



**TOGETHER**  
*for a sustainable future*

## OCCASION

This publication has been made available to the public on the occasion of the 50<sup>th</sup> anniversary of the United Nations Industrial Development Organisation.



**TOGETHER**  
*for a sustainable future*

## DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

## FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

## CONTACT

Please contact [publications@unido.org](mailto:publications@unido.org) for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at [www.unido.org](http://www.unido.org)



05174



United Nations Industrial Development Organization

---

Distr.  
LIMITED

ID/WG.146/54  
7 May 1973

ORIGINAL: ENGLISH

Third Interregional Symposium  
on the Iron and Steel Industry  
Brasilia, Brazil, 14 - 21 October 1973

Agenda item 10

THE ESTABLISHMENT AND DEVELOPMENT OF  
THE BULGARIAN IRON AND STEEL INDUSTRY<sup>1/</sup>

by

Vassil Evstatiev Iliev  
Ministry of Heavy Industry  
Bulgaria

---

<sup>1/</sup> The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

### Summary

The present report sets out in brief some views on our experience in the establishment of the Bulgarian iron and steel industry as well as on the problems entailed by its development.

The establishment of the Bulgarian iron and steel industry has begun after the Second World War. In the 50's there was built a small 600000 t/y steel plant and in the 60's there followed a 3Mt/y steel plant.

Two tables and a diagram give the most important figures characterizing the development of the iron and steel industry in Bulgaria in the last twenty years, the level reached by now, and some forecasts for its further development. There are shown figures for the production and consumption of crude steel and rolled steel products, for the production of coke, pig iron, and ferroalloys.

Production and consumption of steel is coming up to 300 kg per capita, while some twenty years ago it amounted to 50 kg per capita. The rate of steel production and consumption development has been comparatively high - 15% per year, in some cases even higher. Two main factors have determined the establishment and development of the Bulgarian iron and steel industry:

- accelerated growth of domestic demands resulting from the Government policy of accelerated industrialization and development of the productive forces in the name of social and economic progress;

- the presence of favourable international, economic, and natural conditions;

The raw-material basis of the country has set up the foundation for the initial development which is to be expanded further. A brief description of the two steel plants, their characteristics, and planned development is also given.

The provision of investment capital for the development of the iron and steel industry in the conditions of a centralized Government management of economy is merely a matter of investment, distribution of the accumulation fund of the produced national income.

In the report are mentioned also the main achievements: high rates of development, meeting the domestic demands, training of qualified personnel, etc., as well as the chief difficulties: fixing the future demands in the whole range of rolled steel products, mastering the new plants, lack of experience in the designing and manufacture of the metallurgical equipments etc.

The overcoming of these difficulties is considered as a process requiring a lot of time, effort, and well-developed international collaboration.

About 70-80% of the metallurgical equipment has been imported and 20-30% of it has been local manufacture. It is not

profitable and efficient for the small countries to manufacture complete metallurgical equipments, As the investments in the iron and steel industry are very large, usually the supply of the equipment is done on a long-term credit.

Know-how is usually provided by the country-supplier of the basic metallurgical equipment.

What is considered a most important achievement is the limiting of imports and fully meeting domestic demands in all the range of rolled steel products. At present the home iron and steel industry is in a position to fully meet the domestic demands in volume.

It is not necessary and efficient to establish the manufacture of the whole range of rolled steel products in order to meet the domestic needs. In this connection arise the problems of rolled steel products exchange and of international specialization and co-operation. These problems can be solved on the basis of preliminary agreement, coordination, economic advantage and profit among the respective partners.

Bulgaria exchanges about 20-30% of its rolled steel products.

The range of products and their quality depend on the characteristics and choice of plant and also on the personnel qualification and discipline. In addition to the previous general and technical education (about 10-12 years) qualification depends on the permanent courses of training which are organized in the plants with the purpose of improving the professional and technical skills of the personnel. A special training system for the whole country should be established to that purpose.

In this paper have been expressed some views on our experience in the establishment of the Bulgarian iron and steel industry as well as on the problems entailed by this development, on the basis of a critical analysis of the main achievements and difficulties, which have been supposed to be of interest to other countries.

Survey of the Development - Factors, Achievements, and Difficulties

Mining of ores and production of metals in the Bulgarian land date back to very ancient times. Bulgaria was closely situated to the Mediterranean countries where ancient human culture first initiated the use of metals for man's various needs. The archaeological studies have shown that on the small territory of the present day Bulgaria (111,000 km<sup>2</sup>) there were 140 mines and about 40 old furnaces for melting iron ores in the Ancient Period and in the Middle Ages, but mainly in the Late Middle Ages. This primitive iron industry kept its importance up to the nineteenth century.

The establishment and development of the modern Bulgarian

The problem of the prices is a matter of price policy and control. In Bulgaria it is in the competence of specialised Government authorities, which take into account the interests of the producer and consumers as well as the international prices. The economic effectiveness of the exchange and exports of rolled steel products depends not only on the production costs but also on the Government price policy.

At the present level of 2 mt/y steel production, Bulgaria has about 1300 people working in the research and design field of the iron and steel industry. Their activities are subsidized by Government. The small country is not in a position to solve all the problems in the development of the iron and steel industry by its domestic research and engineering potential. In this case, close collaboration with other countries is of tremendous importance.

The Bulgarian iron and steel industry has two important achievements in some specific technologies and processes. They are the following:

- treatment of iron ore with a higher content of lead, manganese, and barytes;
- protective coating of graphite electrodes for the electric-arc melting furnaces to the purpose of decreasing their consumption.

Every country stands in need of a home iron and steel industry. And every country, no matter how small it may be, can develop this kind of industry if there are favourable conditions and well-developed collaboration with other countries.



iron and steel industry began after the Second World War - in the fifties a 0.6 mt/y steel plant was built and in the sixties - another 3.0mt/y steel plant. Till then there had been only one small steel factory with electric-arc furnaces and a rolling mill producing up to 10,000 tons per year.

Table 1 contains some figures, showing in a quantitative way the rate of growth in the development of the Bulgarian iron and steel industry in the last twenty years.

It is evident from these figures that in the mentioned period the rate of development, which began from a very low level, has been rather high - about 15% per year, in some cases even higher. The main factor determining this accelerated development is the quick and constant growth of the domestic demands in rolled steel arising from the Government policy of accelerated industrialization.

As it is well known, the social and economic progress of a country depends on the development of the productive forces. The way of that development in the contemporary world passes through industrialization. Steel is the basic constructional material determining the development of the main industries, particularly machinebuilding industry, construction, and transport. The proportional development of economy and of the productive forces is impossible without the constant growth of steel production and steel consumption.

Naturally, in order to develop and establish the iron and steel industry there must be an economic policy of industrialization which increases demand and consumption of steel.

Table 1

DEVELOPMENT OF PRODUCTION AND CONSUMPTION OF THE BASIC  
METALLURGICAL PRODUCTS IN BULGARIA IN THE LAST 20 YEARS

N°	I t e m s	measure	1952	1955	1960	1965	1970	1972	1975 (project)
1.	Production of coke	thst/y	7,0	9,0	20,0	765,0	837,0	1190,0	1440,0
2.	Production of pig iron	"	-	-	195,0	712,0	1201,4	1518,0	1850,0
3.	Production of crude steel	"	6,0	73,9	252,5	589,4	1799,9	2118,7	2840,0
4.	Production of ferro-alloys	"	2,6	5,0	4,5	6,0	49,5	43,7	54,0
5.	Production of rolled steel	"	5,0	74,0	193,0	431,0	1420,5	2024,3	2950,0
6.	Production of crude steel per capita	kg/c	0,8	9,8	32,1	75,0	212,0	246,0	323,0
7.	Consumption of crude steel per capita	"	31,9	45,0	103,1	162,0	259,0	282,0	415,0

But this is insufficient. The country should have good natural and economic conditions for the establishment of the steel industry. This is the second main factor which has been of great importance for the establishment and development of the Bulgarian iron and steel industry. What is meant here is the following: availability of raw-material resources and availability of investment capital.

The raw-material resources for the production of iron and steel, i.e. such raw materials as iron ores, fuel, fluxes, electric energy, water, etc., were available in such quantities as to meet the needs. The iron-ore deposits were enough to start production of steel. Coking coal resources, however, have been rather limited and low-grade, so that almost all the quantities used now are imported. Water and energy resources are sufficient to meet the needs of the iron and steel industry too.

As for investment capital, in the case of the centralized Government management of economy, it is mainly a matter of capital investment distribution. The investments come from the so-called fund of accumulation from the produced national income. The increased production is based and depends on the increase in the national income and on that part of it which is set apart for investments i.e. for the construction of new plants or for expansion of the existing ones.

The achievements of the Bulgarian iron and steel industry, shown on table 1 and fig.1, can be summarized as follows:

- comparatively high rates of increase in the production of steel in view of meeting better the constantly growing needs

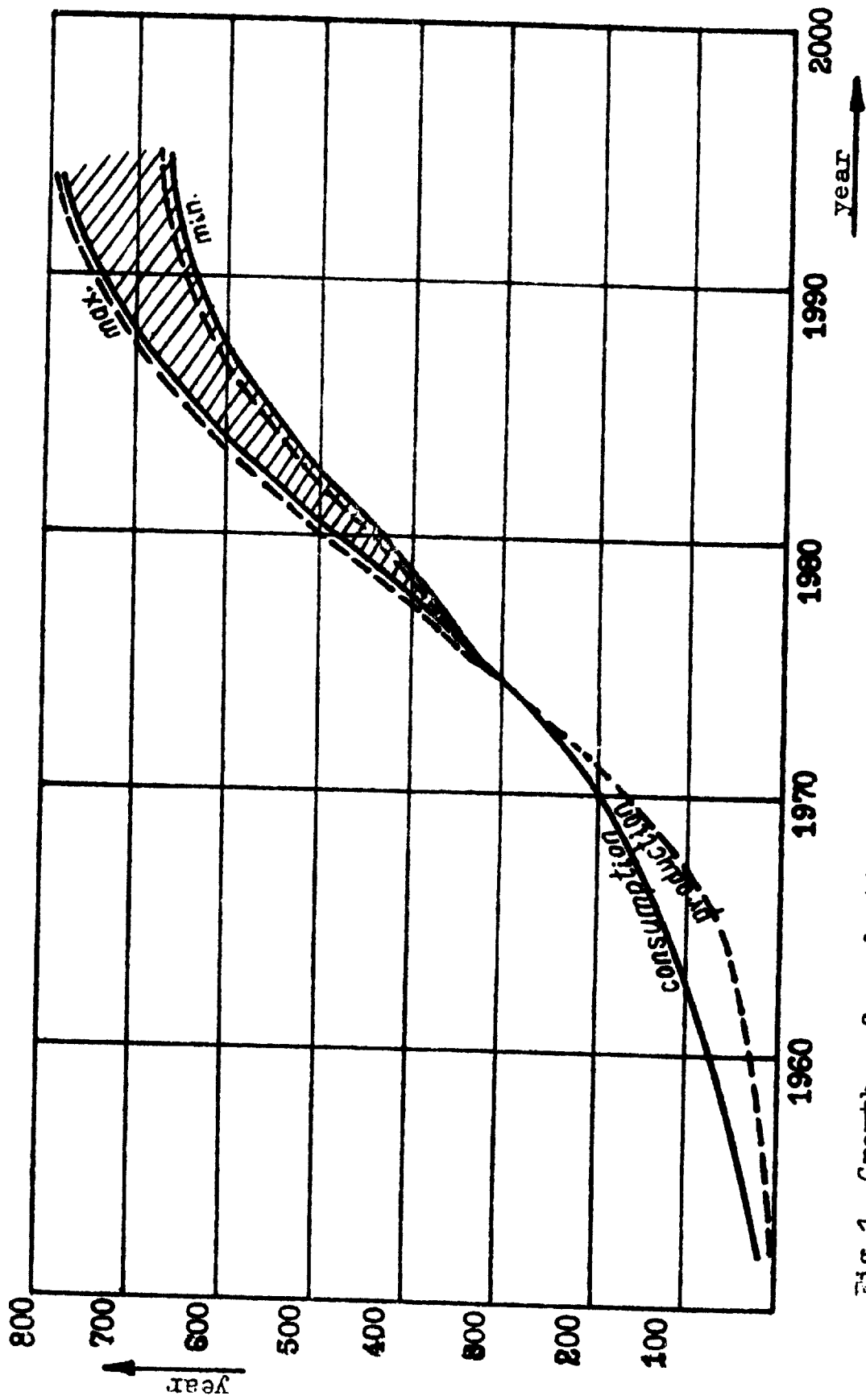


Fig. 1 Growth of production and consumption of rolled steel in Bulgaria

of the national economy in rolled steel;

- establishment of an iron and steel industry based chiefly on domestic raw-material resources and capital;

- establishment of production facilities, i.e. a small-capacity plant and a larger one, which in a short time brought production and consumption of steel close to the level in the developed countries;

- establishment of domestic potential of operational, managing, and research staffs needed in the further development of the iron and steel industry;

The difficulties in the establishment and development of the Bulgarian iron and steel industry consist mainly in the following:

- exactly fixing the future demands of the consumers, particularly for rolled steel products; on the proper solution of this problem depends the choice of the most suitable steel rolling equipment;

- reaching the new capacities and mastering the operation in shorter terms;

- lack of well-trained and skilled running personnel, particularly in the initial stage of development;

- insufficient experience in doing the engineering work and manufacture of the metallurgical equipment.

The overcoming of these difficulties should be considered as a process which, in the conditions of the iron and steel

industry, needs a lot of time and efforts in order to gather experience; well-established international collaboration is also of great importance here.

#### Brief Description of the Existing Plants

Now in Bulgaria there are two iron and steel plants in operation - the "Lenin" Iron and Steel Works and the Kremikovtsi Iron and Steel Works.

The "Lenin" Iron and Steel Works have the output of about 0,6 mt/y of rolled steel and consist of the following plant :

- a sinter plant and a blast-furnace plant with two 230m<sup>3</sup> blast furnaces;
- an open-hearth plant with 70t basic open-hearth furnaces and a 140 t furnace.
- an electro-steel producing plant with 10t electric-arc furnaces
- 500mm, 300mm, and 250mm bar-rolling mills for heavy, medium, and small sections;
- a 2300 mm plate rolling mill and a 1100 mm sheet rolling mill;
- a 1040 mm ball-rolling mill;
- a galvanizing unit for galvanized sheets;

The Kremikovtsi Iron and Steel Works have been designed for the production of about 3,0 mt rolled steel and include the following plant :

- an iron-ore open pit and a dressing factory with rotary kilns for magnetic roasting, magnetic separation, and floatation;
- a sinter plant with  $75\text{m}^2$  sintering machines, a coking plant with coke-ovens and an iron works with two  $1033\text{m}^3$  blast furnaces;
- a basic-oxygen furnace plant with three 100t converters; the crude steel is produced by special blowing of high-manganese pig iron;
- an electre-steel producing plant with 100t electric arc furnaces;
- a 1150 mm blooming-slabbing mill;
- a continuous 850/700/500 mm billet mill and a continuous 250mm wire-rod mill;
- a 1700 mm semi-continuous hot-strip-rolling mill and a 1700 mm continuous cold-strip rolling mill;
- a tube rolling plant for seamless and welded tubes and a unit for formed sections;
- a ferro-alloys plant with electrothermic furnaces;

#### Plans for Expansion of Capacities

Table 2 and Fig.1 give an approximate forecast of the further development of the Bulgarian iron and steel industry which is in the process of a preliminary study and must not be considered as finally adopted.

PROGNOSTIC DATA FOR THE DEVELOPMENT OF THE IRON AND STEEL  
INDUSTRY IN THE FOLLOWING 20-30 YEARS IN BULGARIA

N°	I t e m s	measure	1970	1975	1980	1985	1990-2000
1.	Growth of rolled steel consumption demand	thst/y	1700	2800	4000-45000	5500-6000	6000-8000
2.	Demand in rolled steel products per capita	kg/c	200	320	430- 490	580-530	630-750
3.	Production of coke	thst/y	840	1440	1450-1500	2500-3000	3000-3500
4.	Production of pig iron	"	1200	1850	2000-2200	4000-4500	5500-6000
5.	Production of crude steel	"	1800	2840	3500-4000	6000-6500	8000-8500
6.	Production of rolled steel	"	1420	2950	4000-4500	5500-6500	6500-8000
7.	Production of crude steel per capita	kg/c	212	246	380-430	630-680	680-750



It provides for the capacity of the "Lenin" Iron and Steel Works to expand up to 1,0 mt of rolled steel by way of a basic reconstruction and modernization including the construction of a new electric-arc furnace plant with continuous steel casting; as well as expansion and modernization of the rolling mills.

The capacity of the Kremikovtsi Iron and Steel Works can be expanded up to 4,0 - 5,0 mt by way of expanding the production capacity of the blast furnace and oxygen-converter plants, by installing a new 100t electric-arc steel melting furnace and a new 350/280 mm bar-mill. The range of final products will widen, too, with the construction of the following units: a 1200 mm continuous cold-strip rolling mill, lines for strips and sheets with corrosion-proofcoating (galvanized, tinned, plastic-coated sheets), a dynamo sheets rolling mill, a stainless-steel rolling mill etc.

The construction of the new plants for wires, ropes, heat-treated and sized sections, spiral welded tubes etc. is provided too.

In order to reach, in the long perspective, the total of 6-8 mt (650-750 kg per capita) production and consumption of rolled steel, many new additional plants most probably must be built for the steel industry.

Problems of the Raw Material Resources, Equipment, Know-How and Training of the Personnel; Technical Assistance

Bulgaria does not have available very large raw material resour-

ces as far as high-grade iron-ore deposits and coking coals are concerned. That circumstance has set up some problems to the exploitation of the existing plants.

Operation began first only on local iron ores, but the share of the imported raw materials has been increasing parallel with the increase of the steel production.

The solution of some raw-material problems is sought in the establishment of international economic co-operation and integration. Thus Bulgaria imports from the USSR some quantities of iron ores, coking coals, and crude steel; from India and Algeria - iron ores etc. To them Bulgaria offers for exchange some products of its iron and steel industry as well as a wide range of other industrial goods. The tendency is to establish solid, long-term economic relations on a mutually advantageous basis.

The establishment of an iron and steel industry in a small country, such as ours, comes up inevitably to the problem of the metallurgical equipment supply. In our practice some 70-80% of the metallurgical equipment have been imported - chiefly from countries with well developed heavy metallurgical machinebuilding industries. The remaining 20-30% have been local manufacture depending on the machinebuilding possibilities of the country. Most probably this ratio will be kept unchanged, as it is not efficient for a small country as ours to manufacture complete metallurgical equipment. As the investments for metallurgical equipment are very large, its supply usually has been done on a long-term credit.

Know-how is usually provided by the Supplier of the basic equipment who is both general designer and technology licensor. The Supplier undertakes to train in his plants a large number of the operational and managing staff. Since the basic part of the design work and the equipment of the Bulgarian metallurgical plants has been carried out with the technical assistance of the USSR there were no difficulties either in obtaining know-how, or in training our people mainly because of the character of our relations with the USSR and the similarity of the two languages. However, there were difficulties of another character: the ability, aptitude, and quickness to gather experience, knowledge, and habits for a skillful and efficient work in the steel plants. This is a process which is a function of many factors and circumstances in the national development. It is irrefutable, however, that experience cannot be gathered in short time. Besides on the long year practice, the high qualification depends much on the previous general education and scientific and technical condition, measured by the years of schooling.

#### Economic Achievements, Quality and Prices

In the process of the constantly growing domestic demands in rolled steel, as a result of the accelerated industrialization of the country, the most important economic achievement is the favourable solution of the problem of limiting the imports and meeting, as much as possible, the needs in the wide range of final steel products by way of organizing their home manufacture thus saving a lot of money for the purchase of some metals from abroad. Fig. 1 shows that in the last 20 years domestic production and consumption have developed in parallel at high rates, so that now the metallurgical industry is in a position to meet fully the demands of the domestic consumption, a tendency which will be kept in the future.

It is impossible and inefficient to meet the entire demands of the home market in the whole range of final steel products by means of the home iron and steel industry of a small country. In this connection there arise the problems of the rolled steel products exchange, as well as those of international co-operation and specialization. No matter how difficult these problems may be, they can nevertheless be solved if there are contracts and coordination among the respective partners in advance. To be sure, the principle of mutual economic advantage is of great importance here.

Bulgaria, for example, exchanges about 20-30% of its rolled steel products with other countries. The surplus of some sorts of rolled steel products are exported against the imports of such sorts which are either inadequate or not manufactured in this country at all. This kind of exchange does not include the quantities for exports and imports on the line of the regular trade contracts.

The economic achievements are closely connected with the problems of the range of steel products, their quality, prices, and the scale of production.

The range of products and their quality depend on the type and features of the production plants, particularly on the steel melting and rolling plants.

This alternative and the preliminary study of the consumers' demands are considered the most important and difficult stages in the establishment and development of the iron and steel industry. What is needed here is a large professional erudition and a good trade flair. The most efficient structure

of the range of final products and their quality level is of great importance for the home market and for the profitable participation of Bulgaria in the international labour division in the field of iron and steel industry.

Naturally, the quality of the rolled steel products depends much on various factors, i.e. not only on the most efficient technology and equipment as well as control. For a country which is in the process of establishing its home iron and steel industry, with no substantial practice in that field, one of the most vital problems, as far as quality is concerned, is the observance of the technological and operational discipline and the improvement of the running personnel professional skill. In this case the previous general education and technical schooling prove insufficient. It has been necessary to establish a complete training system in the iron and steel works to the purpose of improving the workers' skill and professional qualification.

Another problem closely connected to training and qualification is that of mastering the new plants - their technology, management, and control of all the production processes. This is a difficulty that every country which is establishing and developing its home iron and steel industry inevitably has come up to. Reaching the project technical-economic indices and capacities of the various metallurgical units is a process of different duration depending on many objective and subjective factors. The iron and steel industry is a complex and difficult production and, in our practice, it takes at least one or two years to master its new capacities.

The problem of the prices of the steel products comes to profitable putting into practice of the flexible price policy and control. In Bulgaria this is done by the respective Government authorities which, in a planned and purposeful manner, balance the price level of the various iron and steel products and raw materials in accordance with the changing situations and the interests of the national economy. On principle, what is taken into consideration are the prime cost of production, the international prices, and the interests of the producer and the consumers. By the method of the differentiated prices is stimulated the new range of products and the improvement of quality. The economic effectiveness of the exchange and exports of rolled steel products depends on the total expenditures (materials and labour) and on the price policy of the Government.

#### Research and Design Basis

The research and design-engineering basis, together with its qualified personnel potential, has been set up and developed parallel with the establishment of the iron and steel industry itself.

In the past twenty years, when the Bulgarian iron and steel industry was actually established, its research and design engineering potential was also developed to an extent the needs have imposed. At the present production of 2 mt of rolled steel in the country there is one Iron and Steel Research Institute with a personnel of 400 people and one Design-engineering Institute with 700 people. Besides there are design-engineering departments and research laboratories at the steel works and higher education institutes totalling about 200 people.

The research work is carried out by these institutes under the management of the responsible Government authorities. There is a General plan for their research and engineering activities. These activities are subsidized by the Government and the economic cooperation for iron and steel industry. The research equipment and facilities, pilot plants, etc. are provided in the frameworks of the research work subsidy. Part of it is supplied on the line of the complete deliveries of the iron and steel plants.

A small country, such as Bulgaria, is not in a position to establish large research and engineering basis for the thorough solution of the problems arising from the establishment and development of the iron and steel industry. A considerable part of it, chiefly the design-engineering work, is carried out by other countries with greater possibilities. These are usually the countries - suppliers of the basic plant equipment. In this connection the establishment of close and fruitful scientific, technical, and economic collaboration is of great importance. Such is the case with the USSR, who is the main supplier of the Bulgarian iron and steel equipment.

The ratio between the research personnel and that of the designing-engineering institute is also of importance. Our practice shows that this ratio must be in favour of the design-engineering personnel.

#### Achievements in Some Particular Technologies and Processes

Because of the specific characteristics of the Kremikol iron ore ( high content of lead, manganese, and barites) a special technology had to be developed for a complex ore treatment.

Though it has not yet been quite successfully put into practice it includes the following processes: partial prior removal of lead in the magnetic roasting and sintering; oxygen blowing in converters of high-manganese pig iron in duplex or monoprocess with partial utilization of the manganese; floatation of the barytes from the non-magnetic part after the magnetic separation of the roasted ore. This technology cannot be competitive with the conventional technology for metallurgical treatment of high-grade pure iron ores but for the particular case it has its importance. The problem of the efficient removal and utilization of the by-metals in the iron ores is a problem which in our opinion is not yet solved satisfactorily. For example, the processing and utilization of pyrite cinders contaminated with non-ferrous and noble metals is a proof of this idea.

Lately in Bulgaria have been used in the electric-arc steel melting furnaces graphite electrodes with special protective coating on an aluminium basis so that, as a result, the graphite electrode consumption decreases down to 30-40%. This coating not only decreases the graphite consumption, having thus the economic effect of upto 1 US dollar per ton of steel, but it also makes it possible to use very high electric loading of the protected electrodes and to design furnaces of lighter structure using small electrodes, to improve methods of tapping the gases off the furnaces etc. A special commercial unit for coating of electrodes has been built.

#### Conclusion

The establishment and development of the national iron and steel industry is closely connected with the development



of its productive forces which on its part finds expression in the accelerated industrialization of the country - a premise for the entire social and economic progress. The proportional development of economy is impossible without the regular rate of growth in the production and consumption of steel.

Two main premises determined the establishment and development of the Bulgarian iron and steel industry:

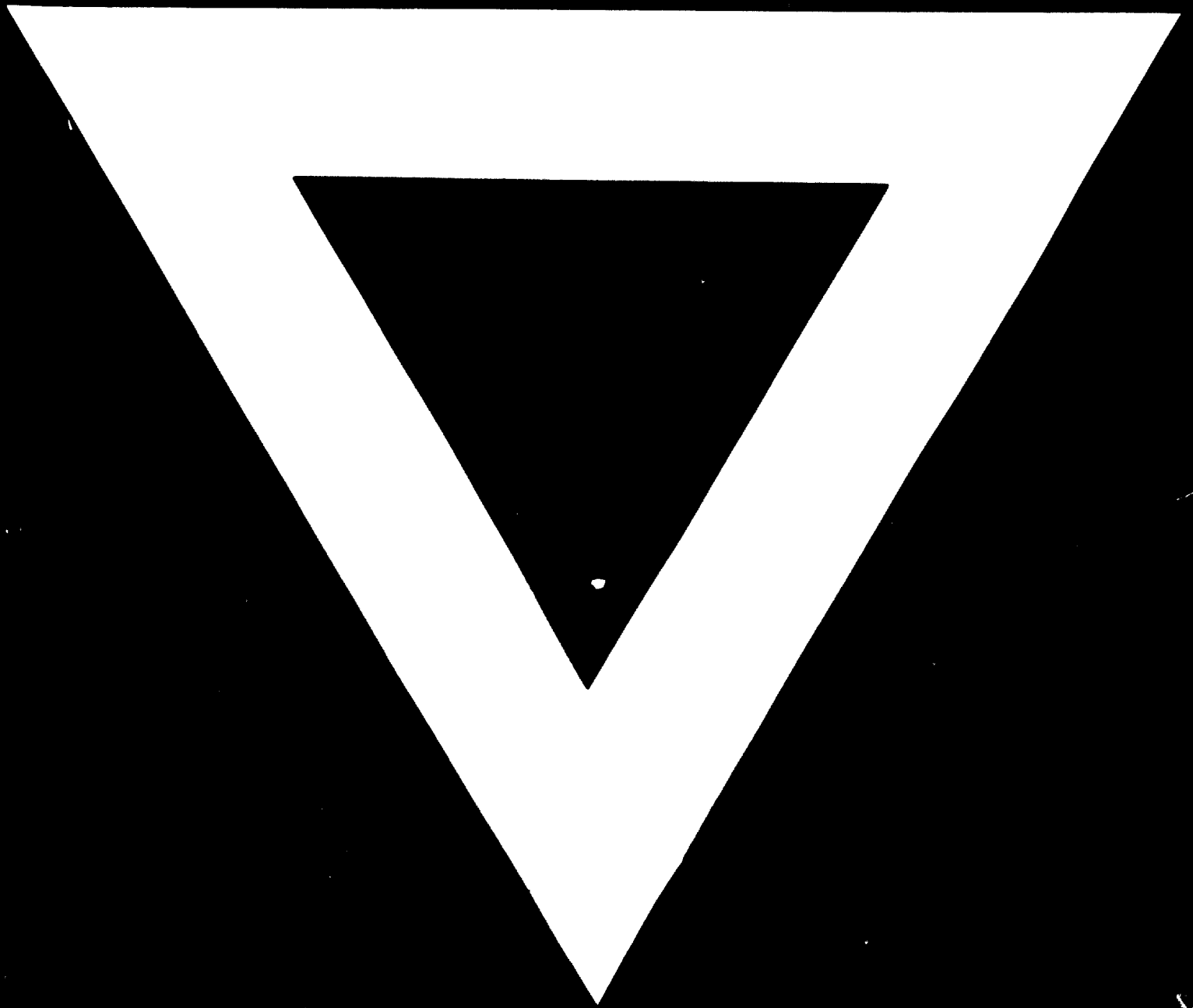
- accelerated growth of domestic needs
- the presence of favourable international, economic and natural conditions.

Providing of raw materials, investment capital, research, designing, supply of equipment, skillful labour, know-how, efficient international collaboration and a domestic research basis - these are the problems arising in the development of the iron and steel industry. The overcoming of the difficulties connected with these problems is a continuous process requiring considerable efforts.

At the contemporary large scales of iron and steel industry, international collaboration in the field of technical assistance, specialization, co-operation, and exchange of metals have paramount importance in the production effectiveness and in meeting the demands in the entire range of rolled steel products.

No matter how small a country may be, it stands in need of a domestic iron and steel industry, if there are favourable conditions, and can establish and develop it to the necessary extent at the well-organized collaboration with other countries.





**30.8.74**