as much as he could.

The first blast furnace inaugurated on December 29, 1959, by Dr. Rajendra Prasad, the President of India, had been producing very well and during the last few months exceeded the rated capacity of 1270 metric tons daily.



The Second Blast Furnace of Durgapur Steelworks with first Blast Furnace and Gas Holder in the background.

He praised the British cooperation in the Project both in the construction and operation and said that the historical advantage of easy communication through English language was pressed into very good use at Durgapur. He thanked Sir John Wrightson, the head of the British firm which had erected the blast furnaces, for his presence and for the good work done.

The Minister agreed to a suggestion of giving suitable names to the blast furnaces and said the Chairman and General Manager would take action accordingly.

RAW MATERIAL POSITION

Welcoming the Minister, Shri P. C. Neogi, General Manager of the Durgapur Steel Project, said that the commissioning of the Second Blast furnace was an important step in the progressive march of the Project. The intensive activity of three years bore fruit last year when the first blast furnace was inaugurated by the President of India. The commissioning of the second furnace pointed to the fact that the raw material position had become easy comparatively. Shri Neogi, however, cautioned that there could not be any complacency as the third blast furnace had to be started soon.

Shri J. M. Shrinagesh, Chairman of the Hindustan Steel, which is running the three public sector steel projects, conveyed his best wishes to those who were responsible for construction and operation.

Durgapur Steelworks, with its three blast furnaces, eight steel-making open hearth furnaces and rolling mills to produce 7.9 lakh ton of finished steel products is scheduled to be completed by the end of this year. Already two coke oven batteries, one blast furnace, three open hearth furnaces and the blooming and billet mills have been operating. The plant when fully commissioned will produce one million ton of ingot steel per year. The steelworks will be expanded to 1.6 million ton production capacity during the Third Plan.

MACHINE TOOL FACTORIES

The Minister of Industry, Shri Manubhai Shah, stated in the Lok Sabha that the German Democratic Republic (East Germany) had offered to collaborate in setting up a machine tool factory. Shri Shah, who was replying to a question by Shri P. C. Borooah and three others, added that a draft agreement had been drawn up setting out the terms of collaboration and that the agreement was proposed to be signed in East Germany after an Indian delegation had visited the Leipzig Fair. The delegation would also select the class of equipment, which would be taken up for production in the new factory with East German collaboration.

Sri Shah also said that a Calcutta firm, recently licensed for manufacture of machine tools, had put up a proposal to enter into technical collaboration with an East German firm for the manufacture of lathes. The proposal was being examined.

Shri Shah further stated that the question of setting up two medium type machine tool factories in the public sector during the Third Five Year Plan was under consideration. The Hindustan Machine Tools Limited had been entrusted with the task of drawing up projects for setting up these factories. The estimates of costs, selection of sites, etc. were under examination by the Hindustan Machine Tools.

BHILAI STEEL PROJECT

By *N. C. SHRIVASTAVA*
General Manager, Bhilai Steel Project

BHILAI is an outstanding example of what our people, encouraged by the enlightened national Government, can accomplish.

India became free thirteen years ago. This brought in new awakening. The country has vast natural resources, and nature is bountiful. Yet hunger and poverty, dearth and disease prevail. By the application of science and technology to agriculture and industry, and development of multi-purpose projects through a series of Five-Year Plans, the country is fast marching towards prosperity.

The Five-Year Plans aim at speedy development of heavy industries. For this an abundant supply of iron and steel is essential. The expansion of iron and steel industry was, therefore, given pride of place in the Second Five-Year Plan.

BHILAI WORKS

Of the many projects taken up since independence the Bhilai Steel Project is a monumental one. Together with Rourkela and Durgapur, Government launched the Bhilai Steel Project to meet the country's need for iron and steel.

The South-eastern region of Madhya Pradesh had been known for its vast natural resources. The Rajhara hills, 55 miles south of the present steel works, with their huge deposits of iron ore, have been lying unexploited for ages past. The Rajhara ore has been adjudged as amongst the best in the world, with high iron content.

There are large deposits of limestone at Nandini, a few miles north of the Steel Works. Also manganese, dolomite and other necessary minerals are found in adjacent areas. An abundant and perennial supply of water is available in the irrigational canal and river systems.

The erection of the Steel Works at Bhilai, therefore, enables this hitherto unexploited natural wealth to be converted into iron and steel, much needed for the country's industrial advancement.

MEMORABLE DAY

The 4th February, 1959, will remain a memorable day for Bhilai. That day witnessed the inauguration of the Steel Works' first blast furnace for production of pig iron at the hands of our respected President, Dr. Rajendra Prasad.

The 12th October, 1959, was another big day for Bhilai. On that day, the production of steel started in the first of the six 250-ton capacity open hearth furnaces. Incidentally, this was for the first time in the public sector that a furnance of such a large size started to produce steel.

Since then, several more units of the Steel Works have gone into production one after another.

Two of the four Rolling Mills of the Steel Works were put into operation last year. On the 24th December, 1959, which was again a red letter day for Bhilai, Sardar Swaran Singh, Union Minister for Steel, Mines and Fuel, inaugurated the production of billets and the first wagons containing these billets, rolled in Bhilai, were despatched in his distinguished presence.

PRODUCTION FLOW

For the last one and a half years, the products of Bhilai have been moving out steadily to the foundries all over India, to be made into articles of every day necessity. Steel, rolled into the form of billets, is also being supplied in large quantities to the rerolling mills in the country.

Pig iron and steel produced at Bhilai are being used for making railway sleepers and railway engine components, sewing machines, fans, cycle parts and hundreds of other articles of every day use.

Bhilai iron and steel have been sold to foreign countries besides meeting the needs of the Indian consumers.

The rail and structural mill, the third of the four rolling mills included in Bhilai plan, has just been put into operation for production of beams, girders and rails. Soon after, the fourth and the last of the rolling mills, will be commissioned.

END OF A PHASE

Thus Bhilai has now reached the closing chapter of the construction phase. The Project which existed on paper only three and a half years ago, has taken concrete shape. Nearly five lakh tons of machines and equipment brought across the seas from Russia in 168 ships, have been erected and have started to contribute towards national prosperity.

NEW EMPLOYMENT AVENUES

Bhilai has opened up avenues of industrial development and economic prosperity. A predominently agricultural area is now humming with industrial activity. Opportunities of gainful employment have opened up in the steel works and its mines, as also in the various subsidiary industries around Bhilai. Boys passing out of the industrial training institutes in this area finds ready at hand opportunities for further training and absorption. Students of neighbouring engineering and mining colleges find facilities for practical training at the Steel Works and the mines.

Public revenues will earn substantial amounts in the shape of royalties on minerals and of various taxes, and excise, electricity and other duties, not only in connection with production at Bhilai Steel Works, but also through the activities of the numerous subsidiary industries which the presence of the Steel Work is attracting.

FUTURE PROSPECTS

A giant project like the Bhilai Steel Works takes a good deal of time in planning and erection. In Bhilai progress has been rapid. All the components of the one-million ton capacity Steel Works at Bhilai, along with their mechanised mines at Rajhara and Nandini, are expected to be put into operation before the end of the second Five-Year Plan period.

As the present construction phase is coming to an end, there are already plans for expansion under the Third Plan. Preparation of a detailed project report in this respect is already in hand.

SOVIET CO-OPERATION

In the task of building the Steel Works at Bhilai, valuable assistance has been received from the Government of USSR. Besides the preparation of the Project Report, design and drawings, and supplying equipment and materials, the Soviet Government sent to Bhilai highly qualified and experienced engineers and specialists. It was largely their friendly co-operation and the mutual goodwill between the Indians and the Russians that enabled the young Indian engineers to pick up the latest steel technology and to train themselves in the modern methods of construction, erection and operation ef the Steel Works. The relations between the Russian and Indian personnel have always been extremely cordial.

MADHYA PRADESH ASSISTANCE

Active co-operation and help from the Madhya Pradesh Government and its various agencies have been readily given, and but for this, rapid progress could not have been achieved. It was the vision of the late Chief Minister of Madhya Pradesh, Shri Ravi Shankar Shukla that was responsible for the selection of Bhilai as the site for the Steel Plant. The Governor of Madhya Pradesh, Shri Pataskar, and the Chief Minister Dr. Katju, have always been keenly interested in the progress of Bhilai and have given every encouragement to the workers at Bhilai—both Russians and Indians.

SYMBOLIC LABOUR

Bhilai does not merely mean iron and steel. Bhilai is a symbol and a tangible result of the laborious effort of the people of an independent nation conscious of their responsibility to the country. Indian engineers had little experience of the construction of a steel plant, but our young men, engineers, technicians and workers have the necessary calibre to learn, adopt and improve upon the methods of construction, design and technique, and they have risen equal to the task set before them.

Young Indian engineers, who have familiarised themselves with the intricacies of the Steel Works, will be increasingly associated with the planning and designing of the expansion scheme and will form the nucleus of the designing organisation for the future steel plants in the country.

CONCLUSION

The Bhilai workers are proud of having this opportunity of participating in the nation-building task. They have crossed difficult hurdles and accomplished a formidable task. The closing stage of the construction phase has at last been reached. Further tasks have, however, yet to be completed. The first of these is to get the highest possible production from the Plant. The second is to put through the programme for the expansion of the Plant to 2.5 million tons of steel. Both these task will be approached with quiet confidence in a spirit of humility and service.

HIGH SPEED STEELS

By A. C. BHATTACHARYA, A.M.I.P.E., A.M.I.Loco.E., A.M.A.I.I.E.

Steel is playing a vital role in the industrial development conceived in the Five Year Plans that are blueprinting a new era of prosperity. High Speed Steels provide an important essential in this context particularly in the development of the far reaching machining techniques.

Production speed, product quality, and economy depend on one single factor—the tooling in the machine and a tool is only as good as the steels used in making it.

THE development of high speed steels reduced a serious obstacle to the efforts of production engineers by making it possible for the tool maker to meet a great variety of specific production problems, and undoubtedly was responsible in a large measure for the phenomenal progress of industry since the turn of the century.

High speed steels are distinguished among tool materials by their ability to develop by appropriate heat treatment an outstanding combination of the principal characteristics required in cutting tools, namely, hot hardness, wear resistance and toughness.

COMPOSITION

The commonly used high speed steels contain comparatively large amounts of tungsten or of tungsten and molybdenum, and smaller amounts of chromium, and vanadium, along with carbon. The large amounts of tungsten and molybdenum provide the hot hardness and resistance to tempering which is the dominant characteristic of high speed steel. The presence of chromium and vanadium assists in the formation of complex carbides which, due to their high hardness properties, provide the high wear resistance of high speed steels.

Sometimes cobalt in amounts of 5 to 10% is also added to impart the ability to maintain hardness under heat and thereby to increase cutting efficiency at high tool operating temperatures. Although some loss of toughness is encountered due to the addition of cobalt, for continuous cuts on high tensile material, this proves advantageous.

PRODUCTION

High speed steels are produced by one slag method. The raw materials required are:— (1) Scrap; (2) Alloying elements; and (3) Material for slag.

Scrap:— The selection of scrap needs a very careful consideration as on its quality depend the quality and rapidity of production. A proper analysis of the scrap is a vital necessity. The phosphorous content of the scrap needs to be carefully watched, as it is most difficult to control it in one slag method where there is no scope for changing the slag. In the finished product it is desirable to keep the Sulphur and Phosphorous content below .04%.

Rusted and oily scraps should not be used as they increase the amount of hydrogen. For the same reason, the scrap should be stacked in a dry place.

Alloying elements:— The alloying elements should be free from gases and slag inclusion. They should neither be used in powder form nor in very big sized lumps. In the former case there is the possibility of their being lost as dust or remaining in the slag, and in the case of latter, considerable time will be taken for them to go into the solution.

Ferroalloys generally used are:—

Fe W with the following analysis—Carbon 1.0% (maximum); Tungsten 80.0% (minimum); Manganese 0.5% (maximum) and Phosphorous 0.5% (maximum).

Fe Mo consisting of C. 1.0%: Mo, 60.0% (minimum), Phosphorous 0.05% (maximum), and Sulphur 0.1% (maximum).

Fe V either with 55% V having a melting point of 1450 deg. C or 80% V with a melting point of 1600 deg. C. Fe V with Copper and Phosphorous contents should not be used.

Fe Cr with 0.1% Carbon

Co either added from scrap or introduced as metal having an analysis of Co 98.0%, C 0.10%, P 0.02% and S 0.02%.

Material for slag:—(i) Lime; (ii) Flusspat; and (iii) Reducing agents.

Lime is used after burning it at a temperature of 1000 deg. C. The composition to be aimed at is as under:—

Lime Stone	90.0%
CaO	2.8%
SiO	2.0%
$Fe_2O_3+Al_2O_3$	2.0%
MgO	0.15%
S and CO_2, etc.	Rest

Flusspat is used for making the slag thin and to ensure better reaction. Its composition is:—Ca Fe_2 85.0%, SiO_2 5.0% (maximum), $CaCO_3$ 10.0% and S 0.2%.

Fine powdered cokes, ferro-silicon, calcium silicate and sometimes aluminium powder are used as reducing agents.

PROCESS

The process described is the one using an electric furnace with automatic temperature recording and control. In big furnaces the charging is generally done from the top. Before charging, the furnace hearth is freed from slag and steel unless of course it is not exclusively used for the production of high speed steels. The hearth should not to be too high. When too high the roof life is considerably reduced.

The furnace hearth and walls are then sprayed with sintered dolomite. The placement of the scrap should be done in the following order:—heavy scrap first at the bottom, medium heavy at the middle and light scrap on the top. The advantage of placing light scrap on the top is to enable the electrodes to make bores in the metal.

When the electrodes are lowered down and the transformer is given the highest duty, the scraps in the centre are melted first. To ensure proper melting the furnace is rotated about its vertical axis keeping the electrodes in position.

Just before the melting is completed the current and voltage are decreased and 2 to 3 shovels of lime are added to protect the roof from high temperature. After melting a portion of Fe Mo is introduced. Amount of slag is about 2 to 3% of the weight of the steel.

The slag is then turned into a carbide slag by adding CaO, Coke, FeSi and Flusspat. Their quantities are determined more on a trial basis by putting a small quantity in cold water and observing whether it gives out the smell of acetylene.

Samples are then taken out at an interval of 15 to 20 minutes. The first sample is analysed for C contents and the second for Cr, W, V, and Mo. The deficit of different elements are calculated and quantities as required to make up the deficit are added. The third sample is then taken out and analysed for C and V. A few Kgs of Fe Si is added after which the last sample is taken and the metal tapped at once. Just before tapping 20 to 30 Kgs of sodium carbonate is added in the laddle.

The points which are to be carefully noted are that:—(a) In no case carbon should not be made to increase in the laddle by adding cokes; (b) Slag shoud not be too thin to allow increased slag inclusions in the ingot; and (c) Casting should be at between 1360 to 1380 deg. C.

The quality of ingots obtained depends on the following four factors:—(i) Method of pouring, (ii) Rate of pouring; (iii) the opening of the laddle; and (iv) Ferro-static pressure and the size of the mould.

While top pouring gives a bad skin, the inside and overall picture is good. Bottom pouring gives a good skin but with an increased non-metallic inclusion in the metal within. Since the bad skin can be removed by machining whereas the latter is not so easy to dispense with, the top pouring is generally favoured. The moulds are general cylindrical with big top up.

The rate of pouring should be about 100 Kgs. per minute and the opening of the laddle 25 to 30 mm dia.

THE MANIPULATION OF HIGH SPEED STEELS

The satisfactory performance of tools made from high speed steels depends to a considerable extent on

the manipulation of such steels in smithing, hardening and grinding.

The start with a saw should be used to cut a length of steel from the cold bar. In the absence of a saw, the bar must be cut clean through whilst hot, the point to be cut being heated to a temperature of about 1100 deg. C. It is a bad practice to nick or break the steel as this procedure may cause small cracks which will open during forging and hardening.

The steel should be charged into a cooler part of the furnace and heated slowly and evenly to about 800 deg. C; and then raised more rapidly to the forging temperature of 1100/1200 deg. C. when a smith's hearth is used the fuel must be clean and the blast must be prevented from impinging directly on the steel by keeping a good bed of fuel between the steel and the blast nozzle.

Protective coatings are usually unnecessary, but powdered borax is sometimes sprinkled on the steel as it reaches a red heat.

The soaking time required at the forging temperature to ensure uniformity of temperature throughout the section, is one quarter of an hour per inch of ruling section. Forging should be done while the heat is in the steel and stopped before the temperature drops down to about 850/900 deg. C.; the steel should be reheated and forged as often as is necessary to obtain the desired shape. After forging, the tool should be allowed to cool slowly out of drafts or contact with moisture. Burying in warm, dry ashes, sand, mica, lime, etc. is desirable in order to prevent the development of undesirable internal stresses.

The annealing temperature range is 850—900 deg. C. In order to protect the surface from decarburisation and scaling and ensure uniform cooling, parts should be packed in tubes or other containers in a material such as cast iron chips, lime, sand or mica mixed with burnt charcoal (1 part charcoal to 10 part of other material). The container should be sealed with fireclay and heated slowly to temperature, soaked for 4 to 6 hours or until heated throughout, and then cooled slowly in the furnace to 500/550 deg. C., and thereafter in air or allowed to remain in the furnace until cold, as convenient.

A twin—chambered furnace or pre-heating and final temperature furnaces are required for hardening high speed steels. In the hardening process the steels are preheated slowly and evenly to about 800/850 deg. C in the separate furnace or chamber and then transferred quickly to the other furnace or chamber kept at the hardening temperature ranging from 1250 to 1240 deg. C depending on the type of the steel. This treatment serves to avoid unnecessary and undesirable heat shock and to carry the steel through that range of temperature in which the main volume change occurs, at such a rate that the mass of the steel can accommodate it without building up a too severe internal stress.

The steels should be held only long enough to ensure uniformity of temperature throughout. The following gives an idea of the time required for various sections:

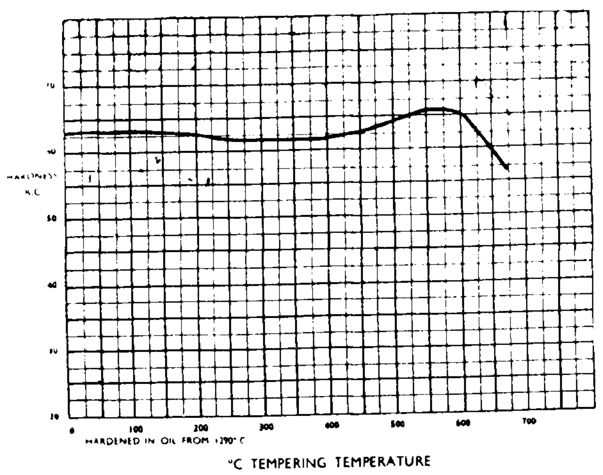
½" round	0 min:	40 Seconds.
¾" "	1 "	00 "
1" "	1 "	20 "
1½" "	1 "	55 "
2" "	2 "	40 "

They should be immediately quenched in oil or air-cooled at the end of the period. Quenching in oil avoids the sealing of the tools during the period in which they are above the sealing temperature, and during which sealing would occur, if the steel were cooled in air.

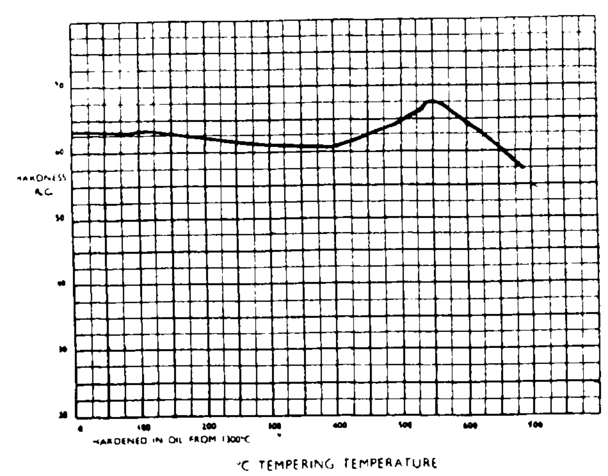
The essential of high speed steel is hardness, particularly the "Red Hardness", that is the capacity of the steel to retain its keen cutting edge for long periods even when the cutting speed is so high that the point of a tool becomes actually red hot. Although it is possible to harden high speed steel by cooling from a temperature of 100 deg. C., when it may have as high a Brinell as when quenched at 1250/1340 deg. C., it is the quenching from the higher temperatures, round about 1300 deg. C., which confers the quality of "Red Hardness".

Although tools will be found to cut well after hardening, a high temperature tempering is given to such tools to relieve hardening strains and to provide a greater and more stable hardness.

Tempering should follow immediately after hardening but not before the tools have cooled down only enough to be touched without discomfort. The tempering should preferably be carried out in a bath of motten tin, lead, or salt, the temperature being maintained at 550—580 deg. C. They should be soaked at that temperature from one to two hours depending on the mass in order fully to dissipate the internal



Graph showing the temperature range of high speed steel of the following composition, C 0.75; W 22.0; Cr 4.5; V 1.20.



Graph showing the temperature range of high speed steel with the following analysis, 0.75 C; 19.0 W; 4.25 Cr; 1.25 V; 5.0 Co; 0.75 Mo.

stress. A double draw is usually desirable for maximum toughness. After the first draw the tools should be cooled fairly slowly to room temperature and then be given the second draw. In some instances, such as when machining steels of a very high tensile strength, it has been found that in the case of high speed steels containing high percentages of cobalt tempering three times at 610 deg. C gives better results. It is preferable that this third tempering be conducted 24 hours later so as to allow the structure to stabilize.

Faulty grinding may be a source of much trouble in the manipulation of high speed steel, specially when emery, carborundum or similar abrasives are used. Hard, close-grained wheels, which become glazed rapidly, should not be used. Because of the local heat generated when using such wheels, surface softness or very fine hair cracks may result. An open-grained, rather soft and oscillating abrasive is the best class of wheel to use.

In the case of high speed tools of large section (e.g. hobs, cutters, shear blades, etc.) it is advisable, prior to grinding, to remove by sand blasting any scale produced during the hardening.

Tools which need heavy grinding should be previously softened. After hardening it is best to finish the tools on a wet sandstone or on an abrasive wheel specially selected for the purpose. The finish grinding should be done without heavy pressure and during the whole process the tool must be flooded with water.

In conclusion it may be stated that no material has been more closely connected with industrial development than steel, and steel has been made possible for exacting strains, stresses, machining and fabricating only by the science of heat treating, which gives it hardness and toughness without brittleness.

Italian Steel Production

On the Italian Riviera one might expect to hear nothing any noisier than the sound of the ocean or of happy vacationers. This is true of much of the Riviera, but in Genoa there are other sounds—those of rapid industrial progress.

Of major importance in this economic development has been the phenomenal growth of Italy's steel industry—much of which is concentrated in and around Genoa. From 1952 to 1958 Italy's production of steel climbed by over 44 per cent—the biggest gain scored by any Western European country. The increase was large enough to put Italy ahead of Belgium as Europe's third largest steel producer.

An important factor in the Italian steel output gain has been the acquisition by the major steel mills of modern equipment which increases productivity. For example, one of the largest companies, Cornigliano S.P.A. of Genoa, bought a number of General Electric (U.S.A.) 65-ton industrial type diesel-electric locomotives in 1957 to speed the movement of raw and finished materials into and out of its plant. Cornigliano has just announced the purchase of four more duplicate units for use in its Genoa mills. These locomotives will be used on a rail line which connects the mill with the bustling port—the largest in Italy.

Roll Types and Applications

BY NORMAN BADDELEY

CAST rolls may be divided into three main classes—Steel, Steel Base and Iron, with carbon content increasing in that order. Cast iron rolls are again subdivided into chilled and grain iron rolls, whilst chilled iron rolls are further subdivided into clear and indefinite chill.

Within each type mentioned there are many variations depending upon chemical composition, hardness or other mechanical and metallurgical properties. It will be convenient for the purpose of this article to deal separately with each type.

CAST STEEL ROLLS

The largest proportion of the world's steel production first appears in the form of ingots for rolling, and almost all of this has first to be rolled into blooms or slabs, usually in large mills utilizing cast steel rolls. It therefore follows that more steel is rolled by cast steel rolls than by any other type.

We usually divide cast steel rolls into two types—carbon steel and alloy steel.

Carbon steel rolls range in carbon content between about 0.4% and 0.85% with hardness varying between about 25° and 35° Shore. It is not possible to go much beyond 0.85% carbon because of the possibility of the formation of graphite within the metal, which can only be suppressed in higher carbon steels by means of certain alloys.

Alloy steel, however, ranges up to about 1.6% carbon and in hardnesses, between about 30° and 55° Shore, occasionally exceeding the latter figure.

As a general rule, the wear resistance of a cast steel roll increases with both hardness and carbon content, but its resistance to breakage, particularly under shock loadings, progressively diminishes. Thus, the lower carbon, low hardness rolls find application at the start of rolling operations where the stock being handled is heavy, and generally undergoes rather severe mechanical working, whilst the higher hardness rolls are used in later stages of rolling where less severe work is done and the rolls are required to keep better shape.

CARBON CONTENT VERSUS HARDNESS

With carbon content and hardness both acting in the same direction, i.e. increasing wear resistance, one might ask which of the two is the more important. In other words, which has the greater wear resistance a low carbon roll of high hardness or a high carbon roll of low hardness?

This question is impossible to answer in general terms as so much depends upon the conditions under which the wear takes place.

A certain degree of hardness is required in a roll in order that it may resist the tendency to deform in a plastic manner, so that its surface and grooves are not literally pushed out of shape. On the other hand, a high carbon content is particularly desirable under conditions of abrasion. Thus, in hot rolling, where drafting is relatively heavy, there is a considerable amount of inherent slip between the rolls and stock caused by the fact that the speed of the ingoing and emergent stock is not the same. The pressure between the rolls, however, may not be high, and under these conditions, carbon content appears to be the more important factor.

At the other end of the scale as, for instance, in the case of a backing up roll for a four-high strip mill, there is little or no slip as the roll is not driven but merely idles. Here, a high hardness is necessary to prevent deformation due to the high pressure between it and the working roll, which it supports over a small contact area. Backing-up rolls seldom exceed about 0.8% carbon and may be as low as 0.3% but with a hardness of up to 55° Shore.

In many cases both a high carbon content and high hardness are desirable. Pilger rolls are a good example of this as the roll performs both a hammering and rolling action in its task of knocking down and rolling out the tube.

Unfortunately, impact loadings arise and consequently one must compromise between wear resistance and strength—two factors which are largely not reconcilable.

ALLOY CONTENT

The softer type alloy steel rolls are alloyed with nickel up to 1%, chromium about 1% and molybdenum up to about 0.35%. The function of nickel in amounts up to about 1% is to confer added strength and toughness. Chromium is an important element in roll-making in that it has a strong tendency to suppress graphite formation in high carbon steel, and materially improves wear resistance and hot strength. Molybdenum is used to prevent temper embrittlement, and its well known action of enhancing the effect of other alloys present is exploited. Like chromium it also improves the hot strength of the steel.

In the harder types of cast steel rolls these elements generally appear in higher percentages, depending upon the hardness required and the diameter of the roll. Very large rolls cannot be cooled very quickly, and thus require higher alloy contents than their smaller counterparts in order to reach a given hardness figure.

Tungsten is often employed as an alloying element cast steel rolls, and other elements, such as Vanadium, may also be added to secure certain properties.

HEAT TREATMENT

All cast steel rolls are subjected to a heat treatment process, the function of which is to improve mechanical properties, relieve residual stresses, and confer the required hardness.

Rolls for hot working are generally annealed or spheroidized, the latter being a treatment which causes the steel to assume a structure consisting of spheroids of iron carbide set in a soft matrix of iron. Annealed and spheroidized rolls are relatively soft, seldom exceeding about 40° Shore, and usually rather lower. Their hardness remains substantially the same right through the section, and they are mainly employed for hot roughing and breaking down work.

A normalizing treatment (i.e. air cooling) followed by tempering is sometimes applied where a rather higher hardness is required, and, if the alloy content is high enough, very high hardnesses can be obtained by air cooling. However, all but the very smallest cast steel rolls must be tempered after air cooling, if only for the purpose of relieving residual stresses, and, as this process does not properly come about below about 500°C, this sets a practical limit to the hardness of conventionally treated cast steel rolls.

In the higher carbon steels, lengthy and complicated cycles of heat treatment may be required in order to ensure that the iron carbide present assumes a desirable form, as this constituent has a profound weakening effect if it is not properly distributed.

APPLICATIONS

One can only generalize on the subject of applications, but Table I will serve as a rough guide.

TABLE I SUMMARY OF CAST STEEL ROLL APPLICATIONS

% Carbon	*Shore Hardness*		
	Below 40	*40–50*	*Above 50*
Below 0.7	Heavy Cogging and Slabbing Rolls		Cold Mill Back-up Rolls
	Roughing Rolls for Rails and Heavy Sections		
0.7–0.85	Billet Roughing Rolls	Hot Mill Back-up Rolls Sheet Roughing Rolls	Hot and Cold Mill Back-up Rolls
Above 0.85	Light Cogging Rolls Intermediate and Roughing Rolls for Rails and Sections Roughing Rolls for Strip Mills	Pilger Rolls Sheet Roughing Rolls Continuous Strip Work Rolls	

It is convenient to divide cast steel rolls into three groups, below 0.70% carbon, which includes the hypo-eutectoid steels, about 0.7—0.85% carbon which are the eutectoid steels and above 0.85% which comprise the hyper-eutectoid steels.

The latter group is characterized by the presence of free iron carbide in their structure, whilst the eutectoid and hypo-eutectoid steels do not have this feature.

Generally, the hyper-eutectoid steels find application in intermediate work, whilst the eutectoid and hypo-eutectoid steels are used where were resistance is secondary to strength.

STEEL BASE ROLLS

The term " Steel Base " is not a good one, for it seems to imply that what is being offered is a substitute for something better. Furthermore, the term does not mean the same in everybody's language. In the U.S.A. all the steel rolls come under the general heading of " steel base ", but certain types of roll manufactured in Britain are called steel by some, and steel base by others.

The reason for this is that steel base is a sort of hermaphrodite between white cast iron and steel, and there is no hard and fast rule by which white iron and steel can be differentiated.

The familiar cast iron, known as " grey iron ", is characterized by a high carbon content, much of which is present in the free form as graphite particles distributed within the metal. Grey iron is thereby readily distinguished from steel. White cast iron, on the other hand, contains all of its carbon combined in the form of iron carbide, as also in the case with steel, and the only difference between these two metals is the proportion of carbon present.

Apart from some tool steels, one seldom encounters steels containing more than about 1.2% carbon, whilst white irons seldom contain less than about 2.5% carbon, thus leaving a gap in the range of iron-carbon alloys in quantity production. Steel base rolls bridge this gap.

It is probably best to regard steel base rolls simply as annealed high carbon alloy steel rolls. They are manufactured in much the same way as steel rolls, and the only difference between them and the more conventional steels is their rather higher carbon content. There are, however, many practical difficulties in casting and processing large masses like rolls in this very high carbon material, and much " know-how ", experience and careful control is required of the roll maker in producing these specialized articles.

It should be acknowledged that steel base rolls originated in the U.S.A. They are a typical example of American ingenuity, decidedly practical and highly productive, and the main producers in Britain operate under American licence.

CARBON CONTENT AND MECHANICAL PROPERTIES

Steel base rolls are graded according to their carbon content. The range of these rolls in production at the works of Armstrong Whitworth (Metal Industries) Ltd., Gateshead upon Tyne, England, for example, commences at 1.2/1 4% carbon and goes up in steps of 0 2% to the highest carbon content of 2.2/2.4%. The remarkably good wearing properties that these rolls possess is due to the presence of a relatively large amount of iron carbide distributed within the metal.

Iron carbide is a very hard white substance readily distinguished under the microscope, and the photographs (Figs. A and B) show the microstructure of the two types of steel base rolls. The white areas are the iron carbides, and it will be readily seen that the

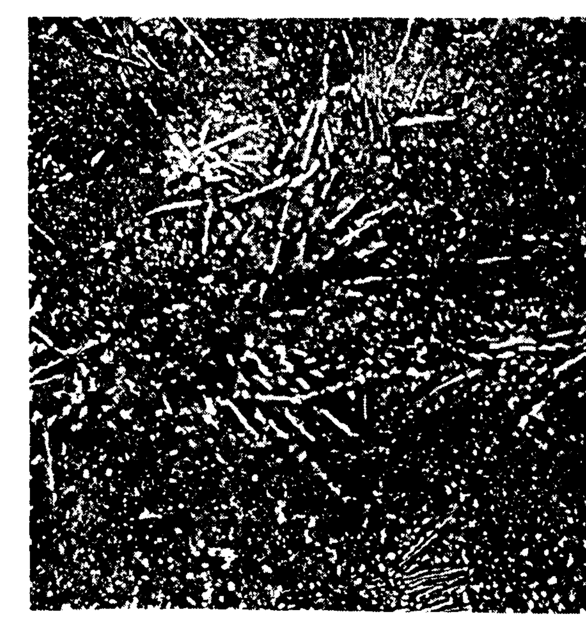


Fig. A. Microstructure of 1.4% Carbon Steel Base Roll
Magnification x 100.

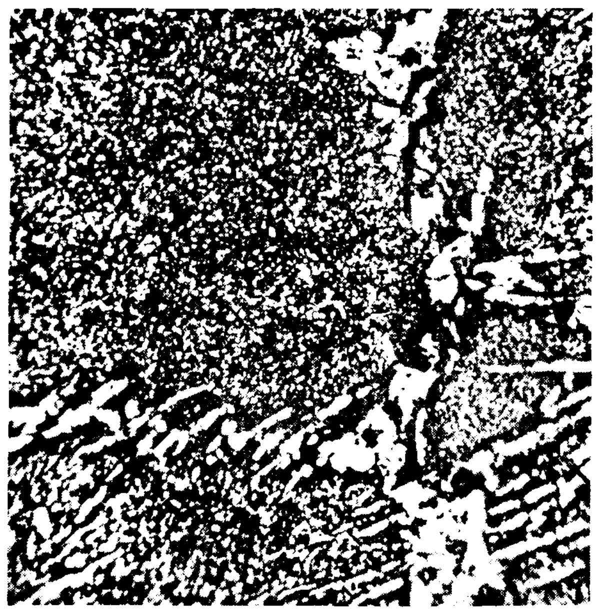


Fig. B. Microstructure of 2.0% Carbon Steel Base Roll Magnification x 100.

higher carbon material contains much more iron carbide than the other.

The strength of a steel base rolls undergoes a progressive diminution as the carbon content is raised, but the wear resistance increases so that the carbon content must be carefully chosen to give the right balance of properties, depending upon the conditions of usage, as I shall describe below.

The hardness of steel base increases with carbon content, but this increase is not particularly marked nor significant. A 1.4/1.6% carbon base roll may have a Shore hardness of about 38°. Increasing carbon upto 1.8/2.0% may give a small increase in hardness up to perhaps 40° Shore, but there will be a marked difference in wear resistance.

ALLOY CONTENT AND HEAT TREATMENT

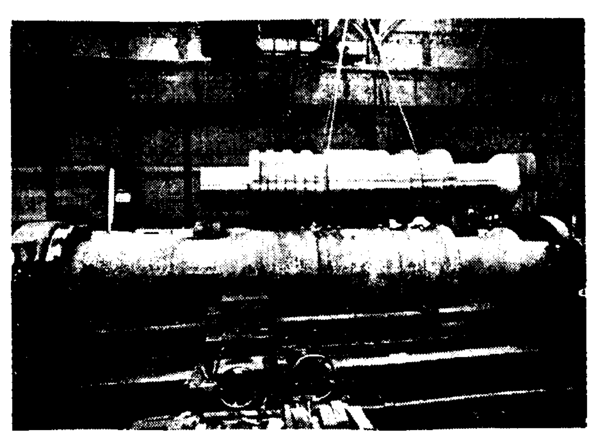
Armstrong Whitworth "Closeloy" steel base rolls are alloyed with 0.5% nickel and 1.0% chromium, a small percentage of molybdenum also being added depending upon requirements.

The presence of chromium is necessary to ensure that graphite is not precipitated within the metal during heat treatment. The heat treatment applied is an annealing process designed to homogenize the structure, and generally cause some softening. The hard iron carbides present exert an embrittling effect of the metal, but this can be offset to a large extent by softening the background material (or "matrix" as it is termed). However, in special cases, for example, where shock loading are not high, the matrix can be made a little harder with advantage. The final stage of heat treatment always consists of cooling in the furnace slowly so as to ensure that residual stresses are kept to a minimum.

SPECIAL PROPERTIES AND APPLICATIONS

Steel base rolls have the very useful property that their hardness and wear resistance are maintained virtually constant throughout the section, so that they find application in rolling heavy sections where deep grooves are required, which would be beyond the limit of the hard zone of a chilled iron roll. Furthermore, these rolls are considerably stronger and more ductile than iron rolls and they can therefore be used where an iron roll would break. Their tendency to "bite" on the stock being rolled is a good deal higher than is the case with iron rolls, and, in mills taking a relatively heavy draft, this property has been exploited with advantage. An interesting example in the experience of Armstrong Whitworth (Metal Industries), Ltd., was a mill rolling 2½ in. billets were trouble, due to slipping, was largely overcome by substituting high carbon steel base rolls in place of chilled iron. In spite of the fact that the steel base rolls were softer, they suffered no more wear than the iron rolls they replaced because of the reduction in abrasion due to reduced slippage.

Steel base is essentially a hot roll material, and steel base rolls do not behave well under indifferent cooling conditions owing to their tendency to give a coarser fire-cracking pattern than, for instance,



A pair of cast steel cogging mill rolls in "as cast" and finished stages.

TABLE II

SUMMARY OF STEEL BASE ROLL APPLICATIONS

% Carbon	Application
1.2–1.4	Small cogging rolls
or	Roughing rolls for section and billet mills
1.4–1.6	Roughing rolls for flat work
1.4–1.6	Intermediate rolls for section mills
or	
1.6–1.8	Roughing rolls for small sections and bar mills
1.8–2.0	Finishing rolls for section mills
or	Universal beam mill rolls
2.0–2.2	Straightening rolls for rails and heavy sections
2.2–2.4	Rolls for rail finishing

indefinite chill rolls. Therefore, it is advisable to use copious water cooling—or none at all. The main applications for steel base rolls are listed in Table II against the carbon contents commonly employed. There is, however, no rigid connection between the application and carbon content, for some mills are able to utilize rolls of a higher carbon content than others, due to differences in drafting, groove depth, and suchlike.

The general rule is to use the highest carbon that the mill can stand without breakage. In addition to the applications listed, steel base rolls are used in any mill where groove depths exceed about 3 in., and for rolls having shallower grooves than 3 in., but where breakage or excessive slip preclude the use of chilled iron rolls.

IRON ROLLS

The characteristics and properties of cast iron are such that it is peculiarly suitable for the manufacture of rolls. It has a high strength in compression, it can be treated to acquire a high surface hardness by chilling, and yet retain a soft core. The graphite particles present in some types of iron roll confer a kind of self-lubricating property which gives enhanced resistance to wear.

Cast iron rolls seldom require heat treatment, and the metal is not nearly so susceptible to casting and other defects, as is the case with steel. It is unfortunate that the utility of iron rolls is limited by their low tension, and low impact strength.

Iron rolls may be divided into two broad classes—grain iron, and chilled iron. Grain iron rolls are ordinary grey iron, cast in a sand mould. They are inexpensive, and simple to manufacture. Somewhat more difficult, and interesting, are—

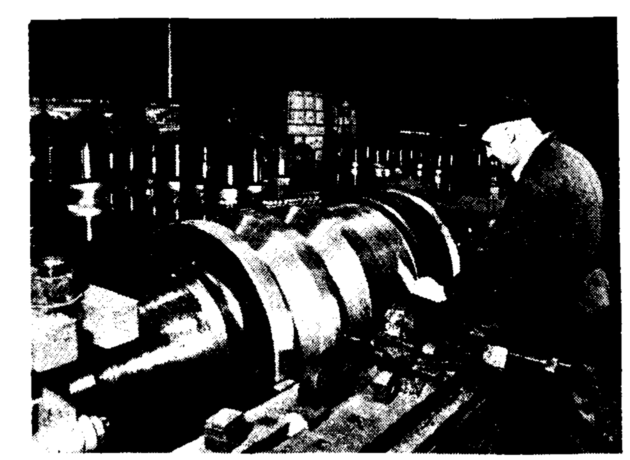
CHILLED IRON ROLLS

Chilled iron rolls derive their name from the process by which they are made, that involves a rapid cooling of the barrel surface during solidification in the mould. This is achieved by the use of an iron mould to form the barrel. The mould is therefore composite in nature for the necks of the roll are moulded in sand. If iron or a suitable composition is cooled quickly from the molten state, it solidifies 'white'; that is, with all of its carbon content combined as iron carbide which causes the metal to be extremely hard. Slower cooling permits the separation of the carbon from the solidifying metal in the form of graphite particles giving ordinary 'grey' iron which is considerably softer and tougher.

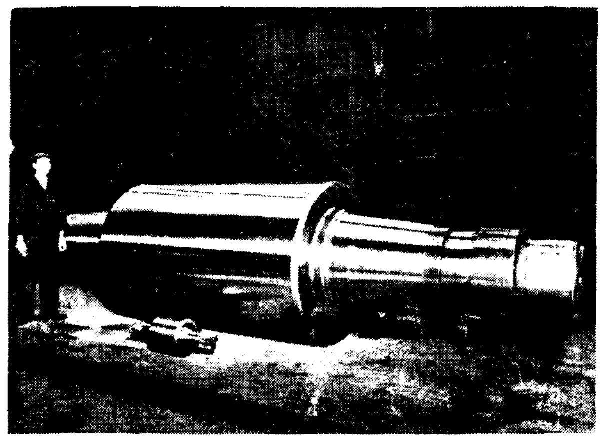
In the manufacture of chilled iron rolls, the composition of the metal must be adjusted accurately so that the necks and cores, which cool relatively slowly, solidify 'grey' while the barrel surfaces solidify 'white' to the exact depth required.

CLEAR CHILLED ROLLS

Chilled iron rolls may be placed in one of two categories 'clear chill', and 'indefinite chill'. The structure



"Closeloy" steel base billet mill roll being dressed by a roll turner.
[With acknowledgements to CONSETT IRON CO., LTD.]



"Major and Minor"—an illustration of the range of rolls produced by Armstrong Whitworth (Metal Industries) Ltd.

of the surface of a chilled iron roll can be seen, under the microscope, to consist or hard white iron carbon crystals, set in a matrix which may be pearlite, or some other constituent. In clear chill rolls, having little or no alloys, the matrix is pearlite, which is considerably softer than iron carbide; therefore it follows that increasing the amount of carbide present (by increasing the carbon content) will cause an increase in hardness.

Unfortunately, because of the brittle nature of iron carbide, a roll becomes progressively weaker as its hardness is raised in this way and, therefore, rolls for the metal industries are not hardened by this means beyond about 65° Sore. However, higher hardnesses than this can be achieved by hardening the matrix by alloying. Small additions of alloys cause of progressive refining of the matrix, giving a stronger and harder pearlite; higher alloy additions cause the pearlite to give way to harder acicular and martensitic structures similar to those found in heat treated steels.

The principal alloying element is Nickel, used in quantities of up to 4.5% depending upon the hardness required. There are, however, two important side effects to be considered. The action of Nickel is such as to bring about a hardening, not only of the chilled surface, but also of the core and necks. This may not be desirable, so a special double-pouring method has been developed to overcome this difficulty, and will be described below. The other effect concerns the character of the chill. The increasing of the nickel content causes the gradual appearance of fine specks of graphite in the surface layer. The appearance of these fine graphite particles can be inhibited, up to a point, by the addition of certain other elements, but at very high Nickel contents, they tend to persist, so that, strictly speaking, these high Nickel, very hard iron rolls cannot properly be called 'clear' chill.

INDEFINITE CHILL ROLLS

The addition of certain elements, notably chromium, has a profound effect upon the chill. In addition to hardening, it causes the mottled zone to spread out to such a degree that there is no clear chill layer at all. This gives a roll with a hard, slightly graphitic surface that becomes progressively greyer and softer toward the centre. There is no clear line of demarcation between the chilled surface and the grey core, and consequently no sudden drop in hardness, but rather a gradual fading away of hardness from the surface inwards. While this type of role does not maintain a constant hardness, the depth to which it holds a reasonable working hardness is considerably greater than is the case with the clear chill roll and, therefore, it finds application in rolls that require relatively deep grooves.

As in the case of clear chill rolls, indefinite chill rolls can be given a very high surface hardness by further alloying, and the double-pour technique is used to avoid hardening the necks and core.

DOUBLE POUR ROLLS

The introduction of double-pour rolls followed from the requirements of the modern four-high continuous strip mill. This type of mill requires a hard wearing roll, capable of maintaining a good surface finish, yet having a core and necks tough enough to transmit the considerable torque necessary for the mill drive. The roll is therefore made by a kind of duplex process giving a barrel surface of high alloy hard iron, with

Steel base section roll before turning. Note that the grooves are cast in.

the core, necks and wobblers in a low alloy softer iron. The mould set-up is similar to that used for conventional type chill rolls with the in-gate at the bottom, but a lip is provided from the head at the top of the mould with a chute leading into a suitable receptacle.

The whole mould is first filled with the hard, high alloy, material that is required to form the barrel surface. Solidification begins at the barrel surface where the metal is in contact with the iron chill mould, and a carefully worked out interval of time is allowed for the required thickness of 'shell' to develop. After this, the remaining unsolidified metal is displaced or diluted by a further pouring of low alloy metal; the displaced metal being conducted away, via the chute, into the receptacle provided. The roll then finally solidifies in the normal way, but consists of two quite different materials—the hard, high alloy barrel shell, usually about 2 in. thick, with soft low alloy necks and core. There is no discontinuity between the two zones, but simply a merging of the two materials over a shallow transitional layer. As one can probably imagine, this process is not an easy one to operate. There are many variables to be reckoned with, and very accurate timing is required to ensure a correct depth of shell. The process is too complex for mathematical calculation and must be evolved on the basis of hard won experience.

SPHEROIDAL GRAPHITE IRON ROLLS

The graphite particles in cast iron usually appear in the form of small flakes, and it is to this feature that cast iron owes its relatively low tensile and impact strength. This is because the flakes, which have sharp ends, act in the same way as notches, thus providing paths through which a crack can travel readily.

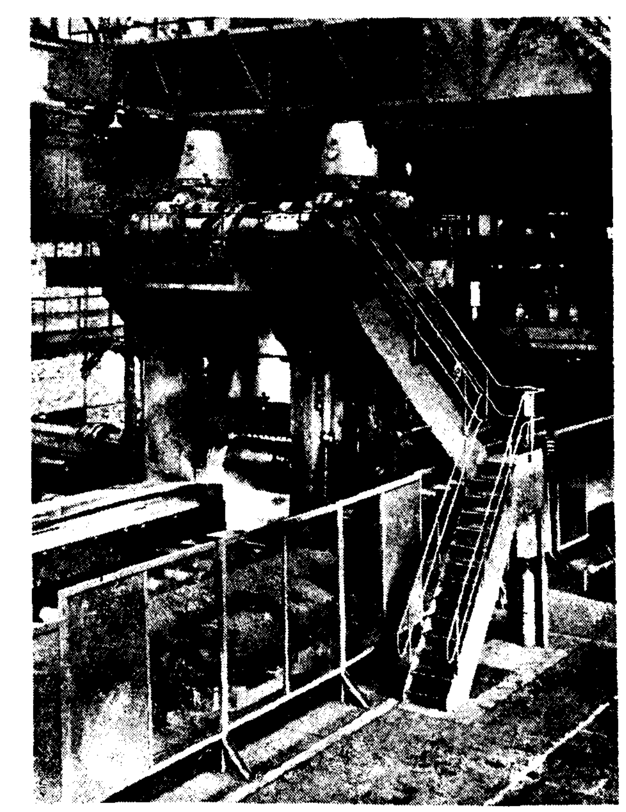
A post-war development of great importance is spheroidal-graphite cast iron, better known more simply as 'S. G.' iron, in which the graphite particles are caused to assume a spheroidal form. This results in a considerable increase in strength, plus the development of some ductility, so that the material combines the advantages of cast iron with a strength approaching that of steel, and thus provides a roll material of great utility. It has one slight disadvantage because it is incapable of throwing a clear chill, and all S. G. iron chill rolls are therefore of the 'indefinite' variety. S. G. iron rolls are usually divided into two broad classifications—'Pearlitic' and 'Acicular'.

A pearlitic S. G. iron roll is one having a relatively low alloy content, its surface structure consisting of iron carbide with pearlite, and with a hardness of up to about 70° Shore. In order to exceed this hardness it is necessary to modify the microstructure by higher alloying, which causes the development of the 'acicular' or needle-like structures referred to previously.

APPLICATIONS

(a) *Clear Chill Rolls*

The surface structure of a clear chill roll is very dense and hard, and the absence of graphite at the surface enables the material to take on an extremely high standard of surface finish. Thus it is used mainly for finishing purposes. Rolls with a depth of chill up to about 1 in. are used mainly for flat work, such as sheet and strip, but chill depths of twice this figure can be obtained for use in rod finishing mills where shallow grooves are required. Very high hardnesses of up to about 90° Shore are used for cold finishing non-ferrous metals, while non-alloy rolls of about 60° Shore find application in old type, two-high



"Closeloy" cast steel rolls at work in a large cogging and slabbing mill.
[With acknowledgements to CONSETT IRON CO., LTD.]

hand mills, for hot finishing steel sheets. Rolls with a hardness between these two extremes are used in the finishing stands of rod mills and two-high strip mills.

(b) *Indefinite Chill Rolls*

The small, dispersed graphite particles in the surface of an indefinite chill roll give the surface layer an enhanced resistance to the cyclic thermal stresses which occur in hot rolling. Indefinite chill rolls, therefore, have good resistance to fire-cracking, and are thus very useful in the hot rolling of many types of product. Because of their graphitic surface, they cannot acquire such a high degree of surface finish as clear chill rolls, but, in many applications, this slight disadvantage is offset by their increased resistance to fire-cracking during working. The deeper hardness penetration of the indefinite chill type extends the use of these rolls to small section, and billet mills, where fairly deep grooves (up to about 3 in.) are required.

For grooved rolls, the softer types with a surface hardness of about 60° Shore are used. Hardnesses of between 60° and 70° Shore are used for finishing plates, while the highest hardnesses, of up to 85° Shore, are employed in the finishing stands of four-high wide strip mills. In the latter case, the rolls are invariably of the double-pour type.

(c) *S. G. Iron Rolls*

The surface characteristics of chilled S. G. iron rolls are similar to those of ordinary indefinite chill rolls, but, because of their increased strength, they can be employed with advantage in cases where ordinary type rolls would break or spall.

The grain type of S. G. iron, cast in a sand mould and without a hardened surface, has been found useful, particularly in the acicular variety, where a relatively uniform hardness of 50° Shore or more can be achieved right through the section. This provides a good wearing roll suitable for deep grooves.

(d) *General*

It is not possible here to give a full list of all the applications for iron rolls as their usage is so diverse. Apart from mills for rolling ferrous and non-ferrous metals, iron rolls are used in the manufacture of flour, paper, rubber, chocolate and plastics. Table III summarizes the main applications in metal rolling. As a general rule, chilled iron has the best wearing properties of all the roll materials, and its utilization is limited only by its strength. An example of its great utility is the fact that some of the continuous billet mills in Britain use indefinite chill rolls from the second stand right through to the last finishing stand.

TABLE III SUMMARY OF IRON ROLL APPLICATIONS

Type	*Shore hardness*	*Application*
Clear Chill	up to 65	Finishing sheets and plates 2 high and 3 high mills
Alloy Clear Chill	65–75	Finishing stands of 2 high continuous strip and skelp mills. Intermediate and finishing stands of rod mills. Early finishing stands of 4 high strip mills.
Alloy Clear Chill (Armstrong Whitworth Phoenixloy)	80–90	Cold rolling non-ferrous sheets and strip. Temper rolling of steel strip and sheets.
Alloy Indefinite Chill	55–65	Intermediate and finishing stands of billet and bar mills and small section finishing. Roughing and intermediate stands of rod mills and non-ferrous sheet mills. Straightening rollers.
	65–75	Work rolls for roughing wide strip and for finishing plates.
	75–85 (Double Pour)	Finishing stands of 4 high wide strip mills.
S. G. Iron	up to 75	Various types of mills where ordinary iron rolls have insufficient strength.

Rourkela Uses the LD Process

It is the first time that the LD process, a new steel-making process, has been used in the iron and steel-works at Rourkela. In contrast to the conventional Bessemer and basic Bessemer processes, which employ air to provide oxygen, the LD process uses pure oxygen. It is blown from the top onto the hot-metal bath through a water cooled lance at a pressure of about 142 to 170 psig.

LOW CAPITAL OUTLAY

The process has been extremely successful and, compared with the conventional basic Bessemer or open hearth processes, it is characterized by low capital outlay and operating costs, higher production and greater purity of steel from nitrogen. On addition, the LD steel plant requires less space and less auxiliary equipment. Hence, steel production in these converters has many advantages over the conventional processes, both technically and economically.

It is mainly for this reason that the Mysore Iron and Steelworks have decided to use the LD steel-making process for extending their capacity. The order for design, delivery and erection has been placed with DEMAG.

DEMAG DESIGNED AND SUPPLIED FIRST LD CONVERTERS

DEMAG is always seeking to achieve progress in steelmaking whether it is a question of advising metallurgists on the machinery and equipment they need, of investigating and developing new processes conceived and perhaps tested in the laboratory, of designing and supplying plant and machinery required for large-scale projects, or of extending existing plants and installing new plants to put recently-developed processes into operation.

DEMAG designed and supplied the first LD converters for the iron and steel plant in Linz-Donauwitz, Austria, where the LD Process has been developed. These were then followed by many others for other destinations. It also built the first rotor plants, and the first Kaldo furnaces for use on a large scale, two other new methods of using pure oxygen in steel-making. These facts prove conclusively that DEMAG has always been a pioneer in this field, and has played an important part in the development of new processes for steel production. Since DEMAG devoted itself to the construction of open-hearth furnaces from the very beginning, it is in a position to meet any development in steel production with the greatest confidence—no matter which direction this development may take.

* * *

BIG ADVANCE IN HARDENING OF CARBON STEEL

A big advance in the hardening of carbon steels has been made by a British firm manufacturing induction heating equipment. The firm was asked to produce equipment for a company of motorcar manufacturers with special application to the hardening of gears and spline shafts. The result was so successful that it has now been decided to make the equipment available to the general engineering industry.

In the hardening of carbon steels the ideal result is to have the outside hard, for its desirable wearing qualities, and the core soft to be more resistant to fracture. Heating by induction is better suited to produce this effect than any other method, because it is easier to localise the heat; the heating takes place initially only on the surface of the metal while the interior is cold, and the heat is applied only where it is needed, effecting an economy in power consumption.

Technical Progress achieved through A Consistent Economic Policy

BY *JOSEF SCHÜLLER*
Vice-president of DEMAG

IN the Second Indian Five Year Plan, great stress was laid on the development of the basic industries in general, and of the iron and steel industry in particular. The Indian Government based this policy on the conviction that steel production is the criterion by which a country's technical progress is to be judged: A thesis which the present situation in the industrial countries of the world has proved correct. There is no need to illustrate the different ways in which the entire economy of a country is stimulated by the possession of an independent iron and steel industry. The success of the Indian Development Plan up till now has fully justified the Government's policy. India has doubled her annual steel production. In the Third Five Year Plan she will increase the production of steel further.

INDUSTRIAL COUNTRIES GIVE ASSISTANCE

However, all this is only part of the tremendous task facing India in the years to come. By forcing the pace in industrialization, she is striving to bring her own technical development up to a standard approaching that of the industrial countries, in order to be able to participate in international trade as an equal partner. India is not the only country which must grapple with this problem. The countries of the Far and Middle East, of Africa and South America, with their high birth-rate, are in the same position. The industrial countries are fully aware that they must give every possible assistance, if this world-wide problem is to be solved, which will raise the standard of living in the whole world.

NO GOLDEN RULE FOR PROGRESS

There is of course no ready-made solution or golden rule for the achievement of economic progress in these countries. They differ widely in mineral wealth, sources of power, infrastructure, and in the quantity and quality of the labour available. If a country's industrial potential is to be realized, the methods employed must always be adapted to the individual case. Effective economic aid can consist only in giving young nations the means of meeting the future demands of their domestic economics.

The industrial countries of the west have long rid themselves of the out-of-date notion that the world may be divided into countries producing raw materials on the one hand, and industrialized countries, on the other. It has now been generally realized that the growing prosperity of the industrial countries depends on the economic progress their neighbours are making.

INDUSTRIALIZATION OVERNIGHT

Naturally, countries which are largely agricultural or producers of raw materials cannot be expected to achieve industrialization overnight. There are ready markets for agricultural produce throghout the world. It is certain, however, that in many cases an intensive advertising campaign is called for, if sales of domestic products are to be increased, and the market thus exploited to the full. The result of increases in exports, especially in industrial countries is that the balance of payments can be settled and more foreign exchange made available to further industrialization.

With the active assistance of the western industrial countries, technology has rapidly gained a footing in these countries, when one considers that industrial development in Europe has been spread over a period of 200 years. What often slows down the rate of industrial development is the lack of adequately trained skilled staff. Aid to the developing countries necessarily has two distinct aspects, therefore, which must be estimated as equally important: first, the training of skilled staff and, second, the delivery of high-grade industrial equipment.

QUALIFIED ENGINEERS NEEDED

Every year, thousands of young men from abroad are trained at German universities and technical colleges for their later careers in their native lands. In the most widely varied branches of German industry, foreign engineers and technicians are shown how to operate machines to be delivered to their home land. However, these technicians are not only trained to operate the machines independently: it is also intended that they should pass on the knowledge and experience they have acquired in Germany to their as yet untrained fellow-countrymen. In this way, a works primarily intended for the production of manufactured goods becomes at the same time a training-centre.

The delivery of machines and equipment has been far more often the subject of public discussion than the question of imparting technical know-how. Too little attention is often paid to this important aspect. The German Government and German industry are fully agreed that speedier and more effective aid must be given by making more funds available in spite of the fact that Germany has been and is facing a lot of burden resulting from the war.

German Industry itself is making in this year more than 1 Billion of DM available for the German Government. With this support German Industry increases the funds to be spent for erection and extentions of industrial plants in the developing countries by its Government and furthers the financial aid which the Federal Republic of Germany has given in past years, either direct or through the international financing institutions for the developing countries.

BASIC INDUSTRIES ACT AS IN IMPETUS

However, the capital thus made available by the industrial countries must be applied in such a way that the expenditure of money and energy is in proportion to the results achieved. It is of course impossible to say, in the planning stage, whether the more effective policy would be to build small and medium-size works or large-scale concerns. Experience has shown, however, that, when an adequate supply of raw material is available, the development of the basic industries acts as an impetus to the entire economy of the country concerned. Moreover, the relatively small number of qualified technical staff required in the basic industries can be used much more economically and rationally. The large concern is normally associated with a great number of suppliers, manufacturers, and public utilities, which in their turn contribute to raise the standard of living of further sections of the population. In one country in Africa, for example, it was observed that, before the first steelworks was erected, there were only 24 engineering firms in existence. Shortly afterwards, the number had risen to 200, and today totals over 700. A similar development was observed at and around Jamshedpur.

THREE NEW STEEL PLANTS WITHIN 5 YEARS

The erection of the 3 new Indian steelworks at Rourkela, Bhilai and Durgapur, with a capacity of 1 million tons each, is one of the Indian Government's most encourageable and notable achievements in the construction field. A further increase of production has been planned. Also both the long existing big private-owned steel works, Iron and Steel Company at Jamshedpur and Indian Iron and Steel Company at Burnpur have raised the capacity to more than 1 Million tons of steel. The state-owned Mysore Iron and Steelworks affords an other example: it aims at increasing its output to 130,000 tons annually by erecting a LD steel plant and extending the rolling mill plants. DEMAG was awarded the order for the extension work involved and will thus be able to continue to assist in the development of the Indian iron and steel industry. Even long before the War, DEMAG equipped numerous works with machines and industrial plant, and after 1945 again delivered to large extent equipment to India for heavy industry, in particular for the Rourkela steelworks, in the construction of which DEMAG played a leading part. The contribution made by the west to India's further industrial development has the object not only of raising the present standard of living, but also of maintaining and consolidating the political and economic freedom of the country.

NEW MINES IN THE UKRAINE

More than a million tons of coking coal will be produced annually by a new mine built in the Donets Coal Basin in the Ukraine. All labour consuming processes in coal mining and transportation are fully mechanised and automated there. Over a hundred mines are being built or reconstructed in the Ukraine now. When this work is completed the output of coal in the republic will grow considerably and reach 211 million tons in 1965. This is 2.5 times more than was mined in the Ukraine on the eve of the second world war.

The Technical and the Human Problems in Iron and Steel Industry

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INTRODUCTION

OF all the elements known to man, Iron is the one single element that has played the most important part in shaping his destiny in this planet, and Steel is the one single alloy that is at the base of all his industrial adventures. Iron and Steel are vitally essential, in fact as essential to the maintenance and growth of the industrial life of a Nation as air and water are for the maintenance and growth of life itself. It is for this reason that this country, in cooperation with a few other countries has launched on the great task, the great adventure of building—and building as fast as she possibly can—its basic Iron and Steel life saving Industry for the Nation. Food from Land, clothings from Cotton and housing from Cement and other construction materials—all these basic necessities for the common man grow around Steel. This is depicted in Fig. 1. All quantities indicated in this diagram are target figures which this country expects to reach after the end of the Third Five Year Plan.

THE TWO VITAL PROBLEMS—METHODS TO MINIMISE

Iron and Steel making is extremely easy and yet extremely difficult. It is easy because the fundamental laws governing iron and steel making processes are now fairly well known. It is extremely difficult because of two fundamental problems—one of which may be broadly looked upon as the Technical problem and the other, the Human problem.

1. *The Technical Problem:* Technical problems apparently may be many and may, in fact, multiply unless the fundamental causes are well understood and weeded out. Broadly, the technical problems are associated with the three "P"s—Planning, Procurement and Performances. These are briefly discussed below:

(a) The coordination of planning, design, construction and operation of the various units of an integrated iron and steel plant is a formidable task demanding the co-operative efforts of many minds. A single mistake committed somewhere along the line either in the formulation of a policy or execution of that policy—be it in the stage of planning and design or in the stage of construction (like defective foundation and structures) or in the stage of operation (such as uncontrolled input of fuels or of faulty materials in a furnace)—any one of these may be fatal both for the speed and quality of production and may substantially decrease the life of a furnace or equipment. Undue haste, for example, in heating up the refractory lining of the Coke Oven, the Blast Furnace or the Open Hearth may not only damage the life seriously but may wreck the furnace completely. The entire lining of the Blast Furnace shaft and the entire roof of the Open Hearth furnace have collapsed soon after starting of operation even in industrially advanced countries. It is well established today that not merely the magnitude of experience but the quality of experience—experience based on scientific knowledge—that contributes to minimise the frequency of troubles, failures and breakdowns in a large concern like an Iron and Steel Plant. Employment of more and more of technically trained men in modern Iron and Steel plants and extension of facilities for scientific and technical training of personnel (including staff-training, refresher courses and so on) are fundamentally directed towards one single objective, viz., to create an attitude of mind (in all levels of workers and officers) which can accept scientific informations and operational data with open mind and which can resolutely employ scientific methods in the resolution of all problems, no matter how difficult and how baffling these may at first sight appear to be.

Iron and steel making a decade ago was more an Art than a Science. Today it is more a Science than an Art. It is often believed that in a large scale operation as in a Blast Furnace or in a Basic Open Hearth furnace, the variables are so many and the exact quantitative informations are so erratic and so difficult to procure that it is highly impracticable to put iron and steel making processes on a concrete scientific foundation. Although such an idea was prevalent a decade ago, the picture is somewhat different today. With the development of fast and precision instruments, with mechanised methods of sampling aided with physical methods of analysis and with the availability of physico-chemical data regarding slag-metal reactions at different temperatures, even a large scale operation can be controlled with fair precision. The high top pressure, the self-fluxing sinter burden, conditioning of the blast with steam and oxygen, injection of fuel and lime through the tuyeres, careful control and distribution of raw materials and last but not the least incorporation of a rigorous and efficient system of instrumentation and automation with the object of procuring correct information of the different variables inside and outside the furnace and automatically adjusting the deviations to a desired known level by carefully designed electronic signalling system and a few other allied factors have all conjoined to transform an unpredictable Blast Furnace of yesterday into a more steady equipment today. What is true for Blast furnace is also true for other units of an iron and steel plant. The advance has been and will continue to be not only in the magnitude and speed of production, but also in the improvement and control of quality with which that speed can be maintained.

The difficulty to attain these in India today lies not so much on the lack of equipment, facilities or technique but in the lack of a coordination and earnest effort to create a structure in which science and technology could effectively function. Withholding authority and power from trained and experienced men, for example, often creates difficulties and barriers which are artificial and preventable but which nevertheless have seriously affected both speed and quality of production. Creation of facilities for the training of manpower and withholding power from that trained manpower tend to become mutually less effective. Training of manpower and dedication of full trust and authority on that power on the other hand create an atmosphere favourable for speed and quality of production.

(b) A modern Iron and Steel plant apart from power, water and other essential requirements—

(i) needs colossal quantities of raw materials and a very large number of equipment accessories and other stores materials (tools, tackles, refractory materials, chemicals, etc.) and,

(ii) needs speedy movement facilities for the above raw materials and accessories.

For the former, the steel plant has to depend on different mining (coal, ores, fluxes) and manufacturing industries and for the latter it has to depend on the three "R"s—the Railways, Roads and/or Rivers (mostly the Railways).

Planning and design with regard to the iron and steel plant proper may be perfect and yet there may be serious difficulties for speed and quality of production if there be difficulties in the raising of raw materials or procurement of refractories and other essential goods or if there be difficulties in speedy movement facilities of those goods or raw materials.

The magnitude of the problem of supplying raw materials to a modern Iron and Steel Plant will be appreciated when one realises that to feed one Blast Furnace (capacity 1000 tons per day) one needs roughly 2000 tons of iron ore, 1500 tons of coal, 600 tons of limestone per day, apart from other essential materials like quartz, manganese ore, etc. For this purpose one has to move 5000 to 6000 railway wagons per day, just for Blast Furnaces alone for all the five existing integrated iron and steel plants in the country. And for 10 million ton steel production in the country, the Railways must have facilities for the speedy movement of nearly 8000 wagons per day for steel industries alone. Furnaces and equipment may remain idle for want of raw materials or may not work to full capacity for want of other essential goods and facilities. Planning for the production of iron and steel therefore involves not only a careful planning in detail of the designs and layout of the Plants themselves but a careful planning of wagon and railroads and other means of transport. It is for this reason that the installation of new steel plants in the country is comparatively a slow process because many of the ancillary facilities like the railways, the mines, the coal washeries, the Power Plants and also in some cases some essential service facilities like water, transport, etc., have to be constructed and provided for. It is for these reasons that the planning for the development of steel has to be done sufficiently at early stages and also a fair estimate made of the country's needs of iron and steel in different areas of development and growth.

TABLE—1

STEEL FOR THIRD PLAN PERIOD (1960-65)

I.	*Construction:*		
	(a) Railways	1.2 million ton	
	(b) Other than railways (Mining, Irrigation, Housing, Heavy machineries etc.)	2.8 ,,	
		——	4.0 million ton
II.	*Manufacturing:*		
	(a) Transport Equipment (Loco, wagons, couches, autos, ships, cycles)	1.00 ,,	
	(b) Electrical	0.15 ,,	
	(c) Industrial Machinery	1.75 ,,	
	(d) Agriculture	1.00 ,,	
	(e) Others, including small scale industries	1.60 ,,	
			5.5 million ton
III.	*Reserves*		1.0 ,,
			——
			10.5 million tons.

TABLE—2

ESSENTIAL RAW MATERIALS FOR ONE MILLION TON PLANT

Materials	*Billion Kgm or million ton/year*
Iron Ore	1.80
Coal for Coke	1.63
Limestone	0.70
Dolomite	0.12
Manganese Ore (28% Mn)	0.05
Refractories	0.07
Ferro-alloys	0.06
Bauxite/Fluospar & other Materials	0.50
	——
	5.00 = 700 wagons loads/day
Water	20 cu. secs.
Power	100 Megawatts.

Towards the end of the third plan period, the railways are to move 7000 wagons/day for the Iron and Steel industries alone.

CONSTRUCTION WORK FOR ONE MILLION TON PLANT

Earthwork			12 million cu.m.
Concrete			3 ,, ,,
Refractories			0.10 billion Kgm.
Steel—			
	Reinforcement	0.05	
	Structural	0.08	
	Piping	0.10	
	Miscellaneous	0.02	
		——	0.25 billion Kgm.
Railway Track work			100 Km.
Main road			25 ,,

(Table 1 indicates an average estimate of different steel requirements in the country for the Third plan periods).

A brief outline of a typical set of some of the essential materials and construction work for a million ton integrated iron and steel plant is shown in Table 2. Apart from these essential materials (indicated in Table 2) which are required in large bulk, an iron and steel plant needs a very large number of other materials whose number may easily run into five or six digits.

Steel in the National planning helps to produce directly or indirectly practically everything that the National Plan may envisage but it is not often realised that the construction and operation of a modern iron and steel plant need directly or indirectly the help of a staggering number of other materials produced in other industries and this is another reason why the growth of a modern iron and steel industry is comparatively slow and difficult at the initial stages of development and calls for so much of foreign exchange and assistance. But once the initial barrier is overcome and other Heavy industries—the mechanical, the mining, the electrical etc.,—also alloy and tool steel plants and the ferro-alloy plants and other ancillary industries are established and put into operation, we would have created conditions for an accelerated growth of our economy.

Whether or not that growth actually occurs will depend however on two important and vital factors, viz., our own ability to gear into motion—

(i) The necessary technological and scientific forces on the one hand, and,

(ii) the necessary collective wisdom or the human forces on the other.

The three "M"s, they say—Men, Money and Materials—are necessary for the national growth of a country. We have the Manpower, we have the Money (at least have been fortunate to get that Money on loan through our international friends) and also many of the essential materials. But in the long run it appears that not only the three "M"—Men, Money and Materials—but the fourth M, viz., the Mind (not only the Mind at the top level, but also the mind at all levels—the mind of the vast masses of our people) is the determining factor practically in every Nation building task.

THE HUMAN PROBLEM

No matter how perfect the planning be with regard to all the scientific and technical aspects of iron and steel and allied industries, speed and quality of production would suffer if the Nation does not set its mind and plan sufficiently in advance to create a suitable atmosphere for human forces to function. There is no one single formula to deal effectively with the human mind but the basic fundamentals are essentially few and simple and these are—

(a) to educate and inspire the individual and the group towards the urgency of nation building tasks and building as fast as one could possibly do.

(b) To train and trust the individual and the group in their respective areas of work not only to infuse confidence in but to create a feeling of possession of those areas. Once an individual is made to feel not only responsible for an enterprise but as a kind of a partner in that enterprise, a large part of the success is assured.

This country is rich in raw materials and rich with human power. But power is a scalar quantity, it does not do any useful work unless given a 'Direction'—a 'Purpose' as it were. Manpower left to itself tends to get dissipated in many directions without the right lead. Wrongly led it has created and may create again explosive situations. Explosion by itself may not be dangerous—in fact a high speed of reaction, in order that it is useful, has to be sometimes of an explosive nature. Atomic chain reaction is 'controlled explosion' and yet generates useful energy. Uncontrolled Chain reaction is Atom Bomb. Explosion of Atom Bomb is as dangerous as explosion in population growth—particularly for this country. To meet this challenge one needs explosion in food production and explosion—controlled explosion—in all other production fronts including iron and steel. Explosion implies speed, control implies quality. The conditions for a high speed and quality of production are similar to the conditions for controlled explosion or a controlled chain reaction.

Chain reaction is an Atomic Pile (or an Atomic Furnace as it is often properly called) is brought about by the tiny atoms arranged in a certain pattern. Chain reaction in the society can be brought about by the individuals, the human individuals arranged or inspired in a certain pattern. What is that pattern? The same as one would like to have for himself—a well knit family of children—a pattern in which one sweats and toils and shares and yet has a feeling of possession of a home in a family, a pattern which in the absence of a suitable word one calls "socialistic".

A chain reaction in an Atomic Pile is possible provided there is a Moderator. The Moderator for a social or industrial chain reaction is the thoughtful leader—be it in a family, industry or a society. He is there to guide and chide if necessary. But his essential function is to lead—to inspire so that the potential

energy of the group is released and directed to useful purposes.

Once the chain reaction has been started, it needs careful control so that it does not lead to destructive explosion. For this purpose 'Control Rods' are inserted in the Atomic Pile. The Law is there as a Control Rod for the industry or society. Let sufficient authority and freedom be vested unto the common man, the hard working worker in the Industry or the farm to initiate a chain reaction in production. There can be no risk of chaos, and confusion or explosion so long as the Law—the Parliament is there as the Control Rod.

In a socialistic pattern—be it a large industrial organisation like an integrated Steel Plant or a larger unit like the State—the philosophy is fast production and equitable distribution, the final objective being a good life for all, a fuller and complete life (though not a life of luxury), a human life worth living. To attain this in this country, there is hardly any time to lose if one has to win the race against the fast speed of growth of population and unemployment. In fact Prime Minister Nehru very rightly says that this country has to grow on a war basis—war against hunger, poverty and unemployment.

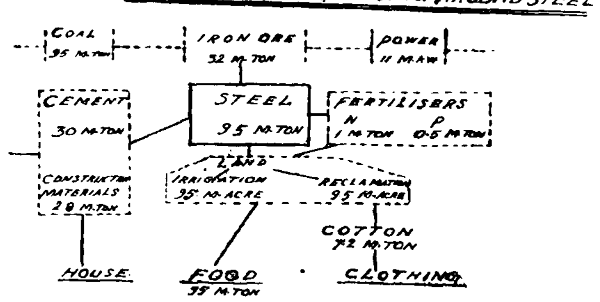
If this country has to develop on a war basis for high speed of production, one must recognise all levels of workers as soldiers of that war. And for a nation geared to socialistic pattern of economy, the responsibility for all actions leading to the welfare—physical as well as mental—of these workers vests with the management and government themselves and not on Labour Unions and other unions of the pattern—pseudo-political type—that exist today. In fact the right to strike work, to impede speed of production is like the right to strike work in the field, when the battle—a mortal battle against hunger and poverty—is going on. Who would think of a Union in the Defense forces of a country, or for that matter, of a Soldiers' Union to decide the destiny in a battle field? The soldier in this field fights and makes the supreme sacrifice because of an idea or Ideal at the back of his Mind and not just for fun. The soldier in the industry or the Farm will similarly fight with all enthusiasm, initiative and drive once the idea—the inspiration to build and produce—is set in his mind, once the trust and authority are laid upon him, once he is made to feel himself as an active player and a partner in the whole Team. No third party, no Union and probably no Tribunal would be necessary then! Once the soldier recognises himself, that to strike work would imply striking against himself, the question of strike would not arise. Bargaining for mere wages and wealth for more care and comfort do not arise when one sees no undue show of luxury or wealth, when one is made to feel that the leader (the management/the government) is there for a fair distribution of the fruits of his toils.

The task to build up a moderate and fair level of living for a huge mass of humanity is indeed formidable and this is particularly so because of the rapidly expanding frontiers of the magnitude of humanity. It is like the task of attempting to build up the level of water in an ocean with ever expanding chasms of large dimensions both in breadth and in depth.

The task is formidable but certainly not impossible. The task to raise the level of living of the sea of humanity can be performed by the sea itself. No doubt it is essential to plan and think and think again but once the decision is taken, it is equally essential that the ideas go deep down into the depths of the sea of humanity—right into their heart. Let them share the trust and authority. As Prime Minister Nehru has rightly advised—the people should have powers not in morsels but in full and at one stroke. This is the right scientific approach to the human problem.

Speed needs space and motion. It is a scientific fact that in a restricted space due to want of enough freedom, as it were, speed tends to create spin. For want of enough freedom similarly, man tends to spin around his little "self" and "ego" within the limits of a space defined by artificial barriers and walls born out of a lack of real interest in the nation building task, due to lack of inspiration on the one hand and lack of dedication of authority on the other. The result has been that millions of individuals who could have otherwise formed into forceful and helpful currents towards purposeful nation building tasks, are found to form millions of individuals spinning vortices in the vast span of the sea of humanity without any integrated movement. As a scientist one finds in Nature that energy in bondage tends to create spin. Restrained flow tends to create vortices. In human affairs it appears similarly that limitations of authority of the common human individual creates artificial Bondage. Let them be free from the fetters of this bondage and see what happens. The common man then performs the uncommon.

FIGURE 2
FOOD, CLOTHING & HOUSING AROUND STEEL



LEGEND

M-ton	..	Million tons
M-kw	..	Million Kilowatt
N	..	Nitrogen
P	..	Phosphorus
M-Acre	..	Million Acre

Some of the above suggestions and steps may seem most extraordinary. But to perform an extraordinary task, extraordinary steps are to be taken. The task to attain high speed and quality of production in all fronts in general, and iron and steel in particular, is most formidable and extraordinary indeed, particularly at the present stage of development of this country. And the first extraordinary yet vital step to be taken for that purpose is to dedicate sufficient authority and freedom of movement in every sphere so that all level of workers in general and scientists and engineers in particular could effectively function.

Mr. Benjamin F. Fairless, President of the United States Steel Corporation, rightly remarks—

"With all our expectations of accomplishments in technology, we feel certain that human values will continue to be placed above all else. The most important part of every company still will be its people. Management's recognition of this fact will be reflected in progress in human relations fully as important as progress in science and technology".

CONCLUSION

It is often not realised that no matter what Technology and Science are brought to bear upon, the speed of production can hardly be attained or maintained unless the human forces are geared on for that speed of production. In a Democracy, this gearing of the human forces becomes spontaneous, once a suitable feeling of inspiration is created. These facts are very important to this country because of the simple reason that speed of production is vital for her growth and development particularly because of the rapidly increasing population and the increasing number of unemployment with its associated problems. Not only by due attention to the Technological and Scientific aspect of the problem but also by careful planning and blending of the human aspect of the problem on the background of her own heritage and cultural, will this country be able to set an Industrial standard and a new trend towards a rapid and yet stable pattern of industrial growth.

Giant Steel Plant under Construction in Siberia

Work has started on a West-Siberian steel plant which will be part of the third iron and steel centre being established in the country's Eastern areas under the Seven-Year Plan. The plant will begin operating next year. Its first giant blast furnace is being erected.

The plant is to be equipped with up-to-date automatic large capacity blast-furnaces, coke-oven batteries and high-speed rolling mills.

Material haulage inside the plant will be mechanical for the most part. The blast-furnace department, for instance, will have no stock-yard where the charge is made. It will be brought into the blast-furnaces by transporters straight from the factories.

The plant has not yet been built, but it has already brought to life some out-of-the-way parts of the Siberian Taiga. Satellite towns with a population of many thousands have sprung up near Stalinsk. Their industries will supply the plant with electric energy and coking coal.

New railways, power transmission lines, ore mines, and well-appointed mining settlements are being built within the radius of 500 Kilometres.

The "Zavodskoi" settlement which appeared recently near the future plant has now become a town of 25,000. It has large blocks of flats with every convenience, shops and clubs. Within the next few years its population will increase to 100,000.

Rourkela Produces High Quality Flat Products

1956, when the Second Five Year Plan became operative, was a decisive turning point for the Indian iron and steel industry. Whereas the First Five Year Plan had mainly provided for new power stations, expansion of traffic communications and agricultural production, the Second Five Year Plan concentrated on the expansion of basic industry, especially the iron and steel industry. It envisaged amongst others the construction of integrated iron and steel works in Rourkela, Durgapur and Bhilai each with a capacity of 1 million tons of ingot steel.

WIDE STRIP MILL—THE HUB OF THE ROLLING MILL

The Rourkela Plant makes exclusively high-quality flat products, i. e. heavy and medium plate, plain and tinned sheet.

Finished products from the Rourkela plant go to the processing industries for use in shipbuilding, pipework and boiler construction, manufacture of goods and tank wagons, car bodies, mudguards for motorcycles and bicycles, production of knives, forks and spoons, cans, containers, refrigerators, tools and many other items.

600,000 tons of steel will be rolled on the wide strip mill, the hub of the entire rolling mill. It was supplied by DEMAG. This firm has made a decisive contribution to the expansion of the Indian iron and steel industry. Even before the war DEMAG supplied the Mysore Iron and Steel Works with complete iron and steel plant and rolling mill equipment. An openhearth steelworks was supplied to the Iron and Steel Company of Bengal in Calcutta.

After the war, DEMAG supplied rolling mills and cranes to the Tata Iron and Steel Company and helped to expand the facilities of the Indian Iron and Steel Company by delivering two open-hearth furnaces with a capacity of 225 tons and a 25-ton Bessemer converter, rolling mills and cranes.

The German company helps to increase the capacity of the Mysore Iron and Steel Company to 130,000 tons of ingot steel, thus be able to continue to assist in the development of the Indian iron and steel industry.

* * *

FACTS ABOUT ROURKELA

The plant consists of the following principal units :

Coking Plant	3 batteries of 70 ovens each ; capacity 1.64 million tons of dry coal per year
Blast Furnaces	3, each with a capacity of 1,000 tons per day
Steelworks	3, 40-ton LD Converters ; capacity 750,000 tons per year; 4, 80-ton Open-Hearth Furnaces ; capacity 250,000 tons per year ; 2 mixers each holding 1,100 tons
Rolling Mills	Blooming and Slabbing Mill ; Wide Strip Mill ; Heavy Plate Mill; Cold Rolling Mill; Hot-Dip Tinning Plant
Power Plant	75 MW capacity
Auxiliary and Ancillary Plant	Gas Cleaning Plant with a capacity of 17,650,000 cubic feet per hour Oxygen Plant with a capacity of 349,470 cubic feet per hour Grey Iron Foundry Repair Shop

PRODUCTS

Heavy Plate	200,000 tons/year
Medium-Plate and Wide Strip (hot rolled)	300,000 tons/year
Sheet and Strip (cold rolled)	170,000 tons/year
Tinplate	50,000 tons/year

Products include plate for shipbuilding, wagon construction, bridges, cranes, containers, car bodies etc. Tinplate for cans, apparatus and tanks of all descriptions.

SOME INTERESTING FIGURES

The Rourkela integrated iron and steel works has :

Works railway	69.44 miles
Railway bridges	11
Diesel-electric locomotives	29
Cranes with capacities ranging between 5 and 150 tons	75
Water supply piping	15.5 miles
Drinking water supply piping	11.6 miles
Piping of all dimensions for various uses	46.5 miles in the rolling mill alone
Works roads	26.7 miles
Sewage piping	77.5 miles
Roof-covered area	4,304,000 square feet
Roof-covered rolling mill area	2,259,600 feet (included in above figure)
High and low voltage cables	1,050.0 miles

INDIAN CIVIL ENGINEER TRAINS IN U. K.

" Britain is like a huge factory "—this sums up an Indian civil engineer's general impression after two months' training in the United Kingdom.

The engineer is Mr. S. Mallikarjunaiah, who is in charge of civil and structural works at the Mysore Iron & Steel Works at Bhadravati. He is now halfway through a training course at the Consett Iron Co.'s works in County Durham, where a large-scale extension programme is under way.

Since his arrival in February, Mr. Mallikarjunaiah has been studying the latest building techniques used by the contractors on the site, working under the general direction of the engineering consultants, the International Construction Co.

"One of my most outstanding impressions of Consett has been the great use made by the civil engineering contractors of mechanical equipment," Mr. Mallikarjunaiah said in an interview. "Not only is the work done more quickly, but there is an improved quality."

Since his arrival in Britain under the Technical Co-operation Scheme of the Colombo Plan, Mr. Mallikarjunaiah has travelled considerably. He has seen some of the wide variety of industries established in various parts of England on industrial trading estates. " Britain seems to be a wonderful place for a civil engineer," he said.

* * *

BENEFITS SEEN IN OIL USE BY SOME BLAST FURNACES

Heavy oil of high heat content can be injected into the bottom of blast furnaces and, in many circumstances can increase capacity and decrease costs of iron production, according to a recent report by oil company researchers. Natural gas has also been reported used in a similar manner to increase blast furnace capacity.

Durgapur — A Steel City

By A Special Correspondent

STEEL is the symbol of strength—its production marks the pace at which a nation marches industrially. It goes to make the midget screw and enters into the construction of mighty skyscrapers. It forms the farmer's plough and is shaped into the surgeon's knife. It touches every field of industry and every form of work.

Steel is tool, transport, structure and store. It is the most universal and versatile metal, and as such, production of steel occupies the pride of place in India's development plans.

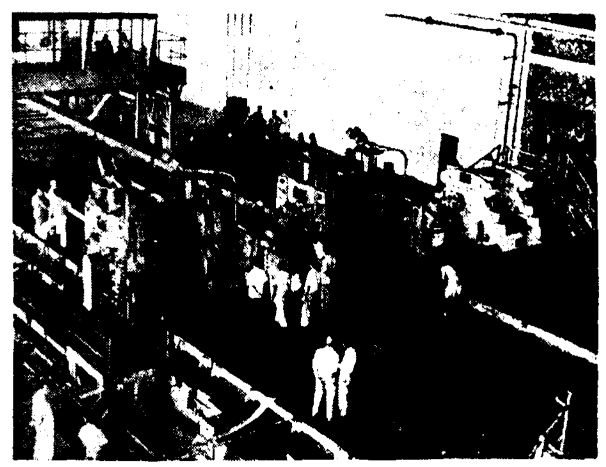
Early in 1954, Shri T. T. Krishnamachari, the then Commerce and Industry Minister, enunciated the steel policy of the India Government by announcing the steel target of the Second Plan as six million tons. Accordingly, the Government decided to establish three steelworks in the public sector, one at Rourkela in Orissa, another at Bhilai in Madhya Pradesh and the third at Durgapur in West Bengal—each with a capacity of a million tons of ingot steel. The private sector in steel industry was allowed to expand its production capacity to three million tons.

A separate ministry to deal with the establishment of new steelworks was constituted and the Ministry of Iron and Steel was brought into being by the Presidential Order of May 22, 1955. The Government industrial undertakings to produce iron and steel came under its charge. The Ministry has since been reconstituted as Ministry of Steel, Mines and Fuel.

The Hindustan Steel Ltd., a Government-owned company was set up in January 1954 to plan and construct the Rourkela Steelworks. The management of Bhilai and Durgapur Steelworks was undertaken in April, 1957. Each of the plants is managed by a General Manager. The Hindustan Steel also conducts the preliminary work connected with the fourth steel plant to be located at Bokaro in Bihar. It has constructed a big pipe plant at Rourkela and two coal washeries. It is also erecting a fertilizer plant at Rourkela which will produce about six lakh tons of calcium-ammonium-nitrate per year. The expansion of the three steel plants and the setting up of an alloy and special steel plant proposed at Durgapur are entrusted to the Hindustan Steel.

DURGAPUR A CHALLENGE AND AN ANSWER

Four years ago—in 1956—the sun set on a skyline of jungles, fields and marsh in a western corner of Bengal. Today, the morning rays are reflected against a row of bright chimneys and tall silvery furnaces. A new steel town has sprung up in barely four years as a challenge to the modern engineering skill. Durgapur has become yet another industrial shrine of modern India, a great centre of pilgrimage.



View of the 24" medium section mill.

Durgapur Steel Project was born out of the recommendations of a Colombo Plan team, headed by Sir Eric Coates. The team was required to investigate the possible sites in the Bihar-Bengal area and suggest a suitable site for locating a one-million ton steel plant. The Government accepted the report of the Coates Mission submitted in April, 1955, and a consortium of thirteen leading British firms was organised in August, 1955 to undertake construction of a steelworks.

On October 31, 1956, the Government of India entered into a contract with the consortium, the Indian Steelworks Construction Company Ltd. (ISCON), " to construct and equip for the Government of India a complete iron and steelworks at Durgapur in West Bengal".

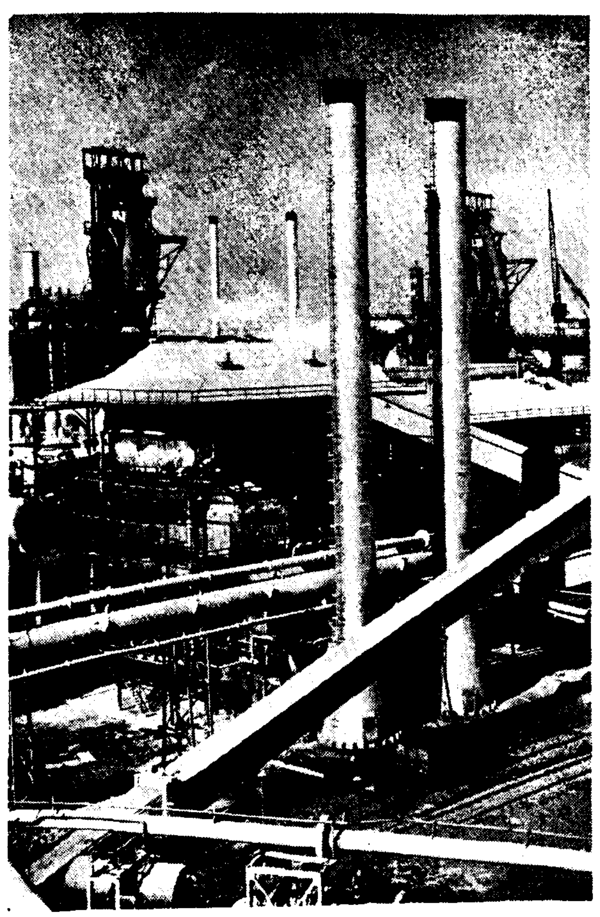
Assistance was given by the U. K. Government in the form of a loan of £ 15 million for financing the Steel Project and a further private loan of £ 11.5 million came through Lazard Brothers from five British banking houses.

The contract is of the value of Rs. 138 crores of £ 100 million, of which £ 50 million were used in Sterling for overseas purchase and the rest in Rupees in India.

The construction of the Steelworks was to be a four-phased programme and now it is in the last lap nearing completion this year.

THE STEEL STRIDE

December 29, 1959, was a historic date for the Project when the President, Dr. Rajendra Prasad, formally inaugurated production. The first blast furnace began producing pig iron needed for steel making and for internal sale and export. The second unit of the steelworks, the steel melting shop, started functioning on April 25, 1960, when the first open hearth furnace was tapped. This was quickly followed by the commissioning of primary rolling mills, namely, the 42″ Blooming Mill and the 32″ Intermediate Mill on May 9, 1960 and May 11, 1960, respectively, when the first steel ingot was shaped into heavy blooms. The continuous billet and sleeper bar mill turned the bloom into the first billet on June 20, 1960.



Blast Furnaces at Durgapur Steelworks.

The second coke oven battery started production on December 27, 1960 and the second blast furnace was inaugurated by Sardar Swaran Singh, Minister of Steel, Mines and Fuel on February 2, 1961.

Besides a number of auxiliaries, like coal washeries, oxygen plant, lime and dolomite plant, the desiliconising plant, the central engineering and maintenance shop and foundry, the by-product plants to extract a long range of by-products from the rich coke oven gas were also commissioned.

The Units commissioned so far have been functioning very successfully. Till the end of December, 1960 the Steelworks produced 4,27,495 tonnes of hard coke, 3,21,868 tonnes of pig iron, 79,347 tonnes of blooms and slabs, 65,276 tonnes of billets and sleeper bars and 1,460 tonnes of sleepers.

The by-product plants have also given a good account of themselves. Till the end of 1960, 4,117 tonnes of sulphuric acid, 3,796 tonnes of ammonium sulphate, 16,793 tonnes of crude tar and 136 tonnes of naphthalene were produced.

Roughly, the value of the sale of the products is as follows:

Pig iron (internal sale)	Rs.	4.18 crores
Pig iron (export)	Rs.	25 lakhs
Billets (internal sale)	Rs.	2.68 crores
Billets (export)	Rs.	11 lakhs
Blooms	Rs.	2 lakhs
Sulphate	Rs.	9 lakhs
Sulphuric acid	Rs.	37,000
Crude tar	Rs.	17,000
Cresote oil	Rs.	4,000
Nut coke and coke breeze	Rs.	3 lakhs

RAW MATERIALS

The Steelworks draws its main raw materials from Orissa-Bihar-Bengal region. Coal come from Ranigunge-Jharia fields and Barakar, all within 60 miles of Durgapur. Iron ore come from Bolani Mines in the Gua region of Keonjhar District of Orissa, 260 miles from the Steelworks, limestone from Birmitrapur of Sundargarh District in Orissa within 250 miles of the Steelworks and dolomite from Jainti, 445 miles away in Jalpaiguri District of West Bengal. Search is being made for additional sources of raw materials.

PERSONNEL

The construction of the township and the Steelworks are proceeding side by side with the operation. At present (February 1961) the steelworks employ 838 technical officers, of them 61 are British personnel. Besides, there are about 100 non-technical officers. There are 3,460 Class III staff on the technical side and 1,835 on the technical side. The Class IV staff on the technical side, including unskilled workers, number 2,550 and on the non-technical side there are 1,031 Class IV staff.

The monthly wage bill for December, 1960, ran to nearly Rs. 1,458,200.

The Hindustan Steel did not experience much difficulty in recruiting senior technicians as superintendents, assistant superintendents etc., nor in the lower ranks as skilled workers and operatives.

It is in the middle ranks as foremen that the required number with adequate experience was not available. The Government through the help of British Iron and Steel Federation obtained the services of many British technicians who now work at Durgapur, in most cases as foremen and general foremen, and in some cases as assistant superintendents.

TRAINING

As it was decided to erect three one-million ton steel plants simultaneously, the problem of recruiting the operation and maintenance personnel with requisite experience became a difficult one. The government tackled it with the generous assistance given by the industrially advanced countries to train our qualified young men in various branches of steel making.

So far, 340 graduate engineers and foremen have been trained abroad for this project. Of them 107 had their training in the United States, 190 in the United Kingdom, 42 in Australia and one in Canada, of the 119 who are under training now, 38 are in the United States, 68 are in the United Kingdom and 13 in Australia. Fortyone engineers are undergoing training in India. Apart from the graduate engineers who will work in supervisory positions, a number of operatives was also trained abroad. Twenty-eight of them were trained abroad and 38 are still under training in the U. K. and Australia.

The Hindustan Steel has plans to open regular training institutes for the operatives and other technical personnel required for expansion and future needs.

As a necessary and important adjunct to the Steelworks, the township, which will house nearly 10,000 employees, have come up at a quick pace. An area of 16 sq. miles was acquired for the purpose.

Already, nearly 5,500 houses have been built and occupied in two zones of the township and another 2,000 houses are under construction. The third zone is being taken up for construction to house more employees as the Steelworks expand to 1.6 million ton capacity during the Third Plan.

Besides the residential buildings, one higher secondary school, three primary schools, three hostels, four neighbourhood shopping centres, two small guest houses, one big guest house (Director's Bungalow), one temporary hospital have been completed and two community centres are under construction.

The water supply to the township drawn from the Durgapur Barrage on the Damodar river has been stepped up from two lakh gallons daily (which was mostly drawn from tube wells sunk in the bed of the river) to 20 lakh gallons of protected water daily in July 1960. This will be further raised to 60 lakh gallons per day in May 1961. The per capita consumption is estimated to be 60 gallons per day.

The township which will have more than 120 miles of modern roads when it is completed has now 28 miles of permanent roads, and 74 miles of roads are under construction.

The afforestation aspects of town planning are not lost sight of and more than 200,000 trees have been planted. The Durgapur Steel town won the State prize for best tree planting in 1958.

The steel town draws its power supply from the Damodar Valley Corporation's power grid. The power consumption has gone up from 300 kva in 1957 to 3,800 kva in 1960.

TRANSPORT

The Steel Project has to transport daily a large number of employees to the works and back. Forty-six buses run 65 trips daily between the Steelworks and the two zones of the township. Besides these services, the Project runs many public transport services to the Durgapur railway station and to the nearby areas for the convenience of the general public.

AMENITIES

The township is planned in such a way that its broad divisions will be self-sufficient units. There will be a medical unit, neighbourhood shopping centre, a primary school etc. Each zone will have a higher secondary school and a community centre.

At present the township has a temporary hospital with 78 beds, which will later be converted into a medical unit. This hospital is well equipped with modern medical appliances and meets not only the needs of the population of the steel town but also of the adjoining areas. Work on a permanent modern hospital with 250 beds on an area of 40 acres will start soon.

There is a public health section manned by a health officer and requisite staff. Apart from doing the routine conservancy work, this unit is also responsible for anti-malaria and other types of preventive hygienic campaigns. A field medical unit, conveniently situated, treats cases of accidents inside the Steelworks.

The township has, at present, a primary school and a higher secondary school. The high school which started barely with 99 students on its rolls in 1956 has 550 students now. Construction of three primary schools has been completed and regular classes will begin shortly.

For the convenience of the operation staff the project authorities have opened two big canteens inside the Steelworks and nearly three thousand people are catered by them daily. More canteens will be opened as the buildings are ready.

Amenity centres where the workers can go for recreation and refreshment will be opened at important places in the plant area. These are planned on modern lines and will prove useful for a steel plant working round the clock.

THE PROMISE OF THE FUTURE

Durgapur is fast becoming a centre of industrial activities with the expansion of existing projects and construction of new ones in the area.

While Durgapur Steel Project proposes to expand its capacity to 1.6 million ingot tons annually, the Government of West Bengal has decided to start a coal washery and to treble the capacity of its coke ovens plant and the thermal project at Durgapur in the near future. Preliminary work in connection with the laying of a pipe line for carrying coal gas from the West Bengal Coke Ovens to Calcutta for domestic use has also started.

A thermal power plant set up at Durgapur by the Damodar Valley Corporation with a capacity to produce 150,000 kws is due to go into commission shortly. Work is progressing on a coal mining machinery project under the Heavy Engineering Corporation, a Government of India undertaking, with assistance from the Soviet Government.

Decision has been taken by the Government of India to set up an alloy and special steel plant at Durgapur during the Third Plan with an initial capacity of 80,000 tons annually. There are also proposals for starting an opthalmatic glass factory and a fertilizer factory.

In the private sector, a project for the manufacture of boilers and ancilliaries is coming up under the management of the A. B. V., a joint enterprise of the A. C. C., Metropolitan Vickers and Babcock & Wilcox Companies. A number of refractory works have also been set up in the same area.

To meet the increasing demands for research and training facilities, a Central Mechanical Engineering Research Institute has already started functioning at Durgapur and the construction of a Regional Engineering College is in progress.

Besides being the focal point of an industrial complex, Durgapur is also the centre of a vast network of irrigation canals forming part of the multipurpose projects like the Damodar Valley Corporation, the Mayurakhshi project and the Kangasabati project. An 85 mile navigation-cum-irrigation canal from Durgapur to Calcutta is on its way to completion.

A number of important industrial towns are within a comfortable distance of Durgapur. Ranchi (Headquarters of Hindustan steel Limited, National Coal Development Corporation), Sindri (Fertilizer Factory,) Chittaranjan (Railway Locomotive Works,) Burnpur (Indian Iron and Steel Co.) Ranigunj (Paper Mill, Ceramics, Aluminium Factory and Collieries) and Jamshedpur (Tata Iron and Steel Co.) are conveniently connected by railway and motorable roads.

The tempo of progress in and around Durgapur can be measured, further, by the proposed construction of an all-concrete express highway between Calcutta and this sprawling industrial area.

DURGAPUR STEEL WORKS

Annual Capacity

Heavy Forging Blooms	10,000 tons
Merchant Sections	240,000 tons
Forging Bars	60,000 tons
Sleeper Bars	60,000 tons
Light Sections	30,000 tons
Wheels and Axles	45,000 tons
Billets for sale	150,000 tons
Pig Iron	350,000 tons

BY-PRODUCTS:

Ammonia sulphate	57 tons daily
Crude tar	156 ,, ,,
Benzene	6.240 gallons
Toluene	884 ,,
Xylene	182 ,,
Solvent Naptha	146 ,,

BHILAI TECHNICAL INSTITUTE

A REVIEW OF TRAINING AT BHILAI

THE Technical Institute of the Bhilai Steel Project started functioning with effect from June 8, 1959, when the training of skilled worker trainees was started. Prior to the functioning of Bhilai Institute, training was being given in the USSR in the case of engineers and operatives, and in the engineering firms in India in the case of skilled-worker trainees. In 1960 as the major departments of the steel plant went into production, the foreign training scheme tapered off and sending of skilled worker trainees to the engineering firms was also stopped.

The original contract for sending 686 persons for training to the USSR has been completed with the exception of one person who is being sent now. Subsequently, it was also agreed to send 50 more trainees to the USSR for training. Against this, 34 engineers and operatives have already gone to the USSR.

TRAINING PROGRAMME

The Bhilai Technical Institute has drawn up a comprehensive training programme for 1961 and the subsequent years.

The Institute will, moreover, undertake to train the personnel required for expansion and it is also expected to train part of the personnel required for the fourth steel plant at Bokaro.

GRADUATE APPRENTICES

During the year 1960, 101 graduate apprentices completed their training in the Bhilai Institute and were transferred to regular establishment. So far 258 graduate apprentices have completed two years' training in the Institute and have been promoted as junior engineers.

In view of the commissioning of the major departments of the Bhilai steel plant, a two-year scheme of training involving general training in the first year and specialised training in the second year coupled with a minimum of theoretical class-room lectures, has been started in Bhilai itself.

It has been decided to train 100 graduate apprentices per year in the Institute.

OPERATIVE TRAINING

Operative training is mostly 'in-plant' training in the respective departments to which operatives are attached. However, they are given a general training for the first two months in the particular department and rest of the period they specialise in the particular section.

The training period of operatives has now been raised from one year to two years. So far, 723 operatives and skilled worker trainees have completed their training and have been absorbed on regular strength.

SKILLED WORKERS

The training of skilled workers started in the Bhilai Technical Institute on June 8, 1959. Some 289 trainees completed their training in Bhilai itself during 1960 as against 115 in 1959 and 15 workers were sent to engineering firms during the year under review, as against 268 sent in 1959. So far, 954 skilled worker-trainees have completed their training and have been absorbed in regular strength.

ARTISAN TRAINEES

The training of artisan trainees for the permanent phase started in August 1959 and 51 artisan trainees completed their training in 1960. These trainees were trained exclusively in the Training Shop of the Technical Institute. From this year, the training period of these trainees has been raised from one year to two years for craftsmanship certificate-holders and three years for raw matriculates. The training of 150 "D.G.R.E." and 50 matriculates has been started in 1961 and the same number is likely to be recruited in 1962.

The Bhilai Technical Institute has trained 54 trainees for the Durgapur Steel project, and 55 vacation

(Continued on Page H.49)

Progress of the Steel Industry and the Problems Confronting it

By A Special Correspondent

THE last year of the Second Plan is noted for its difficulties as well as achievements. For the Steel Industry particularly it will be an outstanding land mark because the fruits of expansion plans of the two major producers in the private sector began to be derived while good progress was recorded in the three larger sized steel plants in the public sector. It is expected that, by the middle of this year, work on the construction of the various departments in the steel plants in Rourkela, Bhilai and Durgapur would be completed. In fact, with the commissioning of the Wide Strip Mill at Rourkela and the Sectional Mill at Durgapur nearly all the important units have been commissioned into production. The problem henceforth will relate mainly to the gearing into full production of the newly installed capacity and the achievement of the maximum return on the colossal investment that has been incurred in the past few years. It can now be stated that the total outlay in the steel industry is over Rs. 750 crores and that we have a definite obligation to make effective use of the large new capacity. Large debits have been incurred in importing the required plant and machinery and we have to adhere to a plan in regard to the payment of interest and instalments as and when they fall due. The mere fact that a good portion of the foreign debt in respect of Rourkela plant will not be payable for some years should not lull us into a false sense of complacency.

The foreign exchange requirements, so far as the two producers in the private sector are concerned, have been mainly provided by the World Bank while the U. S. S. R. has extended a Rouble credit on a package deal basis for constructing the Bhilai unit. West Germany has permitted deferred credit arrangements for erecting the Rourkela plant. In regard to the Durgapur unit a consortium of British companies has provided the required foreign exchange, repayable over a period of 9 years.

When the estimates for constructing the three plants of the public sector and expanding the capacity of Tata Iron and Steel Co. Ltd., and Indian Iron and Steel Co. Ltd., were drawn up, it was somehow assumed that not much difficulty would be experienced in servicing the foreign credits and making also the payments towards instalments on the due dates. Even rough calculations indicated that a steel plant having a million-ton capacity and costing about Rs. 180 crores would pay for itself in a period of 5/6 years taking into consideration also the time for completing the plant and gearing it into full production. It was assumed that the output of 2½ million tons of steel in ¾ years would lead to a saving in imports of common steel to the extent of Rs. 180 crores or thereabout with the result that the net displacements of imports alone

(Continued from Page H.48)

trainees sponsored by different Engineering Colleges in India.

FACILITIES

The Institute has a special Assembly Hall where lectures to all categories of trainees are delivered from time to time by experts of various departments and important personalities visiting the plant.

The trainees of the Technical Institute have also prepared a model for Blast Furnace, which was displayed at the Congress Exhibition at Raipur and at Gwalior. This model was prepared within a month.

The Institute has been equipped with a library, which has at present about 5,000 books.

Trainees are provided with hostel accommodation. There is at present a hostel to accommodate 150 trainees and another hostel is likely to be constructed in the near future. A proposal for a third hostel is also being prepared.

The First Annual Day of the Bhilai Technical Institute was celebrated on August 16, 1960.

would lead to the release of foreign exchange for paying interest and instalments towards the principal amounts. As the expansion plans cost very much less the problem of repayment in the case of both TISCO and IISCO was regarded as much easier.

The actual developments, however, have come about in a different way. Apart from the fact that the cost of construction has considerably exceeded the original estimates, much longer time has also been taken to complete the work of construction. As a consequence, it may take another two years at least to achieve full production.

Recent experience in this regard has, however, not been happy. Actually, the newly created capacity has not been put to effective use. Unexpected teething troubles have been experienced, particularly in Rourkela, while in Jamshedpur and elsewhere it has been found that a much higher level of output can be achieved with some modifications to plant lay-out and design. Above all, the bottleneck in regard to transport of raw materials and shortages of limestone, coal and iron ore, as the case may be, have led to lower efficiency in operation or delay in the commissioning of newly erected coke ovens or blast furnaces. It is only with serious efforts and a careful understanding of the various problems a slight improvement in the efficiency of the working of the steel plants has been reported latterly and the output of iron and steel, coke and by-products has tended to increase.

But it has not been adequately realised so far that much valuable production has been lost and that an already difficult balance of payments position has been made even more complicated. The lack of co-ordination between the various Government departments, defective planning and inexperience in executing major projects has been reflected in a huge loss of output. This has meant heavy expenditure in terms of foreign exchange on imports making it more difficult for the country to service 15 foreign obligations and pay also the instalments as scheduled. The failure to secure the anticipated increase in production of steel and other items and the using up of whatever sums released through the net displacements of imports for other purposes has compelled us to ask the West German Government to extend the credit provided by the suppliers for importing steel machinery so that repayments could be made more conveniently over a longer period. It is only after prolonged negotiations that a satisfactory settlement in this regard was reached recently.

With regard to Bhilai no difficulty has been felt about the repayment problem as the credits are for a fairly long-term period and the interest charged is the rather low rate of $2\frac{1}{2}$ per cent per annum. Also, no foreign exchange is involved either in servicing or repayment of the loan instalments as the U.S.S.R. has more or less agreed that it will accept payment in rupees and also effectively use such rupees for purchase of goods and services in this country. One of the most significant developments in the past few years is the sharp increase in the two-way trade between India and the U.S.S.R. In fact, between India and the countries in the communist bloc on the Continent of Europe it is expected that there will be a continual increase in both the quantum and value of trade on a bilateral basis. It is even suggested that there may be a doubling in the value of foreign trade within a short period.

In respect of the Durgapur project, the problem of repayment has not arisen in a series form while the two companies in the private sector have started repaying the loans taken from the World Bank on the stipulated basis.

In view of the fact that the investment in steel companies during the Second Plan period has been over Rs. 600 crores and a good portion of it in foreign exchange the question has been asked how this large investment has yielded the desired results and how we have proceeded with a proper accounting of the expenditure involved in the payment of interest in foreign exchange and also repayment of the principal amounts. While, as stated above, only TISCO and IISCO have started deriving tangible benefits out of the expansion plans and the three units in the public sector will be able to maximise their output only in 1963 or thereabout it has been complained that there could have been a much larger increase in output of pig iron, steel billets or other items, if there had been more careful planning and greater thought had also been given to the completion of work on the various departments so that there could be continued operation and the newly installed machinery could be fully utilised after the trial runs.

As events have developed, on account of the coal shortage, three new blast furnaces could not be lighted for a long time, even though they were ready, as the required coal supplies were not available. Besides, it is stated that in Rourkela, after the initial difficulties were got over, available capacity could not be fully utilised and pig iron in larger quantities could not be produced on account of the difficulties relating to the pig casting machine and the delay in the completion of

the steel melting shop. Also, the slabs could not be rolled into flat steel until recently because of the dely in commissioning the wide strip mill.

The various difficulties can surely be expected to be got over by the end of this year. But it would be no exaggeration to say that over two million tons of steel output has been lost in the process which would really mean that the total investment on the steel plant has been increased to this extent especially as the lost production cannot be got back. Besides the loss of the valuable production the delay in the completion of the new plants has meant a corresponding delay in the execution of the expansion plans. It had been earlier feared that, for a time, there would be a glut of steel and that the producers may experience serious difficulties in stepping up exports. There was even a controversy on this subject and it was urged by some that further expansion of capacity should be at a much slower rate. There is actually no room for controversy as there is reason to believe that the shortage will continue to be in evidence for quite a long time and that, without a determined bid to complete the expansion of all the existing producers on the basis of a definite schedule, it may be necessary to import one million tons of steels, on an average, if not more, during the Third plan period.

In the annual report of the Commerce Ministry recently published it is estimated that the demand for steel was for over 5 million tons in 1960-61 while internal production was only 2.6 million tons. Imports were of the order of 1 million tons so that availability was only 3.6 million tons and demand may continuously have to remain unsatisfied for sometime. It is expected that there will be an increase in output during the current year to 3.5 million tons. It can naturally be expected that there will be a further increase in the demand for steel specially as there is a boom in factory construction and there will be a larger outlay on third plan schemes. Residential building also has assumed larger dimensions. Under the circumstances, there is no prospect of any large surplus in indigenous output emerging as even with all the steel plants working at full capacity total production may not be more than 4.5 million tons. This would imply that if the demand has to be met in full there will be continuing imports of about 1 million tons and that the gap will grow bigger after 1962. If the expansion plans take a long time to be completed unprecedented difficulties might arise even with a higher indigenous output. These are the paradoxes of a growing economy.

It is, therefore, of the utmost importance that, during the current year, when all the steel plants will be in full working, a careful study is made of the various difficulties experienced in operating the newly installed plant and machinery. The difficulties experienced in mining and transporting the required raw materials should also be correctly understood and the necessary remedial measures adopted.

While there are many lessons to be learnt from the construction of the three steel plants in the public sector it is felt that the problems relating to the transport of raw materials and the development of mines on the planned basis have not been given proper attention. With a view to conserving metallurgical coal reserves it had been assumed that there should be a larger use of blended coal and the washeries would have to play an important role in helping the use of slightly inferior grades of coal for smelting purposes. The inexcusable delay in the erection of washeries in the public sector and the need to get iron ore and limestone supplies over much longer distances have had complicated effects. It has been complained that, apart from irregular receipts of raw materials, the deterioration in quality has been responsible for the newly installed machinery operating at only about 80 per cent of capacity in Jamshedpur and Asansol. It is only latterly that a serious effort has been made to meet the requirements of the steel units more fully and step up production to the maximum extent possible. It would appear, however, that the Railways cannot move much larger quantities. The Railways have no doubt done a magnificient job. But there can be an increase in the volume of freight traffic handled by 10 per cent with greater efficiency, even with the existing capacity, with quicker turnround of wagons and co-operation from all quarters. If the Railways have to carry a much larger traffic more expeditiously there will have to be larger additions to rolling stocks while the necessary adjustments will perhaps have to be made in the track capacity besides greater attention being paid to dieselisation and electrification of important sections particularly in North East India. Recently the Railway Minister indicated that the much larger traffic offering can be efficiently handled only with a larger expenditure and the necessary adjustments. The transport question has obviously to be given greater attention as a much more difficult situation might arise in the latter half of this year with a general increase in industrial and agricultural output. The new steel plants alone will be accounting for originating traffic of over 20 million tons.

It has, therefore, been suggested that, before the end of 1962, the various bottlenecks and shortcomings should be overcome both in the operation of the steel plants and in the transport of the required raw materials.

While these questions are being attended to the work involved in connection with the expansion of the capacity of the five major units both in the public and private sectors should be pushed through. As indicated earlier, an entirely new situation has arisen and there is no prospect of this country emerging as an exporter of steel in the near future.

The earlier mistakes should not be repeated. Available resources should be utilised effectively. Though the steel industry has grown greatly in stature in the past few years the lack of a proper understanding of the issues involved and the absence of a sense of urgency have been responsible for the country sustaining huge losses in terms of foreign exchange on account of the need for permitting large imports of steel. Somehow, in the First Plan no serious steps were taken to expedite the expansion plans of the existing producers while no thought was given to the establishment of a large sized plant in the public sector. The delay in completing the schemes of both Tata Iron and Indian Iron has been costly, not to speak of the fact that the changes in the estimates relating to the Rourkela plant and the various experiments during the course of its construction effectively pushed back the schedule of construction by several years. There is a danger of these mistakes being repeated again if ideological considerations are not thrown aside and the maximum benefit is not derived from the existing set up of the steel industry.

For reasons which have not been clearly explained the expansion plans of the steel units relate only to those in the public sector. In spite of the fact that both TISCO and IISCO have signified their anxiety to proceed with the further expansion of their installed capacity and it has been amply demonstrated that the cost of expansion, with the most required facilities already created, will be much cheaper, there is somehow an insistence to proceed with the construction of a larger sized unit at Bokaro. The necessary preliminary work is being done and it has been assumed that the Bokaro unit would be able to produce one million tons of steel ingots in order to enable a target of 10 million tons to be reached by 1966.

It has been already announced that the capacity of the Bhilai plant should be increased to 2.5 million tons of steel ingots from 1 million tons, Durgapur to 1.6 million tons from 1 million tons and Rourkela to 1.8 million tons from 1 million tons. The capacity of the Mysore Iron and Steel works is to be raised by 1 lakh tons. The public sector will, therefore, have a total capacity of 7 million tons which, with the outputs of units in the private sector, will enable a total capacity of 10 million tons of steel ingots to be reached. There will also be capacity for producing nearly 1.5 million tons of pig iron, the public sector accounting for 9.5 lakh tons. There are, of course, plans for producing alloy tool and special steels which are not discussed in this article.

It is estimated that, on the basis of the present trends, the requirements of finished steel and pig iron by 1965—66 would be about 7.3 million tons and 1.5 million tons respectively.

Opinion is divided on the question whether there will be an increase in demand to the anticipated extent and whether it would not be more advantageous to concentrate on the development of the processing industries and secure a larger investment of resources in terms of foreign exchange and technical personnel. While it will certainly be advisable to promote the engineering industries as far as possible, the output of common qualities of steel should also be increased to the maximum extent because we now have a good set up and on the basis of the latest developments steel will not be in surfeit at any stage. With an outlay of around Rs. 600 crores the capacity for production can be easily doubled. It can be expected that, on the lines of the Russian credit, the requirements in terms of foreign exchange for the increasing the capacity of the Durgapur steel project, would also be provided by British interests while efforts are being made to secure credit for the Rourkela plant from the same sources. It is not clear, however, why the capacity of Durgapur and Rourkela is not being increased more ambitiously.

In view of the difficulty involved in servicing even the existing loans care should be taken to complete the new credits on a fairly long-term basis. At the same time, the Governments concerned should make a serious effort to offer as low a rate of interest as possible. The repayment in the case of the U.S.S.R. cannot probably present any serious difficulties as the experience of past few years has suggested that there has been a two-way increase in trade and the exports are such that they do not cause any serious strain on

the economy. It has, however, been suggested in some quarters that the cost of imports from the U.S.S.R. in some cases has been inflated especially as they have to be diverted from other sources. Even so, the interest charged on outstanding loans is so low that it has been regarded worthwhile to import large quantities of plant and machinery from the U.S.S.R. It will be necessary, however, to watch how the trade between the two countries has been developing. In regard to the U. K., ways and means could probably be devised to wipe out any deficit in our trade account on a bilateral basis. But the problem is intractable so far as purchases from West Germany are concerned.

Under these circumstances, there is no point in thinking in terms of establishing a new plant at Bokaro in Bihar immediately because an entirely new project takes at least 4 to 5 years to be completed while large sums will have to be spent on the improvement of railway transport facilities. The expansion schemes will take only 2½ years to be completed besides the cost being less than 2/3rd of the outlay on a new plant. While it would be necessary to have a large-sized plant at Bokaro, in order to broaden further the basis of the steel industry and take care of future requirements, the emphasis at the present moment should be laid on securing the maximum yield from investments which could be achieved only through expansion of the capacity of all the plants, both in the public and private sectors.

So far provision has been made only for the expansion of the capacity of the three plants in the public sector. It is not clear why there has been no serious discussion of the plans of TISCO and IISCO while even Bhadhravati would be stepping its output from 30,000 tons to 1.3 lakh tons by 1962 and there may probably be a further expansion of the capacity in the coming years. The Government has also wisely decided to permit manufacture of pig iron in medium sized units in the private sector as only then the requirements for the purpose of casting can be easily made and there would be a proper division of labour apart from achieving the desired dispersal. The foundries that are being established in different parts of the country might thus be able to secure their supplies more easily. They may even produce the required quantities on their own. It is happy to note that there is also a possibility of a medium sized iron and steel plant being erected in the Neyveli area for producing iron in the first instance with Salem ore and Neyveli lignite coke. Laboratory tests have proved that it is possible to produce iron with Salem ore and lignite. The experience of East Germany has also borne out clearly that iron and steel can be produced with lignite on a fairly cheap basis. If this project comes into being, as it is likely, it can be expected that the beginning of this new industry would lead to the formation of many other engineering industries for which this part of this country has the ideal facilities.

In view, however, of the fact that the output of iron and steel on account of the various projects will not be large it is of the utmost importance that the expansion plans of both Tata Iron and Steel Company Limited and Indian Iron and Steel Company Limited are taken up at an early date. Tatas have had future expansion in mind when the two-million ton programme was completed. It is stated that, with an outlay of not more than Rs. 120 crores, the capacity can be stepped upto 3 million tons of steel ingots while the Indian Iron and Steel Company also can add to its capacity to the extent of 5 lakh tons on a cheap basis. If these two expansion schemes can be pushed through during the Third Plan the Bokaro project can be taken up more leisurely and completed by the second year of the Fourth Plan. It will be much easier to arrange the required foreign credit if the expansion plan of the established producers are taken up first though there is speculation that the Americans on prestige considerations might offer substantial aid for the Bokaro plant. Whatever might the ultimate schedule for the fourth steel plant in the public sector there is no excuse for delaying the scumes of both TISCO and IISCO. The mistakes of the First Plan should not be repeated. It is extremely important the foreign exchange expenditure is kept down as low as possible. The most logical course that should be adopted to stepping up further steel output to 10 million tons would be the effective exploitation of the existing facilities. Apart from the need for securing the maximum benefit out of fresh investment there is also the compulsion to ensure continuous growth in steel output which can be possible only with greater attention to expansion plans.

THIN SHEET ROLLING MILL

The first section of the huge continuous production thin sheet rolling mill "1700" has been put into operation at the Ilyich Iron and Steel Works in Zhdanov (Ukraine). The designing and construction of the first section has been completed in the record-breaking time of 18 months. The builders have placed in position and assembled 255,000 cubic metres of concrete and prefabricated ferroconcrete parts and 22,000 tons of technological equipment, and have laid 568 km. of cables and 1,135 km. of pipelines.

Blast-furnace and Coke-oven Plants

MODERN PIG IRON PRODUCTION

EXCEPT when it is required immediately in its liquid state, the iron produced in the blast furnace is cast in pigs directly it leaves the furnace. The old process of casting in sand pits is still in use, but this is a costly method that exerts a considerable strain on space and labour facilities. It has therefore been replaced in modern iron works by pig casting machines which can be installed wherever convenient in the works and need only a few operators. Furthermore these machines turn out pigs of even size and weight and avoid non-metallic inclusions.

The molten iron is carried to the pig casting machine in ladles mounted on cars. The ladles are of a special design, fitted with supporting and tipping

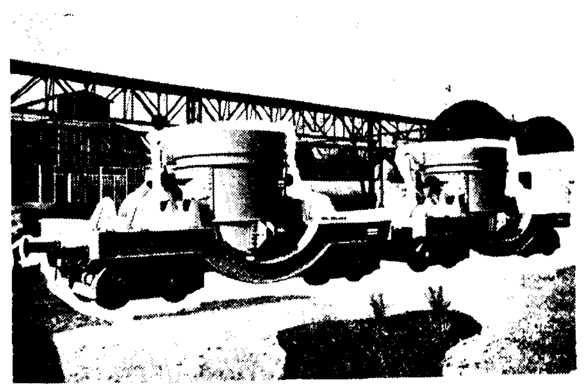
Ladle pouring molten iron into the travelling molds of a double-strand pig casting machine.

trunnions and horn-shaped tipping brackets which fit into a corresponding cradle to support the ladle while it is being tilted by a crane that attaches to it near the bottom. With this design it is possible to keep the molten iron flowing into the runner in a steady, slow stream to reduce splash wastage.

From the runner the stream of molten iron flows over the inclined endless chains of travelling pig molds.

The speed of travel of the chains and rate of lift of the ladle crane can be controlled independently from the operator's stand.

Before the iron is poured into them, the molds are sprayed with lime wash to prevent the metal sticking to the sides. Additionally, a knocker is provided at the head end of the chains to loosen the pigs, which drop down a chute into special wagons

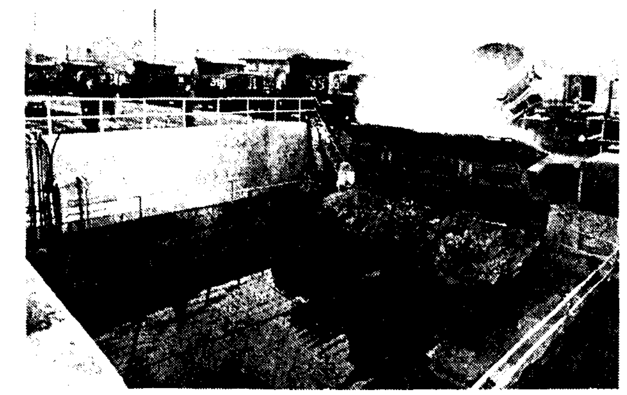


Pig iron transfer cars carrying special 40-ton ladles fitted with tipping brackets for the charging of pig casting machines.

Control pulpit of a pig casting machine. From here the operator can control the travelling speed of the two chains of molds and the lifting rate of the crane which tilts the ladle.

or hopper cars. BAMAG has developed a new chain link design which, coupled with stationary rollers mounted in antifriction bearings, greatly reduces the heavy wear that normally constitutes quite a problem with pig casting machines.

The cast-steel chain links are machined on the treads; the hardened and ground link pins are fitted in austenitic manganese steel bushings and are so arranged as to be fully protected inside the links.

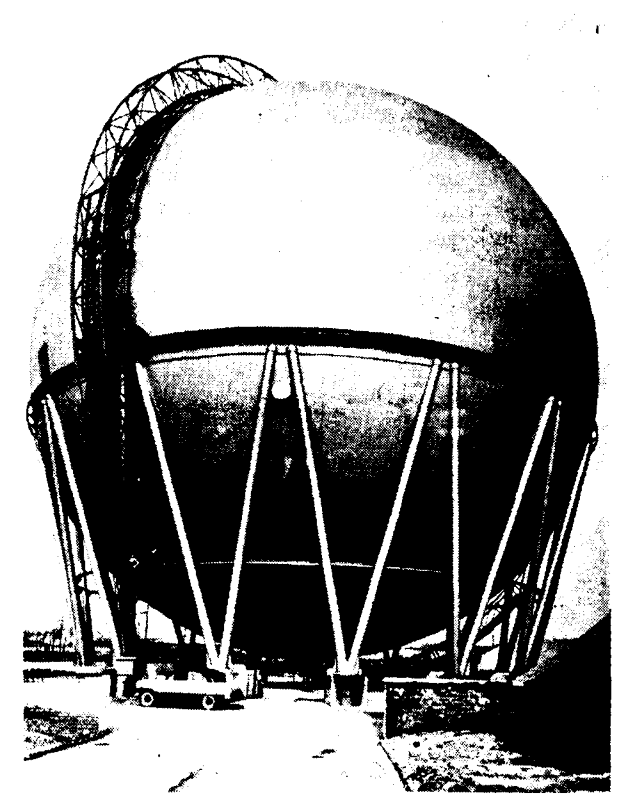


Plant for production of expanded slag. Pouring of slag from slag car on to tiltable distributing bin.

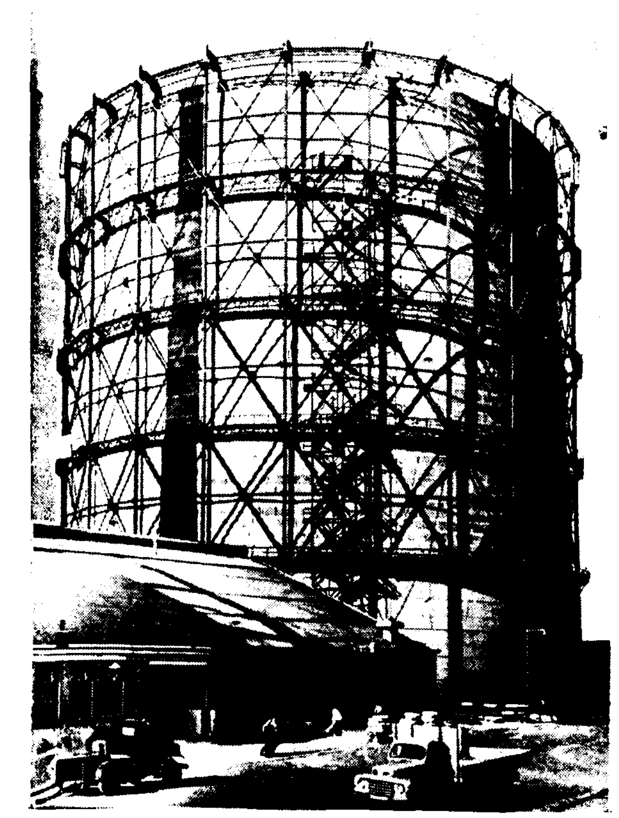
Through these design innovations it has become possible to build doublestrand machines capable of a continuous output of 1600 tons a day with an operating staff of only five men. With the outdated sand-bed technique it would need 25 men to achieve the same pig ouput.

Blast furnace slag was originally considered a worthless nuisance, but has now advanced to a much-demanded aggregate for cement, for use in the building industry, and so on in its granulated or expanded form. BAMAG builds dry granulating mills which produce from slag a vitreous fine-grain product featuring good hydraulic properties and a low moisture content. The molt slag is mixed with a small amount of water and then fed between the grinding discs of the mill, where it is broken up and granulated, the water for the greater part evaporating in the process. From the mill the granulated slag is discharged directly into rail cars if such a layout is possible.

Cinder pots mounted on carriages which have a built-in tilting mechanism carry the slage from the blast furnace to the granulating mill. On an average, the conical pots are built in sizes of about 11



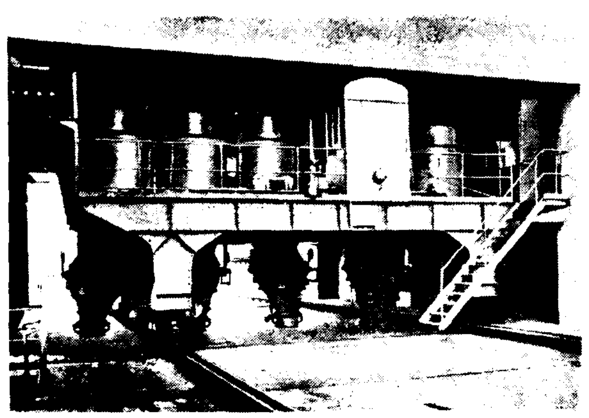
High-pressure spherical gas holder.



Quadruple-lift low-pressure gas holder of 150,000 cubic meters capacity.

cubic meters and are mounted in rings which have rollers instead of the usual trunnions so as to permit a sideways movement of the pot for easier emptying.

More recently expanded slag has come into use as a material for making lightweight brick or concrete. In contrast to granulation, expanded slag requires a somewhat larger plant. The molten slag is first emptied from the pot into a tilting distributing bin and from there poured in a wide stream over a "foaming bed" consisting of a large level, railed platform that can be tipped by a rack and pinion to dump the foamed product into a collecting pit. The platform is equipped with a large number of nozzles through which water is forced at a certain pressure as the slag slowly flows over it. The water is



Car for charging coal into coke ovens. Unit here has a battery of five hoppers and a total capacity of 24 cubic of coal.

immediately converted to steam and inflates the slag to a porous foamed mass which quickly sets and can then be tipped into the pit. Broken up and screened, the product yields a valuable porous aggregate for lightweight bricks and concrete.

ACCESSORY COKE-OVEN EQUIPMENT

At the Butzbach division of PINTSCH BAMAG a complete department of engineers and designers is set aside exclusively for the development and construction of accessory equipment for coke-oven plants, coal stamping machines, and complete coke preparation installations for metallurgical plants and gas-works.

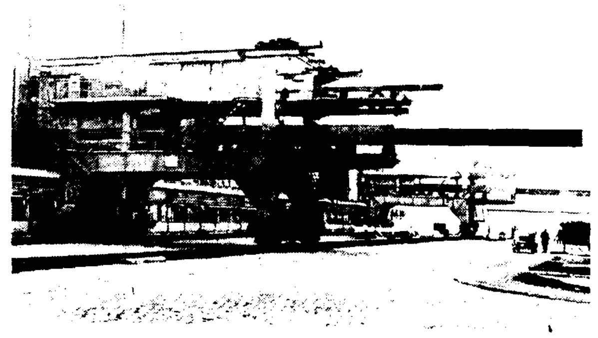
Based on more than fifty years' specialized experience, the present-day department is qualified to tackle every sort of project in this field.

Coke pushers are built in all required sizes for by-product ovens. PINTSCH BAMAG also makes them in combinations with coal stamping machines for use in plants where coal with a very high content of volatile matter is carbonized. Choice can be made between welded and riveted structures.

Coke quenching car and coke guide combined with door extractor.

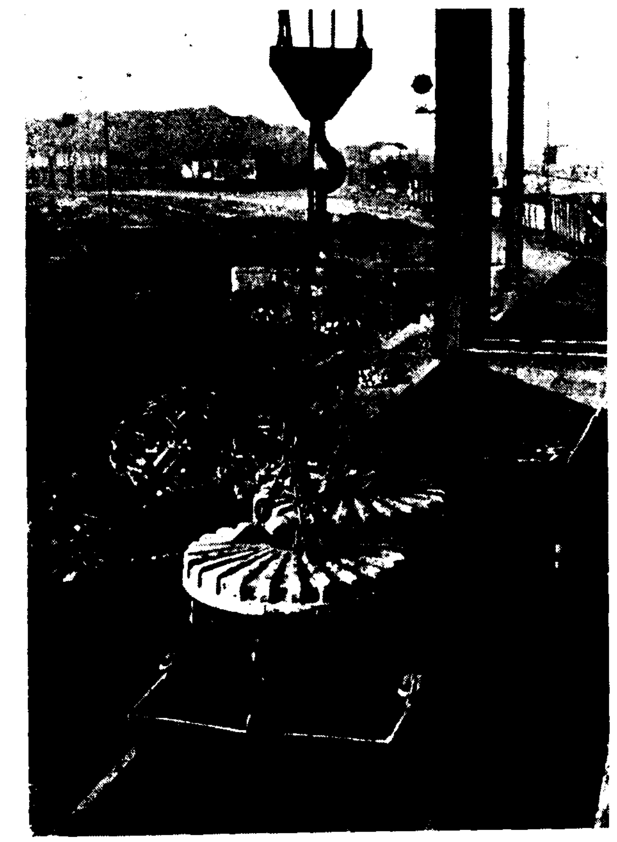
Production at the Butzbach division also covers all other equipment for the operation of by-product coke ovens; included are larry cars for charging the ovens, coke guide cars combined with door extractors, and coke quenching cars of both the self-propelled and the locomotive-operated type. In designing these machines, special attention is paid to providing efficient protection against dirt and wear.

Since 1928 the designers of PINTSCH BAMAG (then the Bamag Meguin company) have been in the forefront of developments aimed at improving the



Coke pusher combined with leveller and door extractor. All drives are electric-powered and can be replaced by diesel engine, pneumatic or other auxiliary drive in the event of power failure.

efficiency of vibrating screens. In the first two years alone a hundred such screens were built in the company's workshops. Today, the number in operation throughout Europe is far in excess of 500.



Lifting magnets loading pigs into hopper cars.

Apart from single machines, the company constructs and erects on site, with its own experienced staff, complete coke conveying, crushing, screening and handling installations for metallurgical plants. In keeping with latest engineering progress, these installations can be equipped for fully automatic operation from a central point, convenient supervision being provided by illuminated circuit diagrams.

GASHOLDERS FOR IRON AND STEEL WORKS AND COKE-OVEN PLANTS

In iron and steel works and coke-oven plants the prime use of gasholders is to store blast-furnace gas, coke-oven gas, ammonia, oxygen, and contact gas.

Mostly, low-pressure storage vessels are used. They are frame-guided or spiral-guided types with a steel or concrete well and are equipped for gas pressures up to 800 mm. w.g. PINTSCH BAMAG gasholder designs incorporate provisions for subsequent erection of telescoping sections. Low-pressure holders are available as single-lift and multiple-lift types in riveted or

Resonance vibrating screen for the classifying of coke, coal, ore and other bulk materials. Capacity up to 500 tons per hour.

welded construction. The construction of riveted tanks with steel flat-bottom wells and straight guide frames is still an important part of the company's activities in this field, especially in mining areas, since this type of design offers utmost safeguard against collapsing of foundations.

PINTSCH BAMAG builds spiral-guided low-pressure gasholders under British licence. Adoption of this design is largely based on requirements or regulations affecting town or provincial planning. Since the normal type of guide frame is not required, the tank is only visible according to the extent of its contents. In the storage of gases which accumulate the sealing water, this being notably applicable to ammonia, the well is constructed in annular-shape of steel or reinforced concrete, allowing the water to be kept down to a minimum.

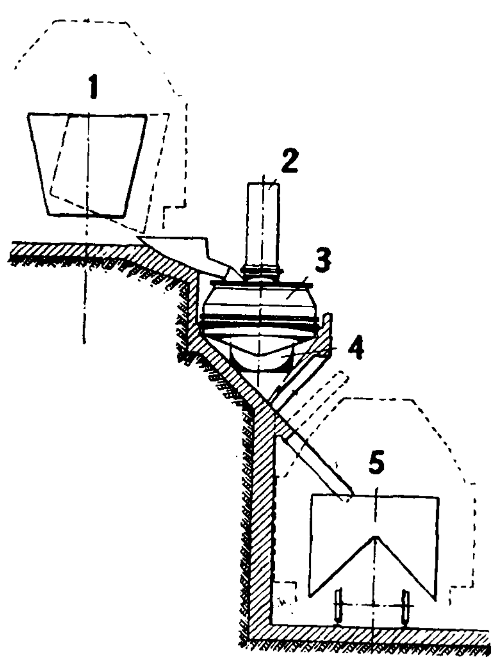
All essential accessories are provided for the gasholders, e.g., contents gauges, heating equipment, lightning conductors, drain tanks with quick-action closures, vacuum seals, etc.

New gasholders are constructed to the operating and erection codes and practices of DVGW.

PINTSCH BAMAG has considerable experience of constructing telescoping sections whilst the gasholder is in service. The company's own staff of specialists is qualified to undertake gasholder repair work of any kind and extent.

As the name implies, high-pressure gasholders are used for the high-pressure storage of gases, enabling a much greater quantity of gas to be stored in the same size tanks as compared with low-pressure storage. They are used in particular where gas is produced under pressure or received through pressure pipe lines.

In metallurgical plants and coke-oven plants the use of high-pressure spherical gasholders is particularly advantageous, as they permit the high-pressure pipe-line transmission of gas using compressors.

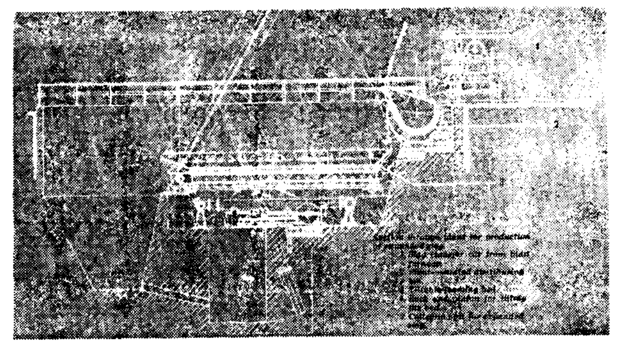


Plant for production of dry granulated slag.

1. Slag pot
2. Air intake
3. Granulating mill
4. Connection to exhaust-steam flue.
5. Rail car to collect granulated slag.

High-pressure tanks and spheres are used in these instances as storage and service vessels for coke-oven gas, pipe-line gas, sewer gas, oxygen, and contact gas.

Additionally, they are well suited for storing carbon-dioxide, hydrogen, liquefied petroleum gas, and so on. PINTSCH BAMAG builds the vessels as spheres or cylindrical tanks, upright or horizontal, in welded cons-



Section through plant for production of expanded slag.

1. Slag transfer car from blast furnace.
2. Pivot-mounted distributing bin.
3. Tiltable foaming bed.
4. Rack and pinion for tilting the bed.
5. Collecting pit for expanded slag.

truction throughout. Spheres are mounted on a tubular supporting structure that is welded at a tangent to the outer shell and rigidly anchored to the foundation. Spheres to hold liquefied petroleum gas (propane, butane, etc.) are provided with a vertical framework. Another type of support designed by PINTSCH BAMAG and registered at the Patent Office is the shell or pan foundation illustrated in the diagram overleaf. The dished parts of the shell are made of standard boiler plates, high-performance boiler plates, and fine-grained structural steel developed by German rolling mills. These fine-grained structural steel components feature a high load capacity, good weldability, resistance to joint fracture, and excellent economy, and are therefore used with preference for constructions such as high-pressure gasholders which are exposed to high stresses. Type and size of foundations are dependent upon the support structure employed and the soil conditions at the site.

Horizontal cylindrical high-pressure vessels are used when only small volumes of gas have to be stored. Capacity can be increased as the need arises by installing further cylindrical vessels.

PINTSCH BAMAG also builds gravity-type high-pressure tanks with and without steel frameworks for the storage of drinking and utility water and groups of storage vessels or tank farms for heavy oil, light oil, benzine, gasoline, other liquid fuels, and molasses, lyes, acids, etc.

Newly Emerging African Nations Speed Development of Natural Resources

ONE new country after the other is becoming politically independent after years of colonial rule and these new governments are turning their attention to economic development plans of major proportions.

Ghana, for instance, has begun work on one of the largest hydro-electric power projects in the world. Nigeria also has a major power project under way.

Africa has a mineral wealth almost second to none. Its known copper reserves, for example, exceed those of Latin America. Africa leads the world in chromite and vanadium, two important metals. And as recent discoveries have shown, the northern part of Africa is rich in petroleum and natural gas. Diamonds and gold are found in many African countries.

The new African nations are literally digging in to develop these underground riches. Here in the Republic of Gabon one of the world's richest manganese deposits is the target of a concerted mining project.

To reach the ore deposits and to insure that sufficient quantities of ore can be brought to the coast for shipment, workers are speeding completion of a 180-mile 42-inch gauge rail line. Three of the seven U13C universal diesel-electric locomotive purchased from the International General Electric Company (U. S. A.) were recently placed in service to assist in building the railroad.

A General Electric service engineer sent to instruct local personnel in maintenance and operation of the new locomotives, said that the new rail line was being built according to the most modern methods. Welded rail joints and steel ties are being used, and pre-fabricated into panels 80 feet long before placement on the roadbed. Track is being laid at a rate of better than a half mile per day, according to the G. E. engineer.

A cableway will carry washed ore concentrates 47 miles from the mine of the rail head at M'Binda in the Republic of Congo where it will be loaded into cars for the railroad trip to the coast. It will be unloaded at the port of Pointe-Noire where storage and ship loading facilities are being constructed.

When the railroad and loading facilities are completed, the four additional locomotives will be delivered from General Electric's Locomotive and Car Equipment Department in Erie, Pa., U.S.A., and all seven will be used to carry the scheduled 500,000 tons yearly output to port. Present plans call for hauling trains of 40 cars, each carrying 47 tons of ore.

In an age when steel is of great importance to the world, manganese, a metallic element which is added to steel to increase its toughness is critical to the industry which purchases 95 percent of the total output.

Manganese is also used as an alloying metal with copper and aluminum, and with copper, tin and zinc to produce manganese bronze and manganese brass.

Compounds of manganese are used in paints electric stortage batteries, and in medicinal and germicidal preparations.

DEMAG's Contribution to Iron and Steelworks

WITH its projects and deliveries of iron and steelworks equipment and complete integrated plants to numerous countries in the world, DEMAG has in the last years made a substantial contribution towards the breaking of new industrial ground, as well as the rationalisation and capacity extention of available industrial plants.

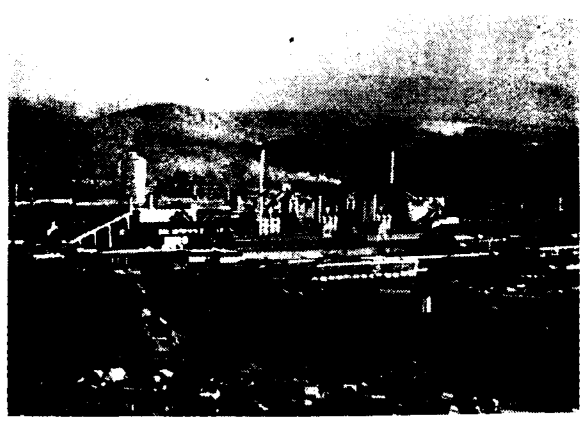
DEMAG's 140 years of experience as one of the world's biggest mechanical engineering firms and supplier of steelworks equipment with 25 subsidiaries and affiliated companies, have basically affected the decision to place orders with this German firm.

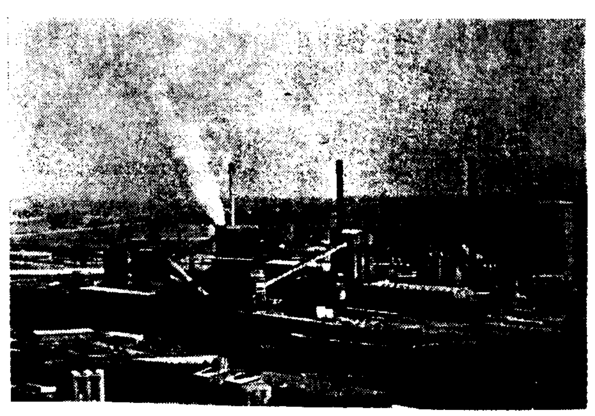
Everything that an iron and steelworks requires in the way of mechanical equipment—from bridge cranes for the loading of raw materials to rolling-mills—is produced in DEMAG's workshops. Over 1,000 patents have been acquired in the course of past decades, and the experience of industrial construction and expansion from all the continents of the world has been concentrated in this one undertaking. It is therefore in the position to plan and build metallurgical works from A to Z, independently and from purely objective and economic viewpoints. It can commence with the exploration and investigation of the raw materials available and proceed right on up to the handing over of turn-key projects. As example we may quote the first Egyptian iron and steelworks at Helwan, which was completed in 1958 and was planned for an annual capacity of 265,000 tons of steel. 1500 designers prepared in Duisburg the plans for the first metallurgical work in South Africa, Burma, in the Philippines, Korea, and for the expansion of already existing works in Japan, the Argentine, Brazil etc.

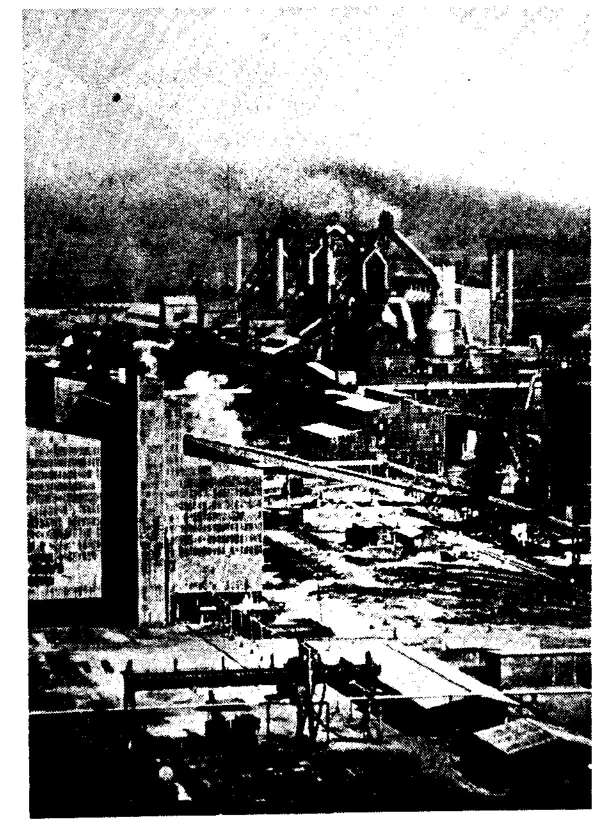
In France, England, Norway and Sweden, metallurgical works already existing were extended, and new plants planned and built. DEMAG also heads the centralized administration for building the first Portuguese iron and steelworks near Lisbon. With regard to the planning of the Rourkela iron and steelworks in India, DEMAG played a leading part, and, together with other large German firms, supplied the equipment required. The hub of the Rourkela rolling mill is the wide strip mill of DEMAG. It is the first German-built mill of this type in Asia.

Since the first large-sized crane of 150 tons capacity was built in 1887, DEMAG can show an uninterrupted run of noteworthy achievements in the field of crane-building. Its crowning achievement was the gigantic floating luffing crane, 117 meters high, with a capacity of 350 tons. The aspect of important ports in Germany and abroad is determined by the enormous DEMAG loading installations. In Narvik DEMAG built the largest ore-handling facilities on the Continent. It also built the loading installations in the port of Amsterdam, the ore-handling installations in Newport-News in the USA, and also many others.

The range of products covered by the general mechanical engineering section of the DEMAG concern comprises excavators, bull-dozers, scraper plants, road-building machinery, canal-making equipment, portable compressors and many other kinds of pneumatic tools, such as hammer drills, concrete







Rourkela—Industry in India

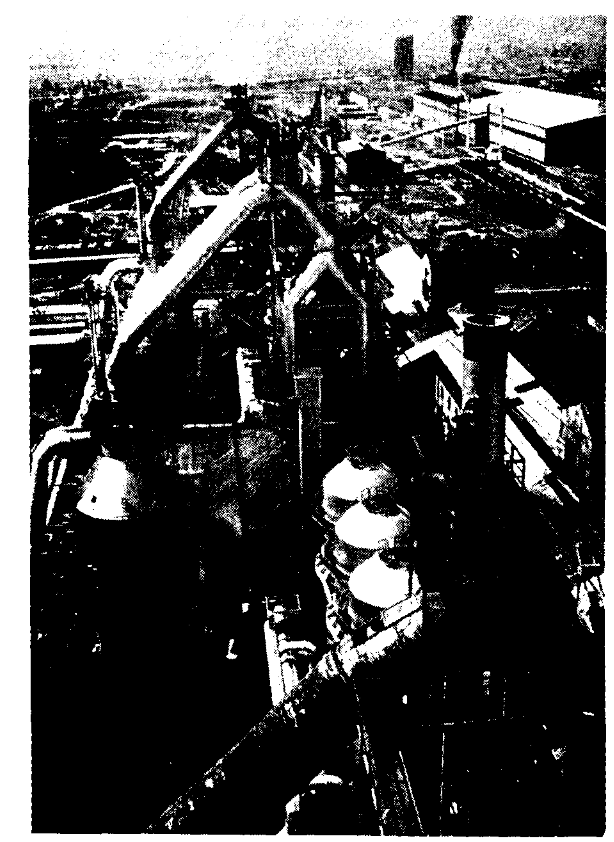
breakers, pile drivers and pile drawers. All these articles of equipment are employed not only in the building industries, but also in the mines, metallurgical works and many other branches of industry.

DEMAG hoists are famous all over the world—so well-known in fact that they are just simply termed "A DEMAG". DEMAG compressors are in use in all the countries of the world. For large-scale gas producers, physico-chemical plants, electrolytic plants, gear units, metal castings and sintered metals, the principal customers are the chemical industry, shipbuilding industry, research stations, municipal works and transport companies.

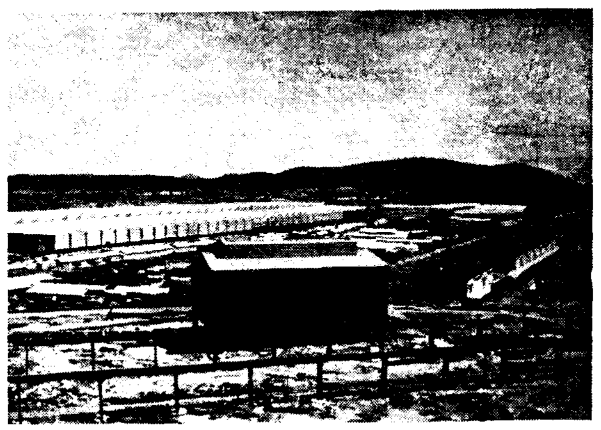
DEMAG's most recent affiliate, the INTERATOM is developing in close collaboration with its partner firm, the North American Aviation, atomic reactors for research and industrial purposes. It has been assigned the task of designing the reactor for the first German atom-powered cargo-ship. Its research reactors are to be found in the universities of Berlin and Frankfurt.

The steel construction department, which has a special works at its disposal in Duisburg, is the complementing and connecting link in production. It supplies steel structural parts, pithead gears, pithead buildings, blast-furnace frames, steel and rolling-mill bays, storage bays and above all, railway and road bridges of steel. In the case of many bridges built in Germany and abroad, DEMAG as head of the centralized administration was assigned the task of carrying out the work. As a result of tireless research work in conjunction with bold incursions into new scientific fields, new designs have been evolved that are trial-blazing for the future. As a visible expression of DEMAG's efficiency in the international sphere is the fact that DEMAG's bridge-building department received the order—in face of the keenest international competition—for 46 bridges, in consequence of a public invitation to tender issued by the Government of Venezuela. Two further orders for over 15 bridges followed, and later for another 5.

The home of new technical ideas, which mean rationalisation and progress, is the "Centre of



View of the group of blast furnaces. In the foreground, left, the blast furnace gas-cleaning system can be seen. In the background, right, is the steelworks.



With a length of 3,069.6 feet and a width of 1,075.2 feet, the rolling mill bay is the largest roofed bay in the whole of India. Here 3 soaking pit cranes and 38 mill cranes with carrying capacities ranging from 12 to 150 tons are in operation. In the foreground, the stripper bay.

Designers"—the heart and brain of DEMAG in Duisburg. Here, the engineers and technicians plan and design plants for customers all over the world. All these technical achievements are only made possible by a close and understanding co-operation between the designers and the men in the dungarees.

MR. RAY—AN INDIAN ENGINEER IN GERMANY

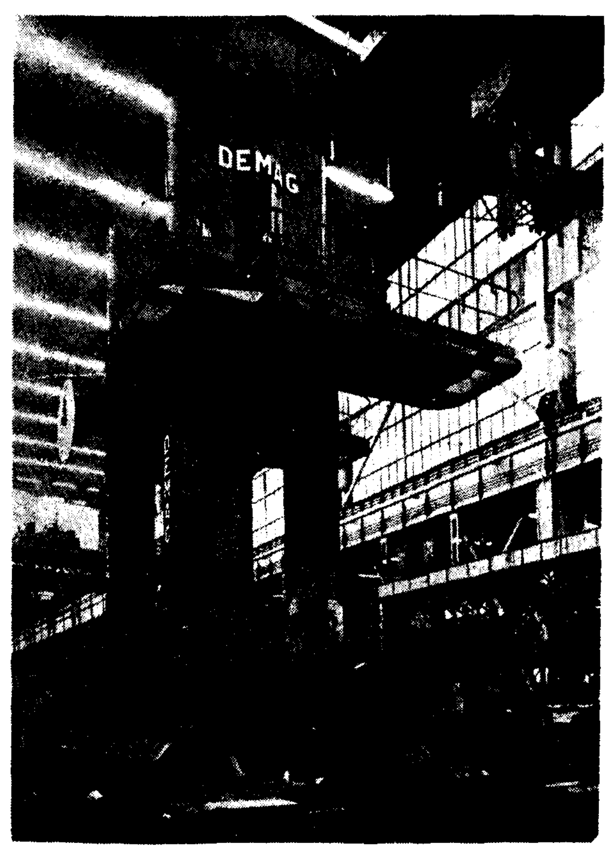
The plant at Rourkela steel works will soon be operated entirely by Indian skilled staff. A great number of engineers and technicians were trained for their responsible tasks for several years in Germany. In German steelworks they worked on machines similar to those delivered to their homeland. Together with their German colleagues, they stood at the control desks, operated the mighty converters in the steel works, helped to tap blast furnaces in the full glare of the white-hot steel, and worked in the laboratories and material-testing shops.

Subrata Ray is one of these engineers. As we were standing in the huge rolling-mill bay of a West German steelworks, watching the glowing steel ingots shoot with a deafening noise from the wide strip mill, we caught sight of him at the control desk of a rolling mill. "We just wanted to have a word with you", we yelled in his ear. He nodded, and a German colleague relieved him for a period.

TRAINING BEGAN WITH DEMAG

Then—in one of the works offices were the roar of the heavy rolling mill was still to be heard—he told us his story: he is a qualified engineer and came to Germany about a year ago with a group of Indian colleagues to receive special training for his future duties at the Rourkela steelworks.

His training with DEMAG began in the Rolling-Mills Division. In the assembly bay, he gained an acquaintance with the various types of rolling mills and helped in the erection and machining of the heavy rolling-mill stands. Following this, DEMAG arranged for Mr. Ray to be transferred to a West German steelworks where he gained experience in all types of work on a wide strip mill. He not only assisted the technicians in charge, but also operated the plant himself, as a foreman.



Precision work and efficiency have earned Demag, the German heavy mechanical engineering company, a world-wide reputation. Today Demag exports to more than 90 countries in all parts in the world. The illustration shows shop assembly of a mill stand for export overseas.

WORK FOR MILLIONS

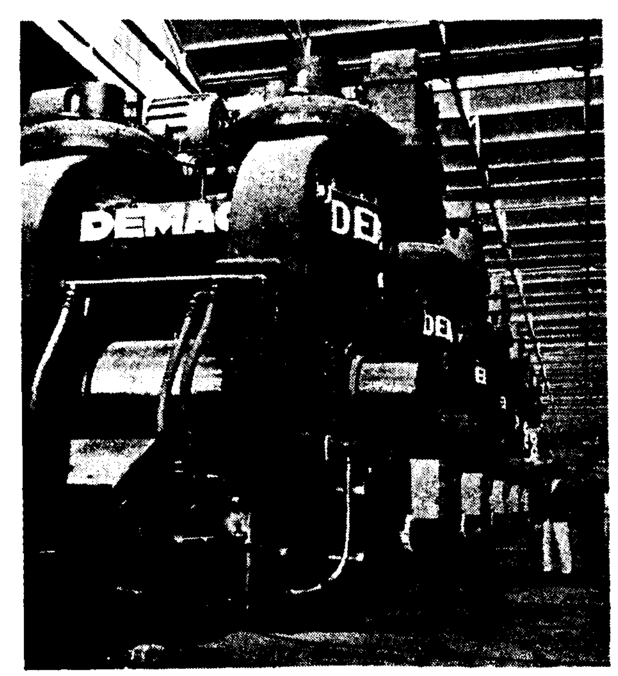
When we asked him a few questions about the way the wide strip mill works, he rather overwhelmed us with a stream of technical terms. We interrupted him for a moment: "Mr. Ray, do you think that the Rourkela wide strip mill will help considerably to raise the standard of living in India?" "Of course, it will. It will be the first wide strip mill in India and we confidently expect that it will be an added stimulus to the car, ship-building and consumer goods industries, and indeed to all branches of industries. These industries will then provide work for many more millions, and so raise the standard of living appreciably.

EXCELLENT CO-OPERATION

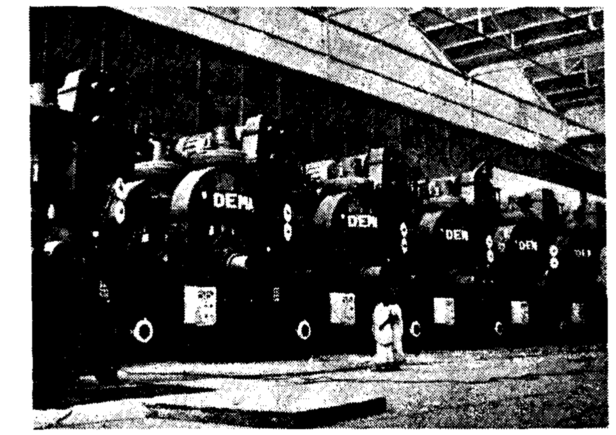
We wanted to ask him further questions, but he waved us away. "Sorry, I just haven't got time. I must get back to the mill". But we managed to get in just one more question: "How did your German colleagues co-operate with you?" Wonderfully well", he said—he was already standing in the doorway—"I learnt a great deal from them and made lots of new friends".

ROURKELA—INDIA'S RUHR DISTRICT

The presence of coal led to the first blossoming of industry in the Ruhr in the last years of the eighteenth century, and nobody anticipated then that the Ruhr



Close-up view of the Wide Strip Mill at Rourkela.



With the official inauguration of the Wide Strip Mill the last of the large-scale plant at the Rourkela iron and steelworks is now complete. This mill will produce wide strips which India so urgently needs. Annual capacity is 1 million tons. The Wide Strip Mill consists of two roughing stands and a six-stand finishing mill which is shown on the picture. It is the most modern mill of its kind in the whole of Asia and can be operated by very few personnel. Production is fully automatic.

district would one day become the industrial nerve-centre of Germany. Today 120 million tons of coal are mined here annually, 19 million tons of steel produced in the steelworks and 85% of the gas consumed in the Federal Republic supplied by the coking plants.

With the erection of the Rourkela steelworks, the creation of a similar industrial centre in India has begun. Although future developments cannot be predicted with absolute certainty, "the coming into operation of the Rourkela steelworks let us hope that this area, known for its mineral riches, may in time become the Ruhr District of India", stressed Dr. Rajendra Prasad, the president of India when the first blast furnace was put into operation at Rourkela in February 1959. He went on:—"Now that the wheels have begun to turn at Rourkela, and that the heaven—sent waters of the Hirakud Dam flow in all directions, we can be sure that we, and especially the people who live in this area, are on the threshold of better times".

* * *

ROURKELA'S WIDE STRIP MILL—HUB OF THE ENTIRE ROLLING MILL PLANT

The rolling mill bay at the Rourkela steelworks is the largest covered bay in the whole of Asia. Having a length of 3,550 feet and a width of 1,285 feet, it covers a total area of 2,247,000 square feet, all of which is

DEMAG's most important sphere of activity is the manufacture of heavy industrial equipment for the iron and steel industry. This German mechanical engineering company plans and builds complete integrated iron and steelworks. Our picture shows the manufacture of converter rings.

roofed in. The entire rolling mill plant of the steelworks is installed in this bay.

600,000 TONS OF STEEL ANNUALLY

The most important unit is the wide strip mill delivered by DEMAG, which will roll 600,000 tons of sheet steel annually and is intended to have an eventual capacity of 1 million tons. The sheet steel produced by this mill will be utilized by industry in the manufacture of many different kinds of goods. The design of the mill conforms to the most modern rolling mill techniques and it is the first German built mill of its kind in the whole of Asia. It consists of two roughing stands and six finishing stands.

But let us now briefly see how this mill works :

FEW OPERATORS NEEDED

The slabs from the blooming and slabbing mill go into the first and second roughing stand to be rolled

The most modern machines are available for the manufacture of heavy machinery in DEMAG's gigantic workshops. The stands for the Wide Strip Mill at Rourkela, the first German mill of its kind in Asia, were built here, too.

down to a thickness of about 0.956 inches. Now the strip rushed towards the finishing mill, like a flat glowing serpent. But, before the metal enters the finishing mill, it passes under a crop-shear which trims the irregular ends, and runs through a descaling spray in which scale is removed by means of pressure water. Whereas in the roughing train, the metal is issued from each stand, so that processing takes place in only one stand at a time, it is in all six stands of the finishing mill at the same time with the speed increasing from stand to stand.

When the strip leaves the last stand having a speed of 40 feet per second, it is sprayed with cold water from top and bottom and then either built up into coils or cut into sheets. Since all operations are carried out automatically, only very few operators are needed to run the mill.

SHEET-STARTING MATERIAL FOR MANY INDUSTRIES

The steel sheet rolled in the wide strip mill has so many varied uses that it is impossible to give a complete survey of them all. It is the starting material used in the building of ships, locomotives, trucks, piping and containers of all kinds. It is indispensable for the manufacture of cars, tractors, agricultural machinery, engines, bicycles, refrigerators, tools, tins and many other articles in daily use. The significant example of Rourkela shows that the importance of a steelworks in a country's economy can be estimated purely on the basis of its output, and of the market this output finds in the manufacturing industry.

Specialists in the manufacture of Rolls for Continuous Mills

AS mentioned in previous press notices, the rolls used for the Morgan Continuous Billet, Sleeper Bar, Slab and Merchant Mills at Durgapur have been manufactured by John M. Moorwood, Limited, Sheffield. This firm have specialised in the manufacture of rolls for Continuous Mills for many years and have developed special roll techniques to meet the most modern requirements in the fast continuous rolling of Billets, Slabs, Sheet Bar and Merchant Mills of all types. They have supplied through Messrs. ISCON and also direct to Messrs. Hindustan Steel Limited, the complete initial fillings of finished grooved rolls and all the spare rolls, together with all the grooving tools and precision master gauge templates for the Morgan Billet, Sleeper Bar and Slab Mill and also for the Morgan Merchant Mill for the rolling of rods, rounds, flats and angles. These precision master gauge templates have been specially designed by John M. Moorwood, Limited, to obviate the top mounting of all the rolls when grooving and redressing, with the exception of the angles.

The Morgan Billet, Sleeper Bar and Slab Mill has now been successfully put into operation and it is of interest to mention the qualities of rolls John M. Moorwood, Limited supplied. The Billet Mill is operating in the Roughing and Intermediate Stands with their Specially Toughened Alloy Spheroidal Graphite Quality Rolls, which give great strength, together with long life between redressings and ensures delivery of a well shaped section to the finishing end of the Mill :—In Stands 1 to 4 employing their Special 'SGSXA1' Quality Rolls with a non slip characteristic which they have developed for the Roughing end of a Billet Mill with excellent results. In the Intermediate Stands their 'SGSXB', Quality is used and in the Finishing Stands their Super Metal Mooralloy Quality is employed. This gives an excellent combination of rolls to produce a well formed billet with a very good tonnage performance. However, they mention that with many Billet Mills they now supply the complete train in their Special 'SGSX' Qualities throughout the Mill with the appropriate 'SGSX' grade in each position, giving a further increase of tonnage performance. In the Finishing end they then would use their 'SGSXC' Quality. For rolling Sleeper Bars, their Specially Toughened 'SGSX' Alloy Spheroidal Graphite Qualities are used up to and including Stand 6, with Stands 7 and 8 in their Mooralloy 'XLM' Quality. However, again with the latest orders, the Sleeper Bar Train of rolls has been superseded with their 'SGSX' Qualities throughout.

For the Morgan Merchant Mill, the complete initial fillings of finished grooved rolls and all the spare rolls, together with all the grooving tools and precision master gauge templates, have now been delivered and are ready to go into operation.

The whole of the above contract was completed and delivered to enable the mills to be put efficiently and smoothly into operation.

British Steel Output begins to expand again

British steel production in April, though affected by a shorter working month, was at an average rate of 471,600 tons a week, according to figures issued by the Iron & Steel Board in London.

The production of steel in April was just above the March total of 471,000 tons a week, and compared with 478,100 tons a week in April 1960.

Allowing for a shorter working month, the rise in steel production in April compared with the March total is seen in London as an indication that output has begun to expand again after the mild setback experienced in the early part of the year. This setback was caused by a fall in the demand for lighter types of steel by the motor-car industry. Now that output is beginning to revive in that industry—following on the relaxation of hire-purchase restrictions earlier in the year—it is probable that the output of lighter steels will begin once more to keep pace with that of heavy steel, which has been in consistently strong demand.

Demand for Building Materials Rising in Southern California

By A Correspondent

OVERSEAS exporters of steel and all other building materials—who have carefully cultivated the Southern California market—should find a rising demand for their products in 1961, according to the Port of Los Angeles' General Manager, J. Bernard Caughlin.

Caughlin said his analysis of the situation was based on recently announced building plans in the area and a noticeable acceleration in the rate of steel shipments since Jan. 1.

A compilation of scheduled projects shows that $ 6,000,000,000 will be spent on construction of all kinds in the southern half of the state during the current year.

"This represents more than 10 per cent of the estimated $ 58,800,000,000 earmarked for construction in all 50 states in 1961," Caughlin noted.

The $ 6,000,000,000 will be spent in this fashion:

$ 2,000,000,000 for homes. Home starts in Southern California should reach 140,000, compared with 1,400,000 which are scheduled for the entire country.

$ 2,200,000,000 for commercial and industrial construction.

$ 1,800,000,000 for other construction, such as schools, public buildings and works, freeways and farms.

Caughlin singled out steel pipe as a construction product that appears to be in greater demand, judging the number and size of shipments that have crossed the port wharves in the past two months.

While it is far too early to obtain precise figures on types of commodities entering the local port since Jan. 1, Caughlin could report on the following imports of pipe and tubing for the first five months of the present fiscal year (ending June 30, 1961):

Country	July-Nov. '60 Imports	Tons
Belgium	.. ..	9,374
Japan	.. ..	5,363
Australia	.. ..	4,917
Netherlands	.. ..	4,011
West Germany	.. ..	2,534
United Kingdom	.. ..	1,757
Sweden	.. ..	95
Italy	.. ..	83
France	.. ..	33
Total	.. ..	28,167

Caughlin said these figures revealed that the spectacular rise in imports of steel pipe, tubes and tubing the port's last fiscal year—82 per cent more than in fiscal '59—was not maintained in the July-November, '60 period.

But during these same months, the buildings of homes and other buildings dipped sharply. The small gain (one half of one per cent) in construction of all types in calendar 1960 was due to a big gain (61 per cent) in engineering construction.

"With plans finalized for a big expansion in construction, especially of homes and commercial and industrial buildings, there seems little doubt that the Port of Los Angeles will be handling increasing tonnages of overseas building materials of all types in the months ahead," said Caughlin.

Programming—the right action at the right time, automatically

By An Engineering Correspondent

INSERT a card, push a button, and a mill works automatically. It's done with programming—second stage of automatic control.

Programming is the automatic duplication of human commands or actions, in the order required, by means of information contained on punched cards, tapes or manual setups. Result: full, continuous utilization of mill capacity assuring uniform operation for highest product quality and optimum production rates.

Westinghouse has developed the PRODAC*, *PRO*grammed *D*igital *A*utomatic *C*ontrol, system around the "building block" concept of packaged static components. PRODAC usually operates from punched cards as this form of providing preselected information has gained wide acceptance and has proved the most reliable and most suitable for heavy industrial use. However, other forms of input can be used if circumstances require.

Programming is not limited to new mills. It is entirely possible and economically feasible for an existing mill to be programmed with the Westinghouse PRODAC system. To determine the practicability of such a step, all present equipment—housings, gearing, drives, motors, power supplies, electrical controls, operator's manual controls, etc.—must be analyzed and evaluated for adaptability to automatic operation. Westinghouse engineers are skilled in making such analyses and in evaluating any modernization required to permit installation of programming equipment.

REVERSING ROUGHING MILLS

One of the earliest applications of programming was on a reversing roughing mill. In this application, a single punched card contains *all* the information needed to control one complete schedule of passes through the roughing mill. Information for each pass includes edger opening, edger speed, horizontal roll opening and speed, spray operation, table operation and draft compensation.

On the lookout, Mill Operator Monitors Automatic Operation of Mill. Prodac programming control relieves operator of tedious adjustments.

The operator puts a deck of punched cards into the reader—one card for each different schedule of passes. To initiate the first schedule, he pushes the "Schedule Advance" button. The bottom card flashes through the card reader in less than a second and all the information for the first schedule is then stored in the PRODAC control unit. Next, the operator pushes the "Pass Advance" button. Information applying to the first pass is utilized to set screwdown and edger position controls and begin the rolling sequence. When the slab is through the mill, hot metal detectors on either side of the mill and at the roll bite automatically initiate slowdown and mill reversal.

Concurrently, stored information for the next pass is being used to reset edger and horizontal roll openings, establish speeds and direction of rotation for the reverse pass. The schedule continues automatically until the slab is rolled to predetermined dimensions.

If the second slab is to follow the same rolling schedule, the operator merely pushes the "Pass

*Trade Mark

Advance" button to repeat the schedule. If the slab must follow a different schedule, he pushes the "Schedule Advance" button and the information on the second card in the deck is read into the memory unit to replace the previous schedule. Rolling then proceeds automatically on the new schedule.

The digital position regulator is a key element in the Westinghouse PRODAC system for adjusting screwdowns and edger position. This regulator receives signals representing actual roll positions from the ROTRAC* pulse generators and compares these signals with the required positions as punched in the card. If they do not match, the proper error signal is given to correct roll and edger positions.

Extremely accurate and fast, the Westinghouse digital position regulator has demonstrated its reliability in programming sideguard and manipulator positions, horizontal roll openings, edger roll openings and scale breaker setting. In fact, this Westinghouse regulator is adaptable to any application requiring automatic, precise positioning control.

PROGRAMMING ALL MILL OPERATIONS

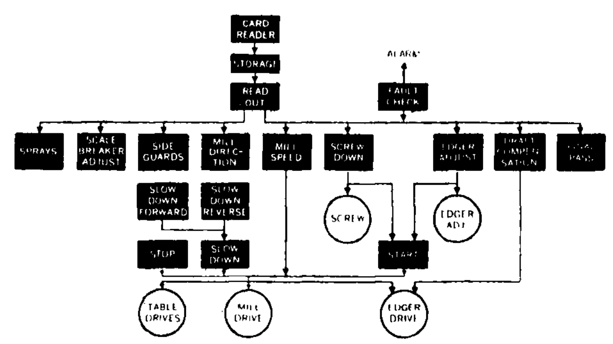
Since these early installations, the basic PRODAC system has been expanded to program more elaborate and involved rolling mills—slabbing, blooming, plate—as well as continuous roughing and finishing mills. Programming these mills involves much more than just positioning drives. It must provide for the smooth integration of all mill operations. However, the same techniques, the same regulators and the same static components in the reversing roughing mill control system are the basis for these more elaborate systems.

As the complete operation of a mill must be fully understood before programming can take place, each function is thoroughly analyzed. This analysis includes such functions as: screwdown, manipulator, and sideguard positioning: mill, table and edger speeds; draft compensation; acceleration rates; sequencing, such as spray and table operations; mill direction: number of passes; the turning operation on blooming and slabbing mills (a Westinghouse exclusive), etc.

From this analysis, the Westinghouse PRODAC system is applied to provide the precise, accurate co-ordination of all mill drives for continuous, automatic operation.

*Trade Mark

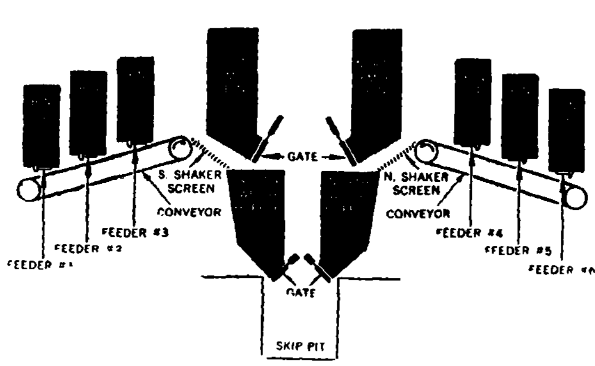
Operation of such mills is much the same as described for the reversing rougher. When any abnormal condition causes the operator to feel he must apply his own experience and judgment, PRODAC control provide for manual take-over of any drive at any time, and return to automatic operation at will without nullifying the manual adjustment.



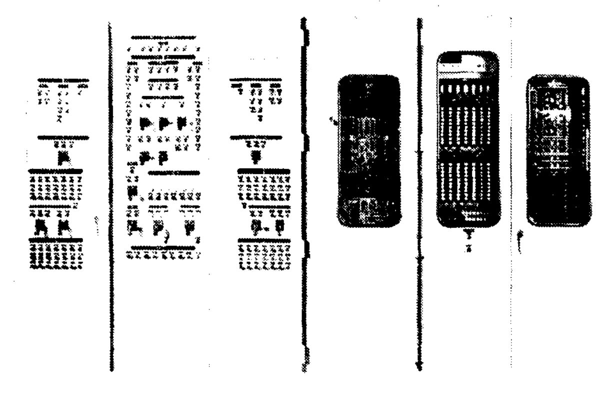
RAW MATERIALS PROGRAMMING

The proven flexibility and reliability of PRODAC digital control are particularly adaptable to materials handling. For example: feeding raw materials to blast furnace skip cars. Westinghouse has applied PRODAC to this operation, permitting replacement of conventional scale cars with automatically controlled conveyors for fast, consistent and accurate delivery.

This system utilizes a patchboard in conjunction with manual setup switches to provide a flexible means of establishing the type, amount and sequence of material to be loaded into the skip cars. PRODAC programs the loading of predetermined quantities of coke, water, metallic and fluxing materials from the stockhouse storage bins into the skip cars for delivery to the furnace. Immediate readout in both printed



Typical layout of automatic conveyors, under PRODAC control, which deliver raw materials to blast furnace skip cars.



Easily accessible patchboards and setup switches at right in PRODAC control unit provide flexible means of selecting quantity and sequence of raw materials. Panels at left indicate material, bin and car status at all times.

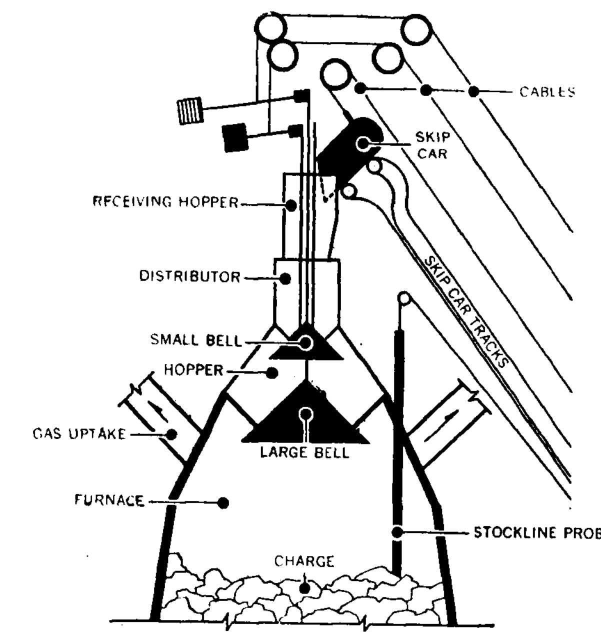
form and punched tape shows type and weight of material, time of charging and skip sequence.

To illustrate the remarkable abilities of this PRODAC system, if one bin of a given material is empty, the control automatically chooses another bin of the same material, as well as indicating the empty condition of the first bin. Further, if the opening of a bin becomes clogged or jammed, PRODAC control initiates a vibrator to attempt to resume material flow. If vibration does not correct the condition, the contol first automatically sounds an alarm and turns on a light to indicate which bin is jammed, then selects another bin with the same material and continues the programmed operation.

The operator may override the program at any time for manual addition of materials and return to automatic operation at will.

BLAST FURNACE PROGRAMMING

Skip hoist delivery to the furnace, as well as furnace top operation, is particularly adaptable to advanced programming. Westinghouse has several successful installations automating blast furnaces similar to that shown. With the Westinghouse PRODAC control, the operator charges the furnace according to a preset program of skip delivery. At the completion of the charge, the control automatically operates the distributor bell to discharge the material into the furnace at the correct distributor angle. The control is so arranged that extra skips of materials and additions of water can be made without changing the preset program.



Precise charging of furnace according to preset schedule is handled by Westinghouse programmed control.

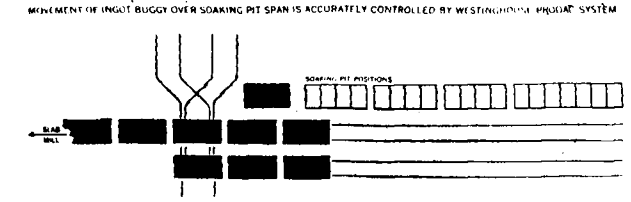
The integrated system assures that the correct level of furnace charge is maintained; that material cannot be dumped in an empty pit; and that the temperature is kept constant.

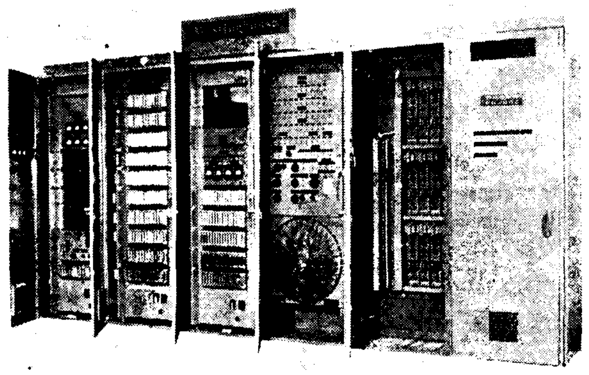
INGOT BUGGY PROGRAMMING

The PRODAC digital control developed by Westinghouse for completely programmed mills is equally adaptable to individual auxiliary drives. Latest example: automatic sequence control of ingot buggy operation.

In this application, the PRODAC control system automatically controls buggy movement over the soaking pit span. Buggy stopping positions are preset, by means of a circular patchboard, in one-foot increments over the total travel or soaking pit span. An unusual feature of the system is that selection of the buggy position is made from one of three pit cranes on a sequence and priority basis. The priority of calls is made by means of setup switches. From the pit crane, the operator may (1) call the buggy, (2) send the ingot buggy to the discharge position and maintain

MOVEMENT OF INGOT BUGGY OVER SOAKING PIT SPAN IS ACCURATELY CONTROLLED BY WESTINGHOUSE PRODAC SYSTEM





PRODAC control cabinet showing static elements and circular patchboard for automatic ingot buggy positioning systems.

his call priority, (3) send the ingot buggy to the discharge position and release his call priority, or (4) release his call priority and initiate emergency stop.

The buggy delivers an ingot to the receiving table where, by means of hot metal detectors, the ingot is tracked and sent on its way to the mill via roll tables and transfer cars controlled by the system.

PROGRAMMING—A JOINT EFFORT

Successful programming is based on fact, not guesswork. This means that a great deal of detailed information concerning all operations must be gathered and sorted. For example, programming a mill demands specific information an auxiliary and mill operation, operator's practices, sequence of events, rolling characteristics, limitations of mechanical equipment, and alloy and product characteristics. Experienced, highly trained Westinghouse engineers, working with your personnel, gather and analyze the precise data required to program and operate the mill equipment. This close co-operation and experience available to you from Westinghouse saves money and time which otherwise could be easily consumed in trial-and-error experimentation.

HOW FAR CAN YOU GO IN PROGRAMMING?

Theoretically, any operation can be programmed ......but there are practical limits. When an operation—such as programming and controlling a series of mills—becomes too complex, the number of cards required skyrockets; large, elaborate information storage units are required; excessive time must be spent preparing cards; circuitry becomes overly involved; reliance on assumptions as to operation and performance increases; a definite need arises to check and monitor performance.

Solution: data logging and computing, the last two stages of automation. Data logging systems provide performance checks, and computers become the co-ordinator of the control system with the ability to make on-the-spot calculations of the program, thus reducing the amount of input information required and optimizing the rolling schedule.

Westinghouse automatic control experts—backed by a complete line of automation components, design facilities, installation and check-out services—are equipped to recommend and furnish the regulation and gauge control, programming, data logging and computing systems best suited to your operations. Westinghouse assumes full responsibility for the co-ordination and over-all performance of these systems whether they are installed all at once or stage by stage. PROGRESSIVE AUTOMATION...... a single-source, single-responsibility combination that assures outstanding automation performance. *You can be sure ....if it's Westinghouse.*

Indian Guides Visitors Round New British Steel Mill

When visitors toured the new steel plate mill which was opened on April 26 at the Consett Iron Co.'s plant in County Durham, England, one of their guides was Mr. D. Surendra Rao of Hyderabad.

He went to Britain almost five years ago as a private student and was awarded, after three years' study, his B.Sc. degree at Durham University. Since then he has been working on research and design at the Consett Iron Co. Mr. Rao hopes to return to India next year.

The new Consett plant has a capacity of 10,000 tons a week. This £14,000,000 mill is the newest phase in the firm's development, which has seen an increase in steel production from under 400,000 ingot tons in 1947 to 1,000,000 tons in 1957. This has been achieved by introducing a new ore-handling plant, a new blast furnace and coke ovens, a new power station, a new slabbing and blooming mill, and a billet mill.

The new plant will raise output of steel plate to 500,000 tons a year in a further stage of the plan to double output by 1965. It will produce larger and wider plates with a superior finish and of more accurate tolerances.

A.E.I.'s INDIAN SUBSIDIARIES HAD A GOOD YEAR

Viscount Chandos, chairman of Associated Electrical Industries Ltd. (AEI), in his annual address to shareholders in London recently, said that in India both the local subsidiaries of AEI had had a good year. Orders for manufacture in India were almost doubled.

"In November," Lord Chandos said, "Mr. Nehru opened the large manufacturing plant at Bhopal for which AEI are consultants to the Government of India. We are very proud to have been entrusted with this task, one of the largest of its kind that has ever been undertaken in the world.

"The factory is designed ultimately to employ no less than 27,000 people, and has already begun to manufacture transformers and switchgear. It will progress to the production of the largest sizes of steam—and water-powered generating plant together with equipment for the electrification of India's railways and industries.

"We particularly welcome the personal link between our engineers and Indian engineers, which has been further strengthened during the year."

In his general survey, Lord Chandos, who disclosed that orders received by the company had risen from £ 182,000,000 to £ 223,000,000 in the year, said: "It is rather a striking fact that in 1960 AEI's total export order for steam turbo-alternators was more than that of any individual manufacturer in the world, and greater than those of all the other manufacturers in this country put together."

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INDIAN TRAINS IN BRITAIN IN DIAMOND TOOL MANUFACTURE

After six weeks' intensive training in the exacting use of diamond tools with J. K. Smit & Co. Ltd., diamond tool manufacturers of Colwyn Bay (Wales), Mr. Dennis D'Souza is returning to India to become works manager of India's first diamond tool factory. This is being run by Voltas Ltd., of Bombay.

Mr. D'Souza will train 12 operatives in making diamond tipped tools for use in India.

Mr. Charles Baines, works manager of J. K Smit, and one of his fully trained technicians will follow shortly to help set up the new factory and to train more operatives. All the plant's industrial diamond raw material will come from the Colwyn Bay factory. Smits have been supplying diamond-tipped drilling equipment to India for a number of years.

* * *

MODERN BLOWER INSTALLATION FOR BLAST FURNACES

Societe Alsacienne de Constructions Mecaniques will deliver the blower installation for the new blast furnaces of the Louvroil Plant of Societe Usinor. The installation is designed to serve three furnaces simultaneously with the constant volume of blast required by each one individually. The discharge pressure is automatically adjusted to the greatest operating efficiency in relation to the permeability of the charge.

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COKE-OVENS IN BELGIUM BUILT BY FRENCH COMPANY

Compagnie Generale de Construction de Fours has fired up the battery of 35 coking ovens built by the company for the Zeebrugge Coking Plant in Belgium. The ovens at Zeebrugge as well as those previously constructed at Vilverde for Forges de Clabecq, were built with refractory materials manufactured in Belgium by the Lens-sur-Dendre Plant of Compagnie Generale de Construction de Fours. The same plant filled very large orders for Dutch coking plants under Benelux agreements.

* * *

FRENCH AUTOMATIC SHEET STEEL HANDLING INSTALLATIONS FOR GERMANY AND SPAIN

Societe P. Capdevielle has received an order from German siderurgical plants for two automatic handling and storage installations for dip-tinned steel sheets. This order comes on the heels of a delivery of 4 such installations made by this company to a metallurgical enterprise in Spain.

STEEL NOTES & NEWS

NEW LOCOMOTIVES FOR IISCO

India's fast growing steel industry will gain more "muscle" this year in the form of ten new diesel-electric industrial locomotives.

The order for the locomotives by Indian Iron and Steel Company was announced recently by officials of General Electric's (U.S.A.) Locomotive & Car Equipment Department which will build the units in its Erie, Pennsylvania, plant.

Estimated cost of the order is in excess of $750,000, according to G-E.

The new locomotives will be used by IISCO to haul raw materials to its mills and to transport finished steel products to railheads for shipment to warehouses and to users.

Four of the new locomotives will develop 550 horse power and the six remaining locomotives will each develop 275 horsepower.

This present order will bring the total number of General Electric industrial locomotives serving India's steel industry to 87, with 27 of these in service with Indian Iron and Steel.

Incidentally, halfway around the world from Indian Iron and Steel's mills in Burnpur, other G-E industrial locomotives are supplying vital motive power for Argentina's big new steel mill in San Nicolas. There, approximately 200 kilometres north of Buenos Aires, 420-horsepower G-E diesel-electrics are being used to haul raw materials to the mill.

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UNIQUE IRON ORE DEPOSIT IN KURSK MAGNETIC ANOMALY

The Soviet Union has a unique iron ore deposit in the area of the Kursk Magnetic Anomaly. Soviet geologists believe that there are some 30,000 million tons of rich iron ore in an area 700 kilometres long and 200 kilometres wide. Together with the poorer iron ores this deposit contains some 200,000 million tons. This was revealed at a Press conference held in the State Committee for Cultural relations with Foreign Countries under the USSR Council of Ministers by Pyotr Antropov, the Soviet Minister of Geology and Conservation of Mineral Wealth.

The Kursk Magnetic Anomaly, he said, is the biggest of the Soviet Union's iron ore deposits, which now accounts for some 40 per cent of the world resources. Antropov said that before 1917 Russia accounted for only 1.5 per cent of the known world iron ore reserves.

The Kursk Magnetic Anomaly lies in the immediate proximity to the Donets coal basin, which opens up broad prospects for the development of the iron and steel industry in the area, Antropov said.

Soviet geologists have found what are called iron magnetites with an iron content of 56—69 per cent in the area of the Anomaly at a depth of 400 to 500 metres. Until 1953, it was considered that the bulk of the Anomaly consisted of iron quartzites with an iron content of 33 to 37 per cent. Antropov pointed out that iron magnetites lie in seams 230 to 350 metres thick.

Turning to the prospects of the Kursk Magnetic Anomaly's development during the current Seven-Year Plan (1959—1965) the Minister said that by 1965 its mines would produce 36 million tons of high quality iron ore, mainly by the open cast method. For this reason its cost will be comparatively low. At present ore is being extracted there at several places, including the Mikhailovsky Mine, whose resources are estimated at half a billion tons.

Antropov stressed that the Kursk Magnetic Anomaly will shortly become the principal iron ore producer of Russia. The prospects for its development are limitless. By 1980 it will produce already

60 million tons of iron ore, that is, as much as extracted now at all the mines of the United States.

The Minister stressed that at the present time the USSR was the biggest iron ore producer in the world with an annual output of 90 million tons. The United States which ranks second produces only 60 million tons a year. Already in the next few years, Antropov said, the Soviet Union will be able to fully supply the demand of all socialist nations for iron ore and, if necessary, will export considerable quantities to other European and Asian countries.

In conclusion Pyotr Antropov noted that at the present time 42 per cent of the entire territory of the USSR had been covered by geological prospecting. With the prospecting of the remaining greater part, new brilliant prospects will open before the industry of the Soviet Union and its national economy as a whole.

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STEEL BARS FOR STAYS, CARBON MOLYBDENUM STEEL FORGINGS AND STEEL PLATES FOR PRESSURE VESSELS

The Indian Standards Institution has prepared three draft Specifications for (i) Steel Bars for Stays, (ii) Carbon Molybdenum Steel Forgings, and (iii) Steel Plates for Pressure Vessels, [Doc: SMDC 5 (237, 238 and 239) respectively].

The first draft standard for Steel Bars for Stays covers the requirements for the material for use in boilers, and includes clauses relating to the process of manufacture, chemical composition, mechanical properties, sulpur print and physical tests, such as dump, bend and izod impact tests.

The second draft standard covers the requirements for two grades of Carbon Molybdenum Steel Forgings used for pressure vessels and includes clauses on process of manufacture, chemical composition, mechanical properties and physical tests, such as tensile test, bend test, etc.

The third draft standard covers the requirements for two grades of steel plates for the fabrication of fusion welded fired pressure vessels and includes clauses on process of manufacture, chemical composition, tensile, bend, temper and homogeneity (for Grade 1 Plate for Fire Boxes only) tests.

* * *

ANALYSIS OF IRON ORES

The purpose of IS: 1493—1959 Methods of Chemical Analysis of Iron Ores published recently by ISI is to provide a standard for the methods of chemical analysis of iron ores which will be helpful in co-ordinating the methods followed by the laboratories attached to the various indigenous steel plants and the public analysts engaged in analyzing the export consignments.

The standard prescribes the methods for the determination of moisture, silica, iron, alumina, titanium, manganese, calcium oxide, magnesium oxide, phosphorus, sulphur, ferrous oxide, vanadium and combined water present in the iron ore. Since for export purpose, the determinations of lead, copper, zinc and arsenic are sometimes required methods for their determination have also been included.

Modification of the procedures for the determination of various constituents have been prescribed, taking into account the variations in the chemical composition as commonly found. However, no account has been taken of the unusual presence of a constituent like chromium which may be rarely found in iron ores.

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SOVIET COAL MINES TO BE FURTHER MECHANISED

A few days back an All-Union Conference of Coal Mining Industry Workers was held in Stalino, the Ukraine. The conference discussed the fulfilment of the decisions of the Twenty-first CPSU Congress and the later decisions of the Central Committee of the CPSU and the Council of Ministers of the USSR aimed at improving the technical and economic operation characteristics of coal mines on the basis of integrated mechanization and automation. This conference outlined a great practical programme aimed at the realization of the tasks set by the party and Government before the Soviet coal mining industry. It has called upon miners to make a still greater effort in socialist emulation for the further development of integrated mechanization and automation, for attaining ahead of time the seven-year targets in increasing labour productivity.

* * *

KOSYGIN CONFERS WITH SWARAN SINGH

The First Vice-Chairman of the Council of Ministers of the USSR A. N. Kosygin called on the Minister of Steel, Mines and Fuel of India Sardar Swaran Singh. During the conversation at the Ministry of Steel, Mines and Fuel, A. N. Kosygin and Sardar Swaran Singh exchanged opinions on the questions of economic co-operation between the Soviet Union and India and the realization of the agreements concluded between the two countries.

The conversation was marked by a warm and friendly atmosphere.

* * *

ELECTRIC FURNACE TO OBTAIN SILUMIN DIRECTLY FROM ORE

An original electric furnace with a capacity 33 times exceeding other such installations, but much smaller than any of them, has been designed by Novosibirsk engineers. The principal purpose of the furnace is to obtain the "silumin" alloy, needed in large quantities by the engineering industry. At present it is produced by costly and complicated methods. The new electric furnace will permit to obtain this alloy directly from ore. "Silumin" will become many times cheaper and its output will grow substantially.

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FIRST HYDRAULIC MINE COMMISSIONED IN THE DONETS COAL BASIN

The first hydraulic coal mine has been commissioned in the Donets coal basin (in the Ukraine). Besides, separate sections with an aggregate annual capacity exceeding 2,000,000 tons have been installed at 15 pits. Preparations are under way for a gigantic hydraulic mine with a daily capacity of 20,000 tons.

The hydraulic method of underground coal production is becoming one of the main trends of technical progress in the coal industry of the USSR. In 1965, 41,500,000 tons of coal are to be produced by this method or about 8.5 per cent of the total.

This method is very economical. Labour productivity at hydraulic mines is two or even three times higher and production costs are one-third less than at conventional collieries. The hydraulic method eliminates manual labour in all production processes.

* * *

SPECIFICATION FOR IRON CASTINGS WITH SPHEROIDAL OR NODULAR GRAPHITE

Iron containing spheroidal or nodular graphite has properties fundamentally different from the normal grey cast iron, but is similar in some respects to malleable cast iron. It possesses greater tensile strength than flake graphite iron and has a considerable measure of ductility and resistance to impact.

The draft Indian Standard Specification for Iron Castings with spheroidal or Nodular Graphite [Doc: SMDC 9(174)] is being drawn up by ISI to cover the major commercial applications existing at present. It specifies three grades of spheroidal or nodular graphite iron castings, namely Grade 1 and Grades 2A and 2B.

* * *

TRAVELLING CRANES SHIPPED TO BHILAI AND RANCHI

The first consignment of the most up-to-date electric travelling cranes has been shipped to Bhilai this year from the Leningrad hoisting and transporting equipment works.

The cranes are intended for handling red-hot rolled stock weighing up to 30 tons. They are remote-controlled.

Travelling cranes with lifting capacities ranging from 30 to 100 tons have been shipped to another Indian project, the heavy engineering plant in Ranchi. They will be used to assemble equipment and for transporting heavy blanks and parts when the plant is commissioned.

* * *

SOVIET ASSISTANCE FOR STEEL PLANT IN U. A. R.

Leningrad specialists have drawn up a scheme for the supply of ores to the Helwan Steel Plant, the first iron and steel works in the United Arab Republic. They have also designed an automated agglomeration factory which will bake ore concentrates from the Aswan deposits and worked out the methods of dressing Aswan iron ores.

A coke chemical works and high capacity rolling mill departments will be built at the Helwan Steel

Plant with technical assistance from the Soviet Union. These departments, being designed in the USSR, will incorporate a sheet mill and some mills for the cold rolling of wide strips.

A new large establishment will in effect be built in place of the Helwan Iron and Steel Mill built by the West German "Demag" Company two years ago. The rolling shops, designed by Soviet specialists, will have a capacity of 200,000 tons of steel sheets a year, with the prospect of it being extended to 750,000 tons at the third stage of construction.

The Helwan plant will produce 1 to 1.2 million tons of steel a year, and will be the biggest metallurgical centre in Africa and the Arab East.

* * *

OIL INJECTION INCREASES STEEL OUTPUT

For more than two years one of Stanvac's affiliate companies in the U. S. has been conducting a concentrated programme which promises to result in one of the most important iron manufacturing developments in the past 20 years.

The project is aimed at proving the feasibility of a 75-year-old iron-making idea. The concept that has now been developed by scientific studies and experiments is that hydrocarbons, particularly heavy oil of high heat content, can be successfully injected into the bottom of blast furnaces and, in many circumstances, can increase capacity and decrease costs of "hot metal" production.

The intensive programme for investigating the practicality of the idea, resulted in the solution of the complex problems involved and the development of an injection and control system which makes the idea usable.

A company spokesman, revealing this, explained that this development was a result from a comprehensive overall programmes undertaken to explore new uses for petroleum products. This work with respect to iron-making could be of substantial importance to two basic industries—steel and oil—and to the free world's economic strength.

The scientific principles underlying the new development involve taking advantage of the chemical properties of oil as well as its heat-producing ability.

Blast furnaces produce pig iron in hot liquid form by extracting oxygen from iron oxide. The blast furnace is actually more of a chemical plant than a furnace. Oil, which contains hydrogen, contributes additional "reducing" gas to speed the reduction of ore into iron.

Coke, iron ore and limestone are today fed into the top and hot air into the bottom of blast furnaces where temperatures reach some 3,500 degrees F.

With the new fuelling method, oil can be injected along with the heated air. The petroleum fuel serves as part of the source of heat and of the "reducing" gases.

One of the most important developments for this application of oil is the fuel injection and control system. Since blast furnaces "stay on the line" for as long as eight continuous years, this system must be so designed that it can be installed into large furnaces without interruption in the use of the furnaces.

In arriving at a suitable system, the company designed, built and operated a pilot plant simulating that part of a blast furnace most critical to oil injection. A unit of this system was later installed and tested in a hot operating largescale furnace with complete success.

The company noted that some United States and European steel firms had been working along similar lines with natural gas injection, and that there are reports some Russian blast furnaces are using natural gas to increase their iron-making capacity.

The study undertaken by the Stanvac affiliate is still continuing on experimental as well as full-scale furnaces to get more accurate data on capacity increase and saving in operating costs.

* * *

INSTRUMENT DESIGNED TO PREDICT BLOW-OUT IN MINES

Moscow scientist Mikhail Antsyferov with a group of collaborators has developed an instrument which can predict, not less than 6 hours in advance, a sudden blow-out of coal and gas which is always a great threat to miners.

The approach of this phenomena is indicated by cracking in the coal seam which increases by the time of the blowout when the coal caves into the mine under the pressure of accumulated methane. The formation of each crack is accompanied by the emission of microseismic waves, and the instrument is based on the principle of their registration.

Placed in a seam, Antsyferov's instrument, the geophone, can detect the slightest sonic vibrations in the rock.

Recording these vibrations, the geophone generates electric impulses which are sent through an electronic amplifier and recorded on tape. The operator watches the intensity of fissure formation. If the number of impulses passes the normal, a blowout is imminent, and the men are ordered out of the mine.

Geophones—of which there are only two at present—were tested in the Donets coal area and fully proved their worth. The first batch of these instruments will be manufactured shortly.

In the course of the tests, Antsyferov and his group established that blowouts can often be prevented. To this end it is sufficient to stop the work at the dangerous place for 2-4 days. It has been established that pressure in the seam redistributes when the seam is left alone, and the gas gradually seeps out into the tunnel through fissures and pores.

Mikhail Antsyferov believes that in principle it is quite possible to design an instrument of predict earthquakes. However, its development should be preceded by special research to determine the peculiarities of the behaviour of earth strata in seismic regions.

Antsyferov believes that the work of the instrument would be based on the fixation of the rupture of seams in the depth of the earth's crust which is usually observed before an earthquake.

* * *

THREE IRON ORE DEPOSITS PROSPECTED IN SOVIET CENTRAL ASIA

Three iron ore deposits with estimated magnetite reserves of 650,000,000-700,000,000 tons and coking coal deposits running into several billion tons have been prospected in Soviet Central Asia.

These supplies are enough to organise an independent blast furnace production at the Lenin Steel Works in Uzbekistan.

The iron ore and coking coal deposits lie in economically developed areas of Uzbekistan, Tajikistan, Southern Kazakhstan and Kirghizia. The iron content of the ore is as much as 50 per cent. Since Uzbekistan has the biggest Soviet deposits of natural gas it will be possible to use gas in the blast furnace process thus cutting by half the consumption of coke.

Uzbek and Tajik geologists are now jointly surveying two more iron ore deposits containing a total of 300,000,000-350,000,000 tons of iron ore.

* * *

PLANT TO DRESS 18 MILLION TONS OF ORE A YEAR

Blueprints for an ore-dressing combine in the Krivoi Rog ore basin are ready. It will turn out 18 million tons of ore every year and will be the last one of five to be put into commission in this Ukrainian ore field before the end of the Seven-Year Plan.

The deposits round the combine, which exceed 600 million tons, will be worked by the open-cast method. All processes will be mechanized and automated. This will help raise labour productivity to 140 tons per 6-hour man-shift, much more than at similar enterprises in the United States.

* * *

SOVIET UNION'S BIGGEST PLATE MILL TO BE BUILT IN LIPETSK

The Lipetsk Economic Council approved the project of the Soviet Union's biggest automated plate mill "4,200". This powerful mill, designed for the Lipetsk combine, will roll plates up to 25 millimetres thick, up to 4 metres wide and 25 metres long. They will be used for the manufacture of electric-welded tubes of large diameter.

The new mill is unique for its parameters, equipment and capacity. It is superior to the existing Soviet and foreign mills of the same type in the degree of automation and mechanisation, and its universality. The project provides for the use of computers and the latest means of automatic control

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ELECTRONIC WELDING

Electronic welding is a new metal-welding method elaborated in Moscow. Its principle, in brief, is as follows :

If electrons are compressed together and directed in one direction they form a powerful stream. When they hit a metal surface the electrons decelerate and collide with each other, just as the passengers of a bus would if it suddenly hit an obstacle. Practically all of the kinetic energy changes into heat energy. The metal hit by the electronic stream melts.

The new welding device has been named an electronic gun. This gun, of course, serves only peaceful purposes. It can be used to weld such refractory metals and alloys as tungsten and molybdenum.

* * *

USSR ACCOUNTS FOR 54 PER CENT OF KNOWN WORLD RESERVES OF IRON ORE

The Soviet Union accounts for some 54 per cent of the known world reserves of iron ore and for 41 per cent of total resources. The USSR surpassed the United States for known iron ore reserves about seven-fold and considerably outstripped the United States in annual gross output.

These figures are quoted in the book " The Iron Ore Base of the Ferrous Metallurgy of the USSR " by the economist Grigory Braun, just put out in Moscow. He analyses the prospects of the development of the most important of the 700 iron ore deposits discovered in the Soviet Union.

In the next 10-years production of iron ore in the USSR is to increase 2.5 fold-3 fold to equal 250,000,000-300,000,000 tons.

Two thirds of the raw material requirements of the steel industry are to be satisfied by developing new deposits. Iron ore is produced at 60 deposits. According to the author of the book, such a rapid expansion of the iron ore industry of the Soviet Union is one of the most complicated problems of the advance of the Soviet economy.

In the next 10 years the emphasis will stil be laid on the production of iron ore by the cheapest, the opencast method. Its share in the total will increase from 54 to 77 per cent.

Grigory Braun considers that more than a half of the total iron ore will be produced in the western parts of the country, recently in the Ukraine and the Kursk magnetic anomaly area. The share of the eastern regions of the USSR beyond the Urals will increase by about 8—10 per cent. The third iron and steel industry centre of the country with an annual output of 15,000,000-20,000,000 tons of pig iron is being set up there.

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SOVIET IRON AND STEEL INDUSTRY FULFILS 1960 PLAN

The iron and steel industry of the USSR fulfilled the annual plan for the entire metallurgical cycle—the production of iron, steel and rolled stock.

Reporting this, the Central Statistical Administration of the USSR Council of Ministers points out that this year's plan was bigger than originally envisaged for 1960 by the Seven-Year Plan.

In 1960, compared with last year, the production of iron increased by 3.8 million tons, steel by over 5 million tons, and rolled stock by almost 4 million tons.

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THREE LAKH TONS OF ORE ABOVE PLAN EXTRACTED FROM A SINGLE SOVIET MINE

Three hundred thousand tons of iron ore over and above the 1960 programme were produced by miners of the Lebedinsky mine, the first mine at the Kursk Magnetic Anomaly where ore is extracted by the open cut technique.

The ore reserves of the Kursk Magnetic Anomaly have no equal in the world and amount to something like 22 billion tons. This means that they are fifteen times greater than the principal iron ore deposits of the United States " Lake Superior " and three times greater than all the United States deposits combined.

The Lebedinsky mine is the biggest of the five already operating in the area of the Kursk Magnetic Anomaly. Its designed capacity is six million tons a year.

The local deposits can be mined by the cheap open cut technique as it is done at the Lebedinsky Mine. It

has been estimated that open cut mines here can produce 35 to 40 million tons a year.

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NEHRU INAUGURATES BHILAI'S RAIL AND STRUCTURAL MILL

The Prime Minister of India Mr. Jawaharlal Nehru inaugurated the rail and structural mill of the Bhilai Steel Plant.

Among those present at the ceremony were: I. A. Benediktov, USSR Ambassador to India, Mr. Lal Bahadur Shastri, Union Minister for Commerce and Industry, Sardar Swaran Singh, Union Minister for Steel, Mines and Fuel, and Dr. K. N. Katju, Chief Minister of Madhya Pradesh.

The half-mile-long rail and structural mill marks the completion of last but one phase of construction work in Bhilai. The commissioning of the giant mill is one more triumph of Indo-Soviet co-operation in a struggle against economic backwardness. The mill has an annual production capacity of 365,000 tons producing rails, components of railway sleepers, beams, girders, channels, etc. The mill has been designed on up-to-date technical and technological processes in use in Soviet Union's best steel plants.

Inaugurating the mill, Mr. Nehru specially thanked the Soviet Union for training Indian national cadres and expressed confidence that the builders of the Bhilai Iron and Steel Plant would fulfil with honour the task confronting them. Bhilai, he stressed, is a symbol of the new, a symbol of future, a symbol of growing India. The co-operation between the Soviet Union and India, Mr. Nehru said, is a great thing. We learn from Soviet Russia and I am glad to see here Soviet engineers whose presence symbolises friendship between our peoples.

Mr.Nehru pointed to the necessity of further promoting and consolidating the Indo-Soviet co-operation.

Amidst stormy applause the Prime Minister of India gave a signal and a diesel locomotive appeared from the shop with flat cars loaded with rails and girders produced at the Bhilai Iron and Steel Plant. Thus the country's largest rail-girdle shop started working. The expanding industry of the Indian Republic will be getting another home-made item which but recently was imported from abroad.

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INSTRUMENTS FOR BHILAI

The manufacture of a consignment of instruments for the Bhilai Steel Plant in India has been concluded at the laboratory of the Ministry of Construction of the Russian Federation in Moscow. They have been designed for automatic temperature measurements of liquid steel in open-hearth furnaces. The newspaper *Vechernyaya Moskva* (" Moscow Evening News ") points out that the instruments made in the laboratory function well at steel mills in the Soviet Union and also Bulgaria, Rumania, Burma and the United Arab Republic.

* * *

RESEARCH AND CONTROL LABORATORY— BHILAI'S LATEST ACQUISITION

The Research and Control Laboratory of the Bhilai Steel Works, inaugurated on the 1st of December by Sardar Swaran Singh, India's Minister for Steel, Mines and Fuel, holds an important place in the working of the entire plant. It has been designed to control the performance of each unit of the Steel Plant and to give guidance in the preparation and standardization of raw materials in order to achieve the maximum output of quality goods at the minimum cost.

The Research and Control Laboratory building occupies a significant position in the sky-line of the Steel Works, symbolic of its vital functions. The Laboratory has been built and equipped at a cost of roughly Rs. 85 lakhs. The building has a total floor area of 7,000 sq. metres. The Laboratory has been conceived, planned and equipped by the Technical Organisation of the Soviet Government on the most modern lines incorporating the latest technological methods in the field of research and control.

It consists mainly of a chemical laboratory for chemical and spectrum analyses; a department of metal; a radio-active isotopes laboratory; a laboratory for the study of ores and sinter reducibility; a refractory laboratory; a fuel and lubrication laboratory; a linear measurement laboratory; an instrumentation laboratory; and an electrotechnical laboratory.

The Research and Control Laboratory performs a variety of functions ranging from analysing and test ing the various raw materials, refractories, fuels and lubricants and all other auxiliary materials delivered to the Steel Works, to ensuring correct operation of all the instruments and appara tuses in the plant.

The elaborate equipment and instruments provided in the various sections of the Laboratory are available for research and applied investigations, besides routine work. Development of instruments for automation of different processes in the Steel Works could also be carried out. Facilities are planned for a Research Bureau with a Statistical Group, Reference Library, Archives, etc.

Apart from the Central Institute, laboratories have also been set up at various units of the Steel Works wherever it is necessary. These self-contained stage laboratories, called " Express " Laboratories, serve the essential operational requirements of the respective shops where they are located.

The well-equipped Research and Control Laboratory will not only facilitate the production of metal of the highest quality, but will also help the new and growing Steel Plant at Bhilai to keep pace with the latest developments in the technology of iron and steel making, and stimulate research of benefit to the metallurgical industries.

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BHILAI FACES NEW YEAR WITH CONFIDENCE

The month of December 1960 sees an intense activity at Bhilai towards commissioning of most of the remaining units.

The Merchant Mill, the fourth and last Rolling Mill of Bhilai, the third and last coke oven battery, as also the last of the three blast furnaces, are due to be commissioned during December. One more open-hearth furnace of Bhilai will also be commissioned before the year runs out. Thereafter only one open-hearth furnace out of the six will remain to be commissioned which is expected to be done early.

The half-mile long rail and structural mill of the Bhilai Steel Works was inaugurated by Prime Minister Nehru in the last week of October 1960. The two other mills—the blooming mill and the billet mill—have been in operation for about a year now. The rail and structural mill will roll 365,000 tons of finished products per year, consisting of rails, beams, girders, channels and other structurals.

Most of the bye-product plants and auxiliary shops have also been commissioned. The Steel Works' iron ore mine at Rajhara and the limestone quarry at Nandini have also been fully mechanised to meet the requirements of the integrated iron and steel plant at Bhilai.

The sintering plant, which was the last of the units taken up for construction, would be commissioned early in 1961.

Thus the steel plant at Bhilai will have taken practically full shape by the end of December 1960, and will be completed early in 1961.

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BHILAI PRODUCTS AT HOME AND ABROAD

For the last one year and ten months, the products of Bhilai have been moving out steadily to all parts of the country. Bhilai iron and steel have also been sold to foreign countries, thus earning foreign exchange for the country.

As on the 30th November 1960, the production amounts to about 9,20,000 tons of pig iron and 2,82,275 tons of steel ingots.

The steel works had fed into the Indian industry by the end of November 1960, about 6,30,000 tons of pig iron and 2,30,000 tons of steel billets and beams and heavy structures. About 90,000 metric tons of pig iron and 11,000 metric tons of billets had been exported to foreign countries.

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BHILAI—A SYMBOL OF THE NEW INDIA

Prime Minister Nehru who went round the Bhilai Steel Works on October 27, 1960, giving his impressions of visit in the Project's Visitors' Book, wrote : " This was my second visit to Bhilai after three years. During this period great changes have taken place and this time the plant stands there in all its strength and majesty—a symbol of the New India. May it prosper and help in bringing prosperity to the people of India ".

Sanjiva Reddy, Congress President, who visited the Steel Works on October 31, 1960, recording his impressions in the Visitors' Book, wrote : " This is my first visit to this modern temple of Indian prosperity. Wonderful achievement indeed ".

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BRITISH FIRM BUILDS BRICK PLANT FOR INDIA

In the Yorkshire factory of William Johnson & Sons (Leeds) Ltd., a complete plant for the manufacture of refractory bricks and blocks is nearing completion for New Bharat Refractories Ltd., of Calcutta.

The plant, worth about £60,000, will eventually stand on a site quite close to the Durgapur steelworks. The equipment includes crushers and screeners, and two mechanical presses for forming the bricks. It will occupy an area of about 3,300 sq. ft.

On behalf of the Calcutta company, the manufacturers have engaged a technician to travel to India to supervise the erection of the plant.

This is the second contract fulfilled recently by William Johnsons for the Calcutta company. At the end of last year they supplied similar equipment to the Bharat Mining Corp., an associated company of New Bharat Refractories.

* * *

NEW £ 250,000 PLATING PLANT AT OXFORD

One white-coated worker will be able, by the mere flick of a switch, to control the new £250,000 plating plant of the Nuffield organization at Oxford.

This new plant—said to be the most advanced of its kind and unique in Europe—will begin producing the chromium trim for all of the organization's cars before the end of the march.

Fully automatic, it deposits copper, nickel and chromium in an unbroken series of operations. Once parts which are to be plated have been fed into the machine, they will not need to be touched or removed again until the plating cycle has been completed, two hours and 10 minutes later. This reduction in the amount of handling hitherto necessary will mean fewer damaged components and a minimum wastage of plating materials.

Basically, the plant consists of 36 welded steel vats, the largest of which can hold 12,000 gallons, arranged in a 177 ft. "U" shape. The "giant" will daily consume some 160,000 gallons of pure water and use sufficient electricity to supply all the needs of a village of about 750 houses. In return, it will deliver 1,000 sq. ft. of high-quality chromium plate an hour. This will entail depositing 60 lb. of copper and 60 lb. of nickel each hour, or about 10 tons of each during a working month.

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UNIVERSITY DEGREE COURSE IN REFRACTORIES AND CERAMICS

In October this year Sheffield University will introduce a new degree course which will be the first of its kind in Britain. The degree will be known as Bachelor of Technical Science in Refractories and Ceramics Technology.

A university spokesman says the course is designed to fill the large demand which exists in industry for men trained in these fields. Sheffield is the only university in the country with a Department of Refractories Technology; so it is natural that a degree course should be instituted there.

The course will extend over three years, the first of which will be devoted to chemistry, physics and mathematics. The remaining two years will cover technology on refractories, ceramics, glass, fuel, metallurgy and geology.

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REFRACTORY MATERIAL FOR RADAR TESTING

Development of an important new refractory material for radar work is going ahead at a North of England factory.

The material, called Termilode, enables a radar station to "stand by" or "test" on full power without transmitting a signal by which it can be detected and without causing interference to other stations.

The manufacturers claim that the material represents a new break through in the field of power absorbing loads. It combines the advantages of thermal shock resistance with chemical stability and controlled electrical properties.

Loads are under development for a wide range of frequencies and Termilodes have been run successfully with a power dissipation of 8 kW (mean).

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NANDINI CRUSHING PLANT INAUGURATED

"The limestone mine at Nandini and the iron ore mine at Rajhara are the life-lines of the Bhilai Steel Works. In comparision to the huge steel plant at Bhilai, the Nandini mine and its plant would appear an ordinary thing, but without limestone, the blast furnaces of the Bhilai Steel Works cannot function even for a day", declared Shri N. C. Shrivastava, General Manager of the Bhilai Steel Project, at Nandini.

He said the Bhilai Project had spent more than fourteen crores of rupees on the mechanisation of the two mines and on putting up two new towns for the workers at Nandini and Rajhara.

Shri N. C. Shrivastava was speaking on the occasion of the inauguration of the crushing plant at the mechanised limestone mine at Nandini by Shri H. V. Pataskar, Governor of Madhya Pradesh.

The Bhilai Steel Works will require about seven and a half lakh tons limestone annually. Accordingly, up-to-date equipment has been installed at this mine for handling and despatching the limestone to the Steel Works satisfactorily and speedily.

As the Steel Works at Bhilai, the equipment for the Nandini mine has been received from the Soviet Union. It includes several drills, large shovels and dump cars at the quarry and the crushing and screening plant. Powerful shovels are being employed for loading wagons with limestone both at the quarry and at the stockpile yard near the crushing plant.

More than five crores of rupees have been spent on the mechanisation of the Nandini mine and on putting up the new town for the employees. About nine crores and twenty lakhs of rupees have been spent on the mechanisation of the iron ore mine and on the new town at Rajhara.

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CHEMICAL ANALYSIS OF LIMESTONE, DOLOMITE AND ALLIED MINERALS

The Indian Standards Institution has prepared a draft Indian Standard on Methods of Chemical Analysis of Limestone, Dolomite and Allied Minerals, [Doc : SMDC 2(245)].

This draft standard covers methods of chemical analysis of various grades of minerals like limestone, dolomite, calcite and magnesite. The methods prescribed deal with the determination of ignition loss, silica, alumina, iron oxide, calcium oxide, magnesia and carbon dioxide.

Since various indigenous laboratories concerned with analysis of minerals follow different methods for a similar estimation, necessity was felt to prescribe standard methods which, as far as possible, could be followed by these laboratories in their day to day work. In preparing this standard, due consideration has been given to existing practices and facilities available in this country for such analysis, as these methods shall be used as referee methods whenever needed.

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INDIANS STUDY U.K. STEEL FOUNDRY TECHNIQUES

Five Indian technicians who will occupy top positions in a steel foundry to be built at Chittaranjan, West Bengal, have started their training with one of Britain's leading steel firms—F. H. Lloyd & Co. Ltd., of Wednesbury, Staffordshire.

They are Mr. T. C. Chadda, of Chittaranjan, who will be foundry manager; Mr. M. M. Lal, of Delhi, production and methods engineer; Mr. R. K. Dutta, of Midnapore, moulding chargeman; Mr. J. Gadgil, of Poona, methods superintendent; and Mr. A. Satyendra, of Bangalore, methods foreman.

During the next two years, 30 Indians will be trained by F. H. Lloyd for managerial posts at the new steel foundry, which, when completed in September 1962, will employ between 700 and 800 workers. Lloyds, whose plant covers 36 acres, employ 1,860 people and produce 22,000 tons of steel castings a year.

Training is being given at Lloyds as, under the contract, the firm is acting as consultants to the Indian Railway Board on the design of the new foundry, the erection of the buildings, the installation of the plant and equipment, and the recruitment of staff down to supervisory levels.

When completed, the foundry will provide castings for locomotive construction. At present Mr. C. B. Carter of Lloyds is supervising the erection of the foundry. A six-man team from the firm will advise during the first five years of production. Then Indian technicians will be wholly responsible for the running of the plant.

Before the first party of trainees arrived at Wednesbury, the firm's Managing Director and Chairman, Mr. F. N. Lloyd, told the works committee: "I hope and know that you will do all you can to make our visitors feel at home and help them to get all the experience they need to establish their own steel foundry in India. On this foundry will depend the building of all the locomotives for Indian Railways."

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EUROPE'S LARGEST CONTINUOUS THIN SHEET ROLLING MILL COMMISSIONED

Europe's largest continuous thin sheet rolling mill "1700" has been put into operation at the Ilyich Iron and Steel Plant in Zhdanov, the Ukraine. It rolls steel sheets up to 1.5 metres wide and from 1.2 to 10 millimetres thick at a speed of 12.5 metres per second. In less than one minute a slab weighing several tons is turned into a thin steel strip several hundreds of metres long.

The new mill is fully mechanized and automated all along its more than one kilometre length. For the first time in world practice the mill is controlled by a continuous self-regulating system with the help of computing devices.

A similar mill has been also built at the iron and steel plant in Cherepovets, North-West of the Russian Federation.

Six rolling and two tube mills have been built at Soviet iron and steel plants in 1960—the second year of the seven-year period ending 1965. Large rolling mills have been put into operation at the Magnitogorsk and Orsko-Khalilovsky combines, at the Krivoy Rog and other metallurgical plants.

The thin sheet rolling mill "2500" built at the Magnitogorsk metallurgical combine, the Urals, is a single transfer line one kilometre long. It is fully mechanized and automated and works at a speed of 12 metres per second (similar mills in the United States work at a speed of 7 to 9 metres per second).

A continuous mills for furnace tube welding has been commissioned at the iron and steel plant in Chelyabinsk, the Urals. It produces tubes for housing and municipal construction. Unprecedented efficiency of the equipment has been achieved due to the introduction of the direct flow line which, for the first time in the world, combines the rolling, machining and finishing of the tubes. They are rolled at a speed of 420 metres per minute (the speed of rolling at similar mills in the United States is 380 metres per minute).

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TV MAKES MEASURING OF HOT STEEL SAFE AND EASY

A new steel mill use of television permits the operator in his air-conditioned booth (or "pulpit") to measure hot steel beams accurately to within 1/8 inch in preparing to cut them to the desired length. Safety and efficiency are improved.

A special measuring scale appears on the television screen, superimposed on the image of a beam on the shear table. The operator manipulates his controls to position the beam properly, and then makes an accurate cut.

Another modern installation combines the use of a fluoroscope with television to permit remote detection of possible flaws in the welded seams of steel pipe.

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Statement about
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I, T.S. Sundar Rao (alias S. Sundaram), hereby declare that the particulars given above are true to the best of my knowledge and belief.

(Sd.) T. S. Sundar Rao
Signature of Publisher

KOSYGIN VISITS BHILAI

The First Vice-Chairman of the USSR Council of Ministers A. N. Kosygin arrived from Calcutta. He was met at the airport in Raipur by the General Manager of the Bhilai Steel Works Mr. Srivastava, his Chief Deputy Mr. Ray, the Police Commissioner of Raipur District Mr. Naron, the Chairman of the State Committee of the USSR Council of Ministers for External Economic Relations S. A. Skachkov, Member of the State Committee for External Economic Relations V. A. Sergeev, the Soviet Chief Engineer at Bhilai N. V. Goldin, and leading Soviet building and production specialists.

From the airport A. N. Kosygin and his party drove to Bhilai where the national metallurgical works—the Bhilai Iron and Steel Works—has been built with Soviet assistance.

All Soviet citizens residing in the young town of the steel workers—Bhilainagar—came out to meet the guest from the Soviet Union. Later in the day Kosygin attended a concert given in his honour by an amateur art group. The concert was a great success.

In the evening Mr. N. C. Srivastava, General Manager of the works, gave a dinner in honour of the First Vice-Chairman of the USSR Council of Ministers. The dinner which was attended by leading Indian and Soviet technicians of the Bhilai Steel Works was marked by a warm friendly atmosphere.

On 26-2-61 A. N. Kosygin laid the foundation stone of an oblisque pillar in front of the Bhilai Steel Works to commemorate the co-operative efforts of Indian and Soviet personnel in building the Bhilai Steel Plant. A number of important Indian and Soviet personages including S. A. Skachkov, Chairman of the State Committee of the USSR Council of Ministers for External Economic Relations, I. A. Benediktov, Soviet Ambassador in India, Mr. S. Dutt, Indian Ambassador designate to the USSR, and others were present on the occasion. A large number of Indian and Soviet residents of the steel town were also present.

Speaking on the occasion Mr. N. C. Shrivastava, General Manager of the Bhilai Steel Project, said, "Success of Bhilai does not lie in completion of this steel plant alone. Bhilai has acquired a wider significance for the whole country. Bhilai was, in a manner of speaking, the first experiment in Indo-Soviet co-operation. Because this experiment has been a complete success, several other large enterprises have been started all over the country depending on Soviet help and advice. Bhilai can thus well be said to have opened up the way for Indo-Soviet collaboration in industrial field on a big scale".

Mr. Shrivastava declared that the Bhilai Steel Works had now taken almost full shape thanks to the combined efforts of the Indian and Soviet personnel of all grades. It was, therefore, in the fitness of things that a monument should be raised to commemorate the friendly and collective efforts of the citizens of the two countries who worked at this place and erected the colossal steel plant in record time of three and a half years. The sixth and last open hearth furnace, which was the last major unit of the Steel Works, had also just been commissioned. Thus all the producing units of the Bhilai plant along with its mechanised iron ore mine at Rajhara and limestone mine at Nandini had been completed and put in operation. The sintering plant and the oxygen plant were expected to be put in operation shortly.

Mr. Shrivastava said that the Bhilai Steel Works had alreay produced more than 11 lakh tons of pig iron and over four lakh tons of steel. Bhilai iron and steel had reached every corner of India. Substantial quantities of metals had also reached foreign markets. Bhilai products worth nearly Rs. 30 crores had already been supplied to consumers and also earned for the country nearly Rs. 3 crores of foreign exchange by way of exports. The expansion of Bhilai to two and a half million tons of steel had been decided and would be carried out with the same speed which characterised the present construction programme.

Mr. Shrivastava said, "Bhilai is a co-operative venture in which Indian and Soviet personnel are participating as colleagues. In spite of language difficulty there has been perfect understanding and happy co-operation between Indian and Soviet personnel inside as well as outside the works. Friendly co-operation between Indian and Soviet personnel has indeed been the outstanding feature of Bhilai, and the pillar whose foundation is being laid today commemorates Indo-Soviet co-operation and friendship at Bhilai".

Speaking on the occasion, N. V. Goldin, Soviet Chief Engineer at Bhilai, said, "Today we are happy to report that the construction of the Bhilai Steel Works has been fully completed and has been completed earlier than the construction of the other steel works in the public sector and that the Bhilai Steel Works now produces more metal for India than other works. The construction of the works has passed in an atmosphere of friendship and collaboration, mutual respect and complete confidence between Indian engineers and workers and Soviet specialists, which is so characteristic of our two great peoples.

"The monument which will be erected here will symbolise the best human ideas—love, labour, brotherhood, mutual assistance, peace and freedom. Let this monument be the eternal symbol of friendship between the peoples of India and the USSR, which, according to Khrushchov, is as strong as Bhilai steel".

A. N. Kosygin planted a sapling in the new recreation park that is being developed near Maroda Water Works at Bhilai.

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KOSYGIN'S SPEECH AT BHILAI ON FEBRUARY 26

Below we give the summary of a speech made by A. N. Kosygin, First Vice-Chairman of the USSR Council of Ministers, at Bhilai on February 26 when he laid the foundation stone of an obelisque pillar in front of the Bhilai Steel Works to commemorate the co-operation of Indian and Soviet workers and engineers in building the Bhilai plant:

A. N. Kosygin, First Vice-Chairman of the Council of Ministers of the USSR, conveyed on behalf of the Soviet people, the Government of the Soviet Union and Nikita Khrushchov the warmest and heartiest congratulations to the Bhilai staff, the workers, engineers, technicians and executives building and running the works and all participants in the meeting.

Bhilai, the distinguished Soviet guest said, is striking evidence of the fruitfulness and successes of Soviet-Indian co-operation. We are pleased to note that for several years Soviet and Indian specialists and workers worked at Bhilai like members of a closely knit family.

The plant has already given the country upwards of a million tons of iron, about 400,000 tons of steel and over 300,000 tons of rolled metal. Its mines have produced over two million tons of iron ore. This is a big victory for Indian industry.

The successful completion of the first stage of the Bhilai plant is a big step forward in the industrialization of the country, in the development of the public sector in Indian economy, Kosygin said.

It is gratifying to realise that the friendship, economic and technical co-operation between the Soviet Union and India are growing and gaining in strength every year. A new agreement has just been signed on the utilization of the Soviet loan of 600 million rupees to finance the building of several industrial establishments and other projects in India with Soviet assistance.

The Soviet Union's friendly, unselfish aid contributes to the all-round development of key Indian industries, Kosygin said. With Soviet technical assistance, your country has undertaken successful geological surveys, builds heavy machinery and mining equipment works and a thermal power station in Neiveli, designs an oil refinery in Barauni, thermal power stations in Korba and Singrauli, and pharmaceutical works. Several other big and important industrial establishments will be built.

We are helping India, A. N. Kosygin said, not in order to coin any profits out of this for ourselves. The Soviet people and their government sincerely desire to help the Indian people in the early industrialization of their country, in building up a comprehensively developed industry—the foundation of the economic and political independence of their state.

The successful fulfilment of the Soviet Seven-Year Plan, the First Vice-Chairman of the Council of Ministers of the USSR said in conclusion, will open up still broader prospects for expansion of the economic co-operation between the USSR and the Republic of India which is designed to further the well-being of our peoples and our countries, to strengthen their economic independence and which rests on mutual confidence, friendship and full equality. This co-operation, equal and mutually advantageous as it is, promotes best understanding between the Soviet and the Indian peoples, helps to strengthen world peace.

May the obelisk to be erected here in honour of the co-operation between the glorious builders of the works be a reminder of the fruitful joint activity of Soviet and Indian people for the sake of friendship between the great peoples of India and the Soviet Union.

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JOINT SOVIET-INDIAN COMMUNIQUE ON COMPLETION OF BHILAI PLANT

A joint Soviet-Indian communique on the completion of the Bhilai Iron and Steel Plant was signed at the Ministry of Steel, Mines and Fuel on 3—3—61. The signatories were the First Vice-Chairman of the USSR Council of Ministers A. N. Kosygin, for the Government of the USSR, and the Minister of Steel, Mines and Fuel Sardar Swaran Singh, for the Indian Government.

The communique expresses satisfaction with the completion of the Bhilai Iron and Steel Plant which has a capacity of one million tons of steel ingots a year. It says in part: This colossal project was accomplished in a relatively short time, on the eve of the completion of India's Second Five-Year Plan. It is a significant event in the economic life of the Indian people.

The agreement between the Government of the Soviet Union and the Government of India of February 12, 1960 provides for an expansion of the Bhilai Steel Plant with Soviet assistance to produce 2.5 million tons of steel a year, the communique points out. In the process of building the plant's first stage, with a capacity of one million tons of steel ingots a year, the Soviet specialists have already shared with Indian engineers and workers their extensive experience and know-how, and have thus helped to train Indian personnel capable of working on its own. The experience gained gives every reason to believe that the work of expanding the plant will be successfully accomplished and that the ties of friendship and co-operation between the two countries will continue to grow and develop.

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3700 STEEL ROAD BRIDGES AUTHORIZED

The highways and byways of America are being linked with an increasing number of steel bridges, large and small.

Nearly 3700 steel bridges were authorized for construction, 1957 through 1959, to join parts of the nation's vast Federal-aid highway system, according to data recently released by the Bureau of Public Roads. The total includes 1588 bridges for [illegible] roads. 989 for secondary roads, 641 for primary roads and 284 for urban. Another 194 were authorized under emergency highway funds. Laid end-to-end, the 3696 bridges, would measure 189 miles, an average of 270 feet per bridge built in the period.

The Federal-Aid Highway Act of 1956 calls for the construction or improvement of 41,000 miles of interstate and defence highways, as well as the improvement of nearly 750,000 miles of feeder roads to the interstate system. Before such an undertaking is completed sometime in the early 1970's, the construction of many more steel bridges will be necessary.

Research by steel fabricators during the past several years has added to the advantages of structural steel as a bridge material. High strength, low alloy steels are an advance, reducing dead weight and offering greater corrosion resistance.

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ROURKELA—INDIA'S RUHR DISTRICT

The presence of coal led to the first blossoming of industry in the Ruhr in the last years of the eighteenth century, and nobody anticipated then that the Ruhr district would one day become the industrial nerve-centre of Germany. Today 120 million tons of coal are mined here annually, 19 million tons of steel produced in the steelworks and 85% of the gas consumed in the Federal Republic supplied by the coking plants.

With the erection of the Rourkela steelworks, the creation of a similar industrial centre in India has begun. Although future developments cannot be predicted with absolute certainty, "the coming into operation of the Rourkela steelworks let us hope that this area, known for its mineral riches, may in time become the Ruhr District of India", stressed Dr. Rajendra Prasad, the president of India, when the first blast furnace was put into operation at Rourkela in February 1959. He went on :- "Now that the wheels have begun to turn at Rourkela, and that the heaven-sent waters of the Hirakud Dam flow in all directions, we can be sure that we, and especially the people who live in this area, are on the threshold of better times".

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BHILAI PRODUCTION DURING DECEMBER 1960

There was more production of pig iron and steel at the Bhilai Steel Works during the month of December 1960. The Steel Works produced 62,016 tons of pig iron during December 1960, compared to 61,206 tons produced during November 1960. The steel production during December 1960 amounted to 41,580 tons compared to 35,871 tons in the previous month. Despatches from Bhilai during December totalled 32,660 tons of pig iron and 33,096 tons of steel billets.

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